UNIVERSITY OF
LINCOLN

# Essays on the Basel III Leverage Ratio:
Leverage procyclicality, bank risk, and liquidity creation in Sub-Saharan Africa

Raphael Kasonde
FCCA, FZICA

Doctor of Philosophy in Finance

Lincoln International Business School
College of Arts, Social Sciences and Humanities

June 2026

# ABSTRACT

Sub-Saharan African low- and lower-middle-income countries operate predominantly bank-based financial systems characterised by shallow financial markets, high informality, commodity dependence, and macroeconomic volatility. These vulnerabilities are compounded by widespread financial dollarisation, with foreign-currency-denominated assets and liabilities often exceeding 30 percent of banking-system exposures. Because bank equity is denominated in domestic currencies, exchange-rate fluctuations and IAS 21 accounting revaluations amplify leverage procyclicality and distort reported capital adequacy. During periods of economic stress, currency depreciation and tightening credit conditions often induce banks to reallocate their portfolios toward low-risk-weighted assets, particularly government securities and foreign exchange reserves. This shift can further entrench financial dollarisation, amplify exchange-rate volatility, weaken credit provision to the private sector, and reinforce sovereign–bank linkages. As persistent currency depreciation inflates the domestic-currency value of foreign-currency-denominated balance sheets and erodes capital adequacy, regulators frequently respond with sharp increases in fixed paid-up equity capital requirements. Such measures, however, are often reactive rather than preventive, resulting in delayed and inherently procyclical recapitalisation policies.

Against this backdrop, this thesis examines whether the Basel III leverage ratio – originally introduced as a non-risk-based backstop to risk-weighted capital requirements – can instead serve as a binding "frontstop" tool for constraining excessive leverage and strengthening financial stability. Essay 1 employs panel data for 30 SSA countries over the period 2005–2024 and fixed-effects estimation to demonstrate that bank leverage is strongly procyclical, driven primarily by balance-sheet management, exchange-rate dynamics, and optimisation of regulatory risk-weighted assets rather than by real economic activity proxied by GDP growth. These findings underscore the potential value of the leverage ratio as a more proactive macroprudential instrument for constraining excessive balance-sheet expansion and strengthening financial system resilience. Essays 2 and 3 exploit Zambia's 2012 recapitalisation reform as a quasi-natural experiment involving equity-to-assets (leverage ratio) requirements substantially above Basel III standards. Using bank-level supervisory data and a difference-in-differences framework, the analyses examine the effects of significantly higher equity-based capital requirements on bank risk-taking and liquidity creation. The findings show that significantly higher equity-to-assets (leverage ratio) requirements reduced insolvency risk without inducing portfolio risk-shifting predicted by standard theory (**Essay 2**), while only modestly reducing liquidity creation among foreign-owned banks subject to substantially higher capital requirements (**Essay 3**). Overall, the evidence suggests that well-calibrated leverage ratio requirements, implemented through genuine equity recapitalisation, can enhance bank resilience and reduce systemic risk without significantly constraining financial intermediation in shallow financial systems.

## LIST OF ABBREVIATIONS

| Abbreviation | Meaning |
|---|---|
| ASLQC | Asset-Side Liquidity Creation |
| AT1 | Additional Tier 1 Capital |
| BCBS | Basel Committee on Banking Supervision |
| BIS | Bank for International Settlements |
| BoZ | Bank of Zambia |
| CAR | Equity-to-Gross Total Assets Ratio (Leverage Ratio) |
| CCyB | Countercyclical Capital Buffer |
| CET1 | Common Equity Tier 1 |
| DID | Difference-in-Differences |
| GDP | Gross Domestic Product |
| GFC | Global Financial Crisis |
| GTA | Gross Total Assets |
| IA | Illiquid Assets |
| IAS 21 | International Accounting Standard 21: The Effects of Changes in Foreign Exchange Rates |
| IG | Illiquid Guarantees |
| IL | Illiquid Liabilities |
| LLRL | Loan Loss Reserves to Total Loans |
| LMIC | Low- and Lower-Middle-Income Country |
| LR | Leverage Ratio |
| LRC | Leverage Ratio Capital Requirement |
| LSLQC | Liability-Side Liquidity Creation |
| MCR | Minimum Capital Requirement |
| MKTSHR | Deposit Market Share |
| NCF | New Capital Adequacy Framework |
| NCFBank | Treatment Dummy for Foreign-Owned Banks under the NCF |
| NPL | Non-Performing Loan |
| OBS | Off-Balance-Sheet |
| OFFBSLQC | Off-Balance-Sheet Liquidity Creation |
| OLS | Ordinary Least Squares |
| ONLQC | On-Balance-Sheet Liquidity Creation |
| PBT | Profit Before Tax |
| PD | Probability of Default |
| ROA | Return on Assets |
| ROE | Return on Equity |
| RW | Risk Weight |
| RWA | Risk-Weighted Assets |
| RWATA | Risk-Weighted Assets to Gross Total Assets |
| SSA | Sub-Saharan Africa |
| TIER1 | Tier 1 Capital Ratio |
| TLQC | Total Liquidity Creation |
| TWFE | Two-Way Fixed Effects |
| VIF | Variance Inflation Factor |

# DEDICATION

This thesis is lovingly dedicated to my late parents, Mr. Paul Kasonde and Mrs. Esther Kasonde, whose memory continues to inspire me. They would have been deeply proud to see this milestone in my academic journey.

**ACKNOWLEDGEMENTS**

First and foremost, I would like to express my sincere gratitude to my supervisors, Prof. Chau Le, Dr Kim Nguyen, and Prof. Marian Rizov, for their unwavering support, insightful guidance, and continued encouragement throughout my doctoral journey. Their expertise, constructive feedback, and intellectual mentorship made this research experience both challenging and deeply rewarding. I am also grateful to my examiners, Prof. Hao Quach and Prof. Muhammad Ali Nasir, for their thoughtful comments and valuable suggestions, which significantly strengthened the quality of this thesis. My thanks also go to Dr Lang Thai for chairing the examination panel and facilitating a smooth and constructive viva process. I am particularly indebted to Prof. Victor Murinde for his invaluable mentorship, encouragement, and for providing the opportunity to present my preliminary research through the Centre for Global Finance Reading Group at SOAS University of London. I also wish to thank Dr Thomas Quirk, a close friend, whose patient guidance in data preparation and Stata programming proved instrumental in navigating the econometric aspects of this research, an area entirely unfamiliar to me at the outset of this journey. I further extend my appreciation to my colleague, Ms. Chilufya K. Kwenda, for her assistance with the data. My deepest gratitude goes to my beloved family – my wife, Alice, and our children, Emmanuel, Shekinah, Elijah, and Raphaela – for their unconditional love, patience, and unwavering support throughout this demanding journey. Their encouragement and belief in me have been my greatest source of strength and motivation. Finally, I gratefully acknowledge the senior management and my colleagues at the Bank of Zambia, together with my close friends and family, whose generosity, encouragement, humour, and companionship lightened this journey and continually reminded me to approach each challenge with perspective, resilience, and optimism.

## CHAPTERS UNDER REVIEW AND SEMINARS

Two chapters of this thesis have been developed into journal articles, which are currently under review at peer-reviewed academic journals:

**CHAPTER 2**

Kasonde, R., Le, C., Nguyen, K., & Rizov, M. (2026). "Backstop" or "Frontstop"? Leverage Procyclicality in Dollarised Banking Systems and the Macroprudential Role of the Basel III Leverage Ratio.

**CHAPTER 4**

Kasonde, R., Le, C., Nguyen, K., & Rizov, M. (2024). Beyond Basel III: Do Stricter Leverage Ratio Requirements Enhance or Impede Liquidity Creation? Quasi-Experimental Evidence from Zambia. SSRN: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5008131

The following chapter of this thesis was presented at the Centre for Global Finance (CGF) Seminar Series at SOAS University of London, chaired by Prof. Victor Murinde:

**CHAPTER 3**

Does a Leverage Ratio Far Beyond Basel III Increase Bank Risk-Taking? Quasi-Experimental Evidence from Zambia.

Recording available at: https://www.centreforglobalfinance.org/cgf-events-list/2023/10/25/does-a-leverage-ratio-far-beyond-basel-iii-increase-bank-risk-taking-quasi-experimental-evidence-from-zambia

# Table of Contents

1. THESIS OVERVIEW

## 1.1 Research background and motivation

The 2007–2009 Global Financial Crisis exposed major weaknesses in pre-crisis capital regulation, particularly the inability of risk-weighted capital requirements to restrain excessive leverage and unchecked balance-sheet expansion (BCBS, 2017). Many banks entered the crisis appearing well capitalised under conventional regulatory metrics, yet remained highly vulnerable because of hidden leverage and substantial off-balance-sheet exposures. In response, Basel III introduced a broad set of reforms aimed at strengthening both microprudential resilience and macroprudential oversight. These reforms included stricter definitions of regulatory capital, higher minimum capital requirements, and the introduction of two key instruments: the leverage ratio (LR) and the countercyclical capital buffer (CCyB). The LR imposes a non-risk-based constraint designed to limit excessive balance-sheet growth and reduce the risk of destabilising deleveraging (BCBS, 2022), while the CCyB seeks to mitigate credit procyclicality by requiring banks to accumulate capital during credit booms and release buffers during downturns (BCBS, 2011).

Although these reforms have generally strengthened financial stability in advanced and large emerging economies, their implementation in low- and lower-middle-income Sub-Saharan African (SSA LMIC) economies faces important structural challenges. These include widespread financial dollarisation, shallow capital markets, and high exposure to commodity-price shocks and exchange-rate volatility (IMF, 2024; Ajide et al., 2019; Asongu et al., 2018). Under IAS 21 accounting rules, foreign currency assets and liabilities must be revalued into domestic currency terms, generating mechanical fluctuations in reported leverage and capital positions that are unrelated to underlying credit fundamentals. As a result, conventional capital adequacy indicators become distorted, undermining the effectiveness of time-varying macroprudential tools such as the CCyB, which rely heavily on indicators like the credit-to-GDP gap.

In response to these limitations, several SSA regulators have pursued regulatory-driven recapitalisation programmes aimed at strengthening solvency buffers. For example, the Central Bank of Nigeria (CBN, 2024) increased minimum paid-up capital requirements for internationally licensed commercial banks fivefold, from ₦100 billion to ₦500 billion. Similarly, the Central Bank of Kenya (CBK, 2024) announced a phased increase in minimum core capital requirements from Ksh. 1 billion to Ksh. 10 billion by 2029. While these reforms are intended to improve banking-system resilience, they are often implemented during periods of macroeconomic stress, when banks face the greatest difficulty in raising new equity capital. Such procyclical implementation may encourage portfolio reallocation toward low-risk, low-yield assets, thereby weakening credit intermediation and liquidity creation.

These challenges highlight a broader limitation of risk-based and procyclical capital regulation within SSA LMIC banking systems. In contrast, a recalibrated leverage ratio – designed to increase during expansionary periods and decline during episodes of stress – could function simultaneously as a structural safeguard and a countercyclical macroprudential buffer. Nevertheless, under Basel III the leverage ratio remains primarily a non-binding backstop, intended to become relevant only when risk-weighted capital measures fail (BCBS, 2022). This sequencing has attracted substantial criticism. Haldane and Madouros (2012), for example, argue that the leverage ratio should operate as a primary regulatory constraint because of its simplicity and superior ability to capture emerging systemic vulnerabilities. Similarly, Le Quang and Scialom (2022) advocate recalibrating the leverage ratio into a binding macroprudential instrument, particularly in jurisdictions susceptible to regulatory arbitrage and distorted risk weights. This critique is especially relevant in SSA LMICs, where banks often hold concentrated exposures to sovereign securities and foreign exchange reserves – assets that typically attract low or zero risk weights – thereby overstating regulatory capital adequacy while masking underlying leverage and solvency risks.

Although earlier theoretical studies (e.g., Kahane, 1977; Koehn and Santomero, 1980; Kim and Santomero, 1988) cautioned that flat leverage constraints might encourage excessive risk-taking, more recent theoretical and empirical evidence within the Basel III framework offers a more favourable assessment of binding leverage requirements. Acosta-Smith et al. (2024) and Choi et al. (2020) show that the stabilising benefits associated with stronger equity buffers under binding leverage ratios outweigh any marginal increase in risk-taking incentives. Fatouh et al. (2024) further demonstrate that UK banks subject to binding leverage constraints increased capital buffers, reduced asset risk, and experienced lower CDS spreads, indicating improved resilience and stronger market confidence. Against this backdrop, this thesis investigates whether a binding leverage ratio, implemented alongside equity-based recapitalisation, can provide a more effective and context-sensitive macroprudential framework for SSA LMICs. More specifically, the thesis evaluates whether such a framework offers a superior alternative to conventional reactive recapitalisation policies, which typically force banks to deleverage only after capital erosion caused by persistent currency depreciation and dollarisation-driven balance-sheet expansion. The thesis contributes to both the microprudential and macroprudential capital regulation literature through a three-essay structure that combines macro-level and bank-level empirical analysis using country- and bank-specific data.

**Essay 1** adopts a macroprudential perspective by examining the structural determinants of leverage procyclicality across SSA LMICs. Using IMF panel data, the analysis identifies the roles of financial dollarisation, exchange-rate volatility, and IAS 21 valuation effects in distorting reported leverage dynamics, thereby supporting the case for a binding leverage ratio as a front-line macroprudential instrument. **Essay 2** employs a quasi-experimental framework based on Zambia's 2012 New Capital Adequacy Framework to examine whether sharp ownership-based increases in Tier 1 equity capital requirements, imposed through implicit leverage constraints, generate unintended risk-taking incentives as predicted by earlier capital regulation theories. **Essay 3** extends this analysis by investigating how significantly higher leverage ratio thresholds affect banks' liquidity creation capacity, thereby shedding light on the trade-offs between financial stability and financial intermediation efficiency.

### 1.2 Research objectives

This thesis investigates the micro- and macroprudential effectiveness and potential trade-offs associated with significantly higher equity capital requirements, particularly when implemented through binding leverage ratio constraints, within the structurally fragile and highly dollarised financial systems of SSA LMICs. The analysis is organised around three central objectives:

1. **Leverage procyclicality:** To examine how exchange-rate volatility, IAS 21 valuation effects, and reliance on risk-weighted capital regulation contribute to leverage procyclicality, thereby weakening the reliability of conventional risk-based capital ratios. The objective is to evaluate whether the leverage ratio can serve as a more transparent, stable, and structurally appropriate macroprudential tool in shock-prone and highly dollarised economies.
2. **Bank risk:** To estimate the causal effects of large increases in equity-to-assets ratios on bank risk-taking behaviour using Zambia's 2012 capital reform as a quasi-natural experiment. Specifically, the analysis evaluates whether equity-driven recapitalisation strengthens resilience by reducing insolvency risk or instead induces risk-shifting behaviour.

3. **Liquidity creation:** To assess whether significantly higher leverage ratio requirements constrain banks' liquidity creation capacity, thereby examining the trade-offs between enhancing solvency and preserving financial intermediation within shallow and structurally vulnerable banking systems.

Collectively, these objectives contribute to ongoing debates on the design of capital regulation frameworks better suited to the structural vulnerabilities and macro-financial realities of SSA LMICs.

## 1.3 Overview of methodology and data

### 1.3.1 Research methodology overview

This thesis adopts a mixed-approach empirical strategy across three essays to evaluate the role of higher equity capital requirements, particularly binding leverage ratio constraints, within SSA LMICs. **Essay 1** employs an unbalanced panel dataset covering 30 countries over the period 2005–2024, using data from the IMF and World Bank to estimate fixed-effects regressions examining leverage procyclicality and its structural drivers, including exchange-rate volatility and financial dollarisation. **Essay 2** applies a difference-in-differences (DID) framework to Zambia's 2012 capital reform, exploiting ownership-based variation in regulatory capital requirements to identify the causal effects of higher equity-to-assets ratios on bank risk-taking behaviour. **Essay 3** extends this analysis using supervisory data from the Bank of Zambia to investigate how the reform affected banks' liquidity creation, combining fixed-effects estimations with a DID identification strategy.

### 1.3.2 Data considerations and limitations

Using IMF Financial Soundness Indicators, the analysis focuses on financial dollarisation and capital adequacy, notwithstanding limitations relating to data coverage, consistency, and reporting frequency. Although the panel dataset is unbalanced and excludes some SSA LMICs, it nevertheless captures a policy-relevant cross-section of banking systems within the region.

For the microprudential dimension, the study draws on bank-level supervisory data from the Bank of Zambia Prudential Returns to analyse bank risk-taking behaviour and liquidity creation. The analysis is therefore conducted within the constraints imposed by the confidentiality of supervisory data. While the empirical evidence is derived from a single-country setting, the findings are interpreted within a broader regional policy context. Overall, the results – including robust evidence from Zambia – highlight structural and cyclical vulnerabilities common across highly dollarised SSA banking systems. As such, the study provides important insights into the design of capital regulation frameworks and the potential role of the leverage ratio in strengthening financial stability.

### 1.4 Contribution of the study

This thesis contributes to the literature on capital regulation and macroprudential policy by focusing on the structural vulnerabilities of highly dollarised banking systems in SSA LMICs. First, **Essay 1** demonstrates that leverage procyclicality in SSA LMICs is driven less by conventional credit cycles and more by structural factors, including exchange-rate volatility, IAS 21 valuation effects, and balance-sheet distortions arising from financial dollarisation. Consequently, traditional macroprudential instruments such as the countercyclical capital buffer (CCyB) appear less effective in these environments, while the leverage ratio emerges as a more transparent and stable tool for managing systemic risk.

Second, **Essay 2** exploits Zambia's 2012 capital reform as a quasi-natural experiment to evaluate the effects of a substantial increase in equity-to-assets ratios on bank risk-taking behaviour. The findings reveal a significant decline in insolvency risk without evidence of increased risk-taking, thereby challenging the conventional risk-shifting hypothesis associated with binding leverage constraints. Third, **Essay 3** examines the effects of significantly higher equity capital on bank liquidity creation. Using supervisory data from Zambia together with adapted Berger and Bouwman (2009) liquidity creation measures, the analysis identifies a negative relationship between capitalisation and liquidity creation, particularly among foreign-owned banks. By incorporating SSA-specific structural characteristics such as financial informality and dollarisation, the study provides context-sensitive evidence on the trade-offs associated with materially higher capital requirements.

### 1.5 Thesis organisation/structure

The remainder of the thesis is organised into four substantive chapters (**Chapters 2–5**), each examining a distinct yet interconnected dimension of capital regulation in SSA LMICs. Collectively, the essays investigate how leverage-based equity capital requirements influence leverage procyclicality dynamics, bank risk-taking, and liquidity creation within structurally fragile and highly dollarised banking systems.

**Chapter 2** (Essay 1) examines the drivers of leverage procyclicality across 30 SSA LMICs over the period 2005–2024 and evaluates the macroprudential relevance of the Basel III leverage ratio. Leverage procyclicality refers to the strong positive relationship between changes in bank balance-sheet size and book leverage (Adrian and Shin, 2010), reflecting banks' tendency to expand balance sheets through debt accumulation during boom periods and contract them during downturns. Using panel data from the IMF and World Bank, the analysis finds that a 1 percent increase in total assets is associated with a 0.40–0.50 percentage-point increase in leverage, with the effect amplified during episodes of currency appreciation. By contrast, GDP growth is statistically insignificant, suggesting that leverage fluctuations in SSA LMICs are driven primarily by balance-sheet management, valuation effects, and regulatory incentives rather than conventional macroeconomic cycles. These findings indicate that traditional credit-based activation mechanisms for the countercyclical capital buffer (CCyB) may be poorly suited to SSA contexts, where leverage cycles are structurally driven. The chapter concludes that a properly calibrated and binding leverage ratio could serve as a more effective macroprudential stabilisation tool.

**Chapter 3** (Essay 2) investigates whether large equity-based recapitalisations, substantially exceeding Basel III standards, reduce bank risk. The analysis exploits Zambia's 2012 New Capital Adequacy Framework (NCF) as a quasi-natural experiment within a difference-in-differences (DID) framework, using foreign-owned banks as the treated group. The reform imposed a more than fortyfold increase in minimum capital requirements for foreign-owned banks, compared with a ninefold increase for locally owned banks. The results show: (i) a 5.9 percentage-point relative increase in Tier 1 capital ratios achieved primarily through fresh equity issuance; (ii) no evidence of the risk-shifting behaviour commonly associated with leverage-based regulation; and (iii) a substantial 13.8 percent reduction in insolvency risk. Overall, the findings demonstrate that equity-driven recapitalisation can strengthen banking-system resilience without inducing excessive risk-taking, particularly where compliance occurs through genuine capital injections rather than balance-sheet deleveraging.

**Chapter 4** Chapter 4 (Essay 3) investigates how higher equity-to-assets requirements affect bank liquidity creation in Zambia. Using supervisory data and an adapted version of the Berger and Bouwman (2009) liquidity creation framework, the chapter applies a two-pronged empirical approach. The baseline analysis finds a significant negative relationship between bank capitalisation and liquidity creation, with the effect being particularly pronounced among foreign-owned banks. These findings support the financial fragility–crowding-out hypothesis, which argues that stronger capital positions can reduce banks' incentives or capacity to create liquidity. The second part employs a difference-in-differences (DID) framework to estimate the causal impact of Zambia's NCF, which imposed differentiated recapitalisation requirements based entirely on equity capital. Foreign-owned banks, treated as the reform group, recorded a substantial increase in equity-to-assets ratios from 10.6 percent to 15 percent after the reform, significant at the 5 percent level. By contrast, locally owned banks experienced only a marginal and statistically insignificant rise from 12.9 percent to 13 percent. The main DID estimate produces a coefficient of -0.047 (t = -2.12), indicating that foreign-owned banks moderately reduced liquidity creation relative to domestically owned banks following implementation of the NCF. Overall, the findings suggest that while recapitalisation measures can improve bank solvency and resilience, they may simultaneously weaken banks' liquidity creation capacity.

**Chapter 5** synthesises the empirical findings and draws out their broader policy implications. The chapter argues that while stronger equity capital requirements enhance financial resilience, they must be carefully balanced against the need to sustain credit intermediation and broader economic development objectives. The thesis concludes that a calibrated leverage-ratio framework incorporating both countercyclical and foreign-exchange-sensitive components is likely to be better suited to SSA LMICs than static fixed capital thresholds. Finally, the chapter highlights several avenues for future research, including the role of climate-sensitive capital buffers and the interaction between capital regulation and liquidity regulation in structurally vulnerable banking systems.

## 2. "BACKSTOP" OR "FRONTSTOP"? LEVERAGE PROCYCLICALITY IN HIGHLY DOLLARISED SUB-SAHARAN AFRICAN BANKING SYSTEMS AND THE CASE FOR A BINDING BASEL III LEVERAGE RATIO

### 2.1 Introduction

A central lesson of the 2007–2009 Global Financial Crisis (GFC) was that banks accumulated excessive leverage while continuing to report strong risk-weighted capital ratios under the Basel II framework, despite holding insufficient equity buffers (BCBS, 2010c, 2011, 2017). When market confidence collapsed, rapid deleveraging amplified asset price declines, eroded bank capital, and sharply constrained credit supply. The crisis therefore exposed a fundamental weakness of relying exclusively on risk-weighted capital measures, which may appear robust precisely when leverage and tail risks are accumulating and risk measurement is most unreliable.

In response, Basel III strengthened microprudential capital requirements while also introducing a stronger macroprudential dimension to bank capital regulation. Two reforms are particularly important for addressing leverage cycles and enhancing systemic resilience. First, Basel III introduced a non-risk-based leverage ratio intended to constrain excessive balance-sheet expansion and reduce the likelihood of destabilising deleveraging (BCBS, 2022). Second, it introduced the countercyclical capital buffer (CCyB), a time-varying instrument designed to promote equity accumulation during upswings and support lending capacity during downturns (BCBS, 2010c, 2011, 2017; Edge and Liang, 2022; Sivec and Volk, 2023; Herz and Keller, 2023). Together, these reforms reflect the post-crisis consensus that financial resilience requires not only risk-sensitive tools, but also simple and transparent constraints that remain effective when risk weights become distorted or excessively procyclical.

Following the GFC, leverage became a central focus of both academic research and financial stability policy (Damar et al., 2013). Leverage reflects the extent to which banks finance assets with debt rather than equity (Ingves, 2014), while balance-sheet leverage –

defined as total assets relative to equity – remains one of the most widely used indicators in banking-sector stability analysis (D'Hulster, 2009). Excessive leverage weakens loss-absorbing capacity, increases insolvency risk, and contributes to systemic fragility, as evidenced during the pre-GFC period (ECB, 2015). In the absence of binding constraints, banks tend to operate above socially optimal leverage levels, particularly during expansionary periods when incentives for risk-taking intensify (Adrian et al., 2015).

Although banks can reduce leverage by raising new equity, deleveraging through asset sales, or expanding assets using equity financing (Admati et al., 2012), deleveraging in practice often occurs through credit contraction and asset disposal. Such contractionary adjustments can amplify downturns, generate macroeconomic stress, and intensify systemic risk (Blundell-Wignall and Atkinson, 2012; Aiyar et al., 2015; Gross et al., 2016; Bostandzic et al., 2022). These dynamics underscore the importance of macroprudential frameworks capable of constraining leverage ex ante rather than relying on disruptive balance-sheet adjustments ex post. The broader macro-financial challenge underlying these dynamics is procyclicality, defined as interactions between the financial system and the real economy that amplify business cycles (CGFS, 2010). Within banking systems, procyclicality is often most visible through leverage cycles: banks expand balance sheets and increase leverage during booms, but contract assets and credit during downturns (D'Hulster, 2009). Thus, leverage procyclicality is commonly characterised by a strong positive relationship between changes in balance-sheet size and changes in book leverage (Adrian and Shin, 2010). Understanding the mechanisms driving this relationship, and how prudential regulation can moderate it, is therefore central to effective macroprudential policy design.

While Basel III has strengthened resilience in advanced and major emerging market economies, its effectiveness in low- and lower-middle-income Sub-Saharan African countries (SSA LMICs) remains less well understood and may be constrained by structural and macro-financial conditions that differ markedly from those prevailing in advanced economies. This distinction is particularly important because financial systems in SSA LMICs remain predominantly bank-based (Abor and Adjasi, 2022), making banking-sector instability especially costly for investment and economic growth. Banking systems across the region also exhibit structural characteristics that distinguish them from other emerging market economies (Beck et al., 2019). Persistent structural constraints – including small financial markets, widespread informality, weak governance structures, and recurrent macroeconomic volatility associated with commodity dependence and political instability – heighten financial fragility and weaken the effectiveness of conventional prudential tools (Beck et al., 2019). These vulnerabilities are further amplified by pervasive financial dollarisation, which constitutes a defining characteristic of many SSA LMIC banking systems relative to global standards (Ajide et al., 2019; Asongu et al., 2018). In several countries, foreign-currency-denominated assets and liabilities account for more than 30 percent of total banking-sector exposures. As a result, exchange-rate movements play a central role in shaping balance-sheet dynamics, capital adequacy, and leverage cycles.

This chapter argues that SSA LMICs provide a particularly informative setting for studying leverage procyclicality because leverage dynamics in these economies are shaped less by conventional domestic credit cycles and more by banks' balance-sheet management behaviour, exchange-rate valuation effects, and regulatory incentives. In highly dollarised systems, bank leverage can fluctuate sharply even when domestic credit growth remains weak, complicating the interpretation of risk-weighted capital ratios and credit-based macroprudential indicators. A key transmission mechanism operates through the accounting requirements of IAS 21, which mandate the retranslation of foreign-currency-denominated assets and liabilities into domestic currency at each reporting date. In economies characterised by volatile exchange rates and large foreign-currency balance sheets, IAS 21 introduces mechanical valuation effects that may become disconnected from underlying credit conditions.

During commodity-driven boom periods associated with currency appreciation, the domestic-currency value of foreign-currency exposures declines, mechanically compressing balance sheets and lowering reported leverage even as underlying lending activity and foreign-currency exposures continue to expand. Conversely, currency depreciation inflates balance sheets in domestic-currency terms, mechanically raising leverage even during periods of weak credit growth or outright credit contraction. These accounting valuation effects weaken the informational content of risk-weighted capital requirements and can interact with regulatory incentives in destabilising ways. During appreciation episodes, balance-sheet compression may create additional room for expansion without corresponding equity accumulation, embedding hidden leverage. During depreciation episodes, rising credit losses erode equity while reported assets inflate, worsening leverage and increasing pressure for deleveraging. When risk-weighted capital constraints become binding, banks may respond by reallocating portfolios toward low- or zero-risk-weight assets – particularly government securities and foreign-currency reserves – thereby tightening credit supply to the private sector and reinforcing financial dollarisation and the sovereign-bank nexus (Ferreira et al., 2019).

Against this backdrop, several SSA regulators have increasingly relied on large-scale recapitalisation mandates to restore banking-sector solvency after stress has already materialised. Recent examples include substantial increases in minimum paid-up capital requirements in Nigeria[1] and Kenya.[2] Although these measures aim to strengthen resilience, they are often introduced only after vulnerabilities have accumulated, precisely when raising new equity is most difficult, and may therefore reinforce rather than dampen procyclicality. Moreover, repeated reliance on fixed amount recapitalisation thresholds may become inefficient in highly volatile environments where balance sheets and exchange rates fluctuate rapidly. These considerations raise important questions regarding the suitability of conventional Basel III macroprudential tools in highly dollarised SSA LMICs. The CCyB framework, calibrated around deviations in the credit-to-GDP gap and expressed relative to risk-weighted assets, assumes that supervisors can reliably identify excessive credit growth and that risk-weighted measures accurately capture systemic risk (BCBS, 2014b). In volatile and data-constrained environments, however, these assumptions may not hold. Credit gaps may provide weak or delayed signals, while risk-weighted assets may decline during boom periods due to portfolio shifts and accounting valuation effects, thereby weakening the effectiveness of the buffer.

By contrast, a Basel III-style leverage ratio may be better suited to such conditions. Because the leverage ratio links capital directly to total exposures, it is less vulnerable to risk-weight manipulation and accounting-driven distortions in measured risk (Dermine, 2015). Empirical evidence further suggests that leverage ratios are less procyclical than risk-weighted

---

[1] In 2024, the Central Bank of Nigeria (CBN) substantially increased minimum paid-up capital requirements in response to macroeconomic and financial stability challenges arising from both domestic and external shocks. The reforms aimed to strengthen bank resilience, preserve solvency, and sustain financial intermediation. Minimum capital thresholds for internationally licensed banks increased from ₦100 billion to ₦500 billion, while nationally and regionally licensed banks faced similar upward revisions. Banks were granted a 24-month transition period, ending in April 2026, to comply with the new requirements (CBN, 2024).

[2] Similarly, in 2024, the Central Bank of Kenya (CBK) announced a phased tenfold increase in minimum core capital requirements, from Ksh 1 billion to Ksh 10 billion, to be implemented between 2024 and 2029. The reform aims to strengthen banks' shock-absorption capacity and enhance their ability to support large-scale financing for Kenya's long-term development objectives. Transitional capital thresholds were set progressively between 2025 and 2029 to allow banks sufficient time to adjust their balance sheets and comply with the enhanced prudential standards (CBK, 2024).

capital measures and are more likely to remain binding during expansionary periods when measured risk tends to decline (e.g., Fender and Lewrick, 2015; Gambacorta and Karmakar, 2018). Although Basel III originally introduced the leverage ratio as a supplementary "backstop" to risk-weighted capital requirements–primarily to mitigate the effects of risk-weight compression and potential model errors–an expanding body of literature increasingly supports its use as a binding capital instrument because of its simplicity, transparency, robustness, and relative resistance to regulatory arbitrage (Haldane and Madouros, 2012; Le Quang and Scialom, 2022). Moreover, while the gradual build-up of leverage over extended periods was a central lesson of the GFC and a key motivation for the introduction of the leverage ratio, a growing literature also highlights the importance of higher-frequency leverage dynamics and financial market volatility (e.g., Damar et al., 2013). This issue is particularly relevant in highly dollarised banking systems characterised by persistent exchange-rate volatility, where exchange-rate fluctuations can rapidly alter the domestic-currency value of foreign-currency-denominated balance-sheet positions. In such environments, exchange-rate volatility contributes directly to balance-sheet dollarisation and can generate substantial short-term fluctuations in measured leverage, even in the absence of significant changes in underlying lending activity.

In this context, the chapter addresses the following central question: What drives leverage procyclicality in highly dollarised SSA LMIC banking systems under persistent exchange-rate volatility? The primary objective is to develop both a conceptual and empirical framework for analysing the determinants of leverage procyclicality in banking systems exposed to recurrent exchange-rate shocks and elevated levels of financial dollarisation. Building on this analysis, the chapter advances the conceptual argument that, in such environments, a well-calibrated Basel III-style leverage ratio may be more effective when deployed as an active, time-varying, and binding macroprudential "frontstop," rather than merely as a passive regulatory "backstop." Although this proposition is not tested directly, it is inferred from the broader empirical evidence on the drivers of leverage procyclicality. To address these objectives, the study employs an unbalanced panel dataset constructed from the IMF Financial Soundness Indicators (FSI) and the World Bank's World Development Indicators (WDI), covering 30 SSA countries over the period 2005–2024.

The empirical analysis yields six principal findings. First, leverage is strongly procyclical: a 1 percent increase in asset growth is associated with approximately a 0.40–0.50 percentage-point increase in leverage, consistent with the balance-sheet framework of Adrian and Shin (2010). Second, GDP growth is not a statistically significant determinant of leverage dynamics, suggesting that leverage cycles in SSA LMICs are weakly linked to domestic macroeconomic fluctuations. Third, reallocations toward lower-risk-weight assets reinforce leverage procyclicality, indicating that banks may respond to regulatory constraints by shifting toward assets carrying lower risk weights. Fourth, positive IAS 21 revaluation effects on foreign-currency assets are associated with reductions in measured leverage, likely reflecting corresponding increases in reported equity. Fifth, currency appreciations may mask underlying risk by lowering reported leverage and creating space for balance-sheet expansion despite the accumulation of embedded foreign-currency exposures. Finally, regulatory-driven recapitalisation episodes – particularly in Zambia, Nigeria, and Ghana – reduce the leverage–asset elasticity, indicating that mandatory recapitalisation measures can help restrain excessive balance-sheet expansion, albeit primarily as an ex post corrective mechanism.

This chapter makes two principal contributions to the literature. First, it extends the macroprudential regulation literature by examining capital-based regulatory tools in a setting where leverage cycles are shaped primarily by foreign-currency balance-sheet dynamics, financial dollarisation, exchange-rate volatility, accounting valuation effects, and regulatory incentives, rather than by domestic credit conditions alone. This contribution is particularly novel because much of the existing macroprudential literature focuses predominantly on intermediate policy indicators such as credit growth and asset prices (e.g., Igan et al., 2023). By contrast, this chapter directly analyses the endogenous relationship between bank leverage and balance-sheet expansion within the broader financial cycle under conditions of persistent dollarisation and heightened exchange-rate volatility. Second, the chapter highlights the interaction between IAS 21 exchange-rate retranslation and risk-weighted capital regulation as an underexplored source of leverage procyclicality in developing economies. Whereas previous research has focused largely on fair-value accounting and expected credit loss provisioning in advanced financial systems (e.g., Acharya and Ryan, 2016; Athanasoglou et al., 2014), this analysis demonstrates how IAS 21-induced revaluations of foreign-currency exposures can distort reported balance-sheet size, obscure the accumulation of embedded leverage, and trigger procyclical regulatory responses in highly dollarised banking systems.

The remainder of the chapter proceeds as follows. Section 2.2 presents key stylised facts on financial stability in SSA LMICs. Section 2.3 reviews the relevant literature and develops the conceptual framework. Section 2.4 describes the data and sample construction, while Section 2.5 outlines the empirical methodology and model specification. Section 2.6 presents and discusses the empirical findings, and Section 2.7 concludes.

### 2.2 Stylised facts: Situating financial stability within the Sub-Saharan African context

This section presents key stylised facts on the persistent sources of systemic risk – including both exogenous shocks and underlying structural vulnerabilities – that continue to challenge financial stability across Sub-Saharan Africa (SSA). As a useful point of reference, the U.S. financial stability monitoring framework explicitly distinguishes between shocks, which trigger episodes of financial stress, and vulnerabilities, which amplify their effects (Cook, 2025, pp. 4–5).

Within this framework, shocks are defined as unexpected adverse events (such as the COVID-19 pandemic, the Russia–Ukraine war, or broader geopolitical and economic disruptions) that occur intermittently and have the potential to destabilise the financial system. As Brunnermeier (2021) notes, shocks are characterised by two key dimensions: amplitude and persistence. Amplitude refers to the severity of the shock and the extent of the disruption it causes, whereas persistence captures the duration of its effects. Larger shocks inflict greater economic and financial damage, while persistent shocks exert longer-lasting effects, slowing the recovery of the financial system and the broader economy.

Vulnerabilities, by contrast, are structural weaknesses that accumulate over time, increasing both the likelihood and severity of systemic distress when shocks materialise. The U.S. framework assesses financial vulnerabilities across four broad dimensions: (i) elevated asset valuations; (ii) excessive household and corporate indebtedness; (iii) leverage within the financial sector; and (iv) liquidity and maturity transformation risks, particularly those arising from banks' funding structures. Building on this conceptual framework, the discussion that follows identifies and contextualises the principal systemic shocks and structural vulnerabilities shaping financial stability risks in SSA, with particular emphasis on low- and lower-middle-income economies (LMICs).

Geographically, Sub-Saharan Africa comprises 48 countries located south of the Sahara Desert, excluding the North African countries of Algeria, Egypt, Libya, Djibouti, Morocco, and Tunisia.[3] Within this regional grouping, the majority of countries fall within the low- and lower-middle-income classifications: 23 countries are designated as low-income, while 18 are categorised as lower-middle-income. Taken together, 41 of the 48 countries in SSA qualify as Low- and Lower-Middle-Income Countries (LMICs). The remaining seven are composed of six upper-middle-income economies and one high-income country.

#### 2.2.1 Persistent systemic shocks in Sub-Saharan Africa

Across Sub-Saharan Africa, financial stability remains persistently challenged by the interaction of economic and climate-related shocks with underlying structural vulnerabilities. These recurrent disturbances have repeatedly weakened banking sector resilience, intensified systemic fragilities, and undermined the capacity of financial systems to support sustainable economic activity.

##### 2.2.1.1 Economic related factors

The SSA continues to face a combination of persistent external shocks and deep-rooted structural vulnerabilities that threaten financial stability and sustainable economic growth. According to the IMF (2025), regional GDP growth is projected to slow to 3.8% in 2025 before recovering modestly to 4.2% in 2026. This weaker outlook reflects an increasingly challenging global environment characterised by declining commodity prices, tighter global financial conditions, and escalating geopolitical trade tensions, including new U.S. tariffs and retaliatory measures. At the domestic level, rising public debt, fiscal consolidation pressures, and declining development assistance have further constrained investment in critical infrastructure and social sectors. These challenges have been exacerbated by the lingering effects of the

[3] World Bank: https://openknowledge.worldbank.org/pages/focus-sub-saharan-africa and ISS Africa: https://futures.issafrica.org/geographic/regions/sub-saharan-africa/.

COVID-19 pandemic, which exposed and intensified longstanding structural weaknesses, including narrow export bases, widespread financial dollarisation, and exchange rate volatility (Calderon et al., 2022; IMF, 2022a, 2022b).

The Russia–Ukraine war further heightened these vulnerabilities by intensifying food insecurity, inflationary pressures, and sovereign risk across the region. At the same time, global monetary tightening has contributed to capital outflows, currency depreciation, and substantially higher external borrowing costs, pushing several SSA economies closer to debt distress (IMF, 2023a). These macroeconomic pressures are compounded by institutional weaknesses, governance challenges, and high climate vulnerability, which collectively undermine policy credibility, erode fiscal buffers, and weaken economic resilience. With limited fiscal space and declining access to concessional financing, many governments have been forced to curtail public expenditure, increasing the risk of social instability and further constraining long-term development prospects (IMF, 2023a, 2023b, 2024a, 2024b).

#### 2.2.1.2 Climate related factors

Climate change has emerged as a major systemic threat to financial stability in Sub-Saharan Africa. The World Meteorological Organisation (WMO) defines climate change as a sustained shift in average climatic conditions lasting for decades or longer, driven by both natural variability and anthropogenic influences, including greenhouse gas emissions and deforestation.[4] Recent WMO climate assessments (2023–2025) indicate that SSA is warming faster than the global average, with 2024 ranking among the warmest years on record at 0.86°C above the 1991–2020 average. Rising temperatures have been accompanied by increasingly frequent and severe extreme weather events, including prolonged droughts, floods, heatwaves, and tropical cyclones (WMO, 2025; IPCC, 2019; AfDB, 2019). For example, record-low water

[4] World Meteorological Organization (WMO): https://wmo.int/topics/climate-change

levels in Lake Kariba during 2024 sharply reduced hydropower generation in Zambia and Zimbabwe, triggering widespread electricity shortages and significant economic disruption. More broadly, climate-related shocks have intensified humanitarian crises, displaced vulnerable populations, and heightened food insecurity across the region.

The macro-financial implications of climate change are becoming increasingly pronounced. The IMF (2024a, 2024b, 2025) reports that Southern Africa experienced its lowest rainfall in four decades during 2024, while the Congo Basin recorded its most severe flooding in over sixty years, causing extensive damage to infrastructure and disrupting agriculture and other climate-sensitive sectors. The resulting economic losses have reduced productivity, increased fiscal pressures, and raised the cost of climate adaptation, particularly in low-income economies. From a financial stability perspective, SSA's heavy dependence on rain-fed agriculture and climate-sensitive infrastructure leaves banks particularly vulnerable to climate-related risks. Declining agricultural output reduces household incomes, weakens borrowers' repayment capacity, and increases credit risk across the banking sector (AfDB, 2019; Maino and Emrullahu, 2022). At the same time, climate shocks propagate through hydropower-dependent energy systems, rural credit markets, and already constrained public finances, reinforcing systemic vulnerabilities, weakening economic resilience, and undermining long-term sustainable development (IPCC, 2019; WMO, 2025).

### 2.2.2 Structural vulnerabilities in the SSA region's financial systems

The financial systems of SSA LMICs are characterised by persistent structural weaknesses that undermine their efficiency, resilience, and capacity to support sustainable economic development, even in the absence of external shocks. These inherent vulnerabilities can themselves become sources of endogenous financial instability by facilitating the accumulation of systemic imbalances arising from asset mispricing, resource misallocation, and other market distortions (Schinasi, 2004, pp. 9–10). Prominent structural constraints include shallow and underdeveloped financial and capital markets, relatively small and highly concentrated banking sectors, limited economic diversification, and widespread financial dollarisation. Collectively, these interrelated fragilities heighten systemic risk by weakening the financial system's ability to allocate capital efficiently, sustain effective financial intermediation, absorb macro-financial shocks, and support long-term, inclusive economic growth.

#### 2.2.2.1 Structure and characteristics of financial systems

Financial systems in Sub-Saharan Africa (SSA) are predominantly bank-based, with commercial banks serving as the primary intermediaries for mobilising savings, allocating credit, and financing investment (Abor and Adjasi, 2022, pp. 3–7). Consequently, capital markets remain relatively shallow and underdeveloped, playing only a limited role in financing economic activity. This places the banking sector at the centre of financial intermediation while simultaneously making financial stability highly dependent on banks' resilience. In SSA LMICs, these banking systems exhibit distinctive structural characteristics and risk exposures that differentiate them from those of other emerging market economies (Beck et al., 2019, p. 1077).

Beck et al. (2019) identify four persistent structural constraints that increase financial sector fragility across Africa. First, the relatively small size of many economies limits the scope for financial institutions to achieve economies of scale. As a result, low demand for savings, credit, insurance, and payment services often renders large segments of the population commercially unattractive to formal financial institutions. Second, the predominance of informal economic activity restricts financial inclusion, as many households and firms lack the documentation required to access formal financial services. This increases transaction costs, exacerbates information asymmetries, and raises credit risk for financial intermediaries. Third, widespread macroeconomic volatility (driven by commodity dependence, irregular income streams among households and microenterprises, and recurring political and social instability) heightens operational risk and complicates effective risk management. Finally, persistent weaknesses in governance and institutional quality impede the efficient functioning of financial markets, constrain private-sector financial development, and reduce the effectiveness of policy reforms and state interventions designed to address market failures.

#### 2.2.2.2 Extent and drivers of financial dollarisation

Financial dollarisation refers to the extent to which residents hold assets, incur liabilities, and conduct transactions in foreign currency (most commonly the U.S. dollar) rather than in domestic currency. It encompasses both the use of foreign currency as a store of value and its role as a medium of exchange and unit of account, reflecting the proportion of real and financial transactions denominated in foreign currency relative to local currency (Corrales et al., 2016, p. 28; Sosa and Garcia-Escribano, 2011, p. 3). Sub-Saharan Africa is among the most financially dollarised regions in the world, with foreign-currency-denominated deposits and loans accounting for more than 30 percent of total banking sector deposits and credit in many countries (Ajide et al., 2019, p. 401; Asongu et al., 2018, p. 232; Raheem and Asongu, 2018, p. 108; Corrales et al., 2016, p. 33; IMF, 2015, pp. 17, 19).[5]

---

[5] The most dollarised countries in SSA are Angola, Liberia, and the Democratic Republic of Congo (Ajide et al., 2019, p. 401; Asongu et al., 2018, p. 234; Raheem and Asongu, 2018, p. 108). Other highly dollarised economies include Ghana, Zambia, Mozambique, Tanzania, Sierra Leone, Djibouti, and São Tomé & Príncipe (Ajide et al., 2019, p. 401; Asongu et al., 2018, p. 234; Raheem and Asongu, 2018, p. 108). Meanwhile, Malawi, Kenya, Eritrea, and Uganda are considered moderately dollarised, while the remaining SSA countries exhibit low levels of dollarisation (Asongu et al., 2018, p. 234; Raheem and Asongu, 2018, p. 108).

The persistence of high levels of financial dollarisation primarily reflects chronic macroeconomic instability, particularly prolonged inflation and recurrent exchange rate volatility, which erode confidence in domestic currencies (Ajide et al., 2019, p. 405; Asongu et al., 2018, p. 243; Raheem and Asongu, 2018, p. 115; Corrales et al., 2016, p. 37; IMF, 2015, pp. 30, 34). This pattern is consistent with the currency substitution hypothesis, whereby economic agents increasingly adopt foreign currencies as a hedge against inflation and currency depreciation, especially where domestic financial markets offer limited risk-hedging instruments (Corrales et al., 2016, p. 37; IMF, 2015, p. 30). Structural and institutional factors further reinforce this dependence on foreign currency. Greater trade openness, financial integration, globalisation, and socio-political uncertainty have strengthened the preference for foreign-currency-denominated transactions and financial assets (Ajide et al., 2019, p. 404; Raheem and Asongu, 2018, p. 115). At the same time, shallow domestic financial markets and the heavy reliance of many SSA economies on primary commodity exports have entrenched foreign-currency intermediation within the banking system (Corrales et al., 2016, p. 37; IMF, 2015, pp. 30–34).

## 2.3 Literature review and conceptual framework

### 2.3.1 Overview of financial stability

Financial stability is a broad and multidimensional concept encompassing systemic risk, market efficiency, macroprudential regulation, resilience to external shocks, and the financial system's capacity to support sustainable economic growth (Ballouk et al., 2024, p. 4). At its core lies the management of systemic risk, defined as the possibility that disruptions affecting a substantial part of the financial system impair the provision of essential financial services, with potentially severe consequences for the real economy (IMF, 2013, p. 6). Systemic risk can arise from a range of vulnerabilities, including abrupt asset-price corrections, fire sales, and other channels of financial contagion (Adrian et al., 2015, pp. 358–362). As Adrian et al. (2015, p. 358) argue, systemic risk often reflects the amplification of financial shocks through system-wide externalities generated by both cyclical forces and structural weaknesses within the financial system. In this framework, adverse shocks act as the trigger for systemic events, while financial vulnerabilities constitute the underlying fragilities that determine the likelihood and severity of shock propagation.

Macroprudential policy is broadly defined as the use of predominantly prudential instruments to mitigate systemic risk and safeguard the stability of the financial system (IMF, FSB, and BIS, 2016, p. 4; IMF, 2013, p. 6). Its overarching objective is to reduce both the probability and the economic costs of systemic financial crises by strengthening the resilience of the financial system (Galati and Moessner, 2013, p. 848; Le Quang and Scialom, 2022, p. 403). Although financial stability remains a broad and evolving concept (Fell and Schinasi, 2005), Schinasi (2004, pp. 6–10) characterises it as a state in which the financial system efficiently supports economic activity while remaining capable of withstanding both internally generated imbalances and significant external shocks. According to the joint IMF–FSB–BIS (2016, p. 4) framework, macroprudential policy pursues three mutually reinforcing intermediate objectives. First, it strengthens the financial system's capacity to absorb aggregate shocks by building capital and liquidity buffers that can be drawn down during periods of stress. Second, it limits the accumulation of systemic vulnerabilities over time by dampening procyclical interactions between credit and asset prices and by constraining excessive leverage, debt accumulation, and unstable funding structures. Third, it addresses structural sources of systemic risk arising from interconnectedness, common exposures, and the concentration of critical financial functions in systemically important institutions.

A central objective of macroprudential regulation is therefore to enhance financial resilience by reducing the strength of adverse macro-financial feedback loops following shocks (Biljanovska et al., 2023, pp. 2, 9). When adverse shocks erode bank capital or trigger funding pressures, the resulting contraction in credit can amplify economic downturns, particularly in highly interconnected financial systems where distress spreads rapidly across institutions (Biljanovska et al., 2023, p. 2). Macroprudential instruments mitigate these dynamics by ensuring that banks accumulate sufficient capital and liquidity buffers during favourable periods, enabling them to absorb losses, maintain financial intermediation, and reduce the risk of cascading failures. Complementary measures that reduce interconnectedness can further limit the transmission of financial distress across the system. Beyond the capacity to absorb shocks, resilience also encompasses the ability of the financial system to recover and adapt following periods of stress. As Brunnermeier (2021) emphasises, resilience differs from robustness: robustness reflects the ability to resist shocks, whereas resilience refers to the capacity to rebound and return to a stable equilibrium. Accordingly, resilience requires not only effective shock absorption but also sufficient adaptability to restore financial intermediation and support the recovery of economic activity following adverse events (Carney, 2021, p. 8).

### 2.3.2 Basel III: Strengthening bank regulation post-global financial crisis

The Basel III reforms were introduced by the Basel Committee on Banking Supervision (BCBS) in response to the weaknesses in banking regulation exposed by the 2007–2009 Global Financial Crisis (GFC). The crisis revealed a progressive deterioration in both the quantity and quality of bank capital, inadequate liquidity buffers, and the excessive accumulation of on- and off-balance-sheet leverage, all of which amplified systemic distress (BCBS, 2010c, 2011, pp. 1–10). A particularly important weakness was that banks were able to accumulate substantial leverage while continuing to report seemingly robust risk-weighted capital ratios, exposing a fundamental limitation of the pre-crisis risk-weighted capital framework (BCBS, 2010c, 2011; BCBS, 2017).

As financial conditions deteriorated, banks responded through rapid deleveraging, triggering sharp asset price declines, eroding capital, and reinforcing a downward spiral of tightening credit conditions and financial instability (BCBS, 2011, p. 4). In response, Basel III was designed to strengthen both microprudential and macroprudential resilience. At the microprudential level, it enhances the solvency of individual banks by improving the quality and quantity of regulatory capital. At the macroprudential level, it seeks to reduce systemic risk and moderate the procyclical amplification of financial shocks. The BCBS emphasises that these objectives are mutually reinforcing, as a more resilient banking sector lowers the likelihood of system-wide financial instability (BCBS, 2011, p. 2).

To achieve these objectives, Basel III increased the minimum Tier 1 capital ratio from 4% to 6% of risk-weighted assets (RWAs), reducing reliance on Tier 2 capital in meeting the overall minimum capital requirement of 8%. Basel III also strengthened the role of Common Equity Tier 1 (CET1)–the highest-quality and most loss-absorbing form of regulatory capital–by requiring banks to maintain a minimum CET1 ratio of 4.5% of RWAs, equivalent to 75% of the minimum Tier 1 requirement. In addition, the framework introduced a 2.5% capital conservation buffer, composed entirely of CET1, and a countercyclical capital buffer ranging from 0% to 2.5% of RWAs to enhance resilience over the financial cycle. Complementing these risk-based requirements, Basel III introduced a simple, non-risk-based 3% leverage ratio, measured using Tier 1 capital, to serve as a backstop to the risk-weighted capital framework and provide additional protection against excessive leverage, model risk, and weaknesses in risk measurement (BCBS, 2010c, 2011; BCBS, 2017).

#### 2.3.2.1 Basel III Framework: Risk-weighted capital and leverage ratio requirements

The risk-weighted capital framework, founded on the principle that banks holding riskier assets should maintain proportionately higher levels of capital, has long been the cornerstone of the Basel capital adequacy regime (Ingves, 2014).[6] Its origins lie in the 1988 Basel Accord (Basel I), introduced by the BCBS and implemented by the G10 countries in 1992 (BCBS, 1987; BCBS, 1988).[7] Under this framework, risk-weighted assets quantify the risk profile of a bank's asset portfolio and determine the minimum regulatory capital required to absorb unexpected losses. Consequently, higher RWAs translate directly into higher capital requirements (Masera, 2020, p. 22). As Haldane and Madouros (2012, pp. 8–19) observe, the Basel capital framework evolved from Basel I's relatively simple classification of assets into five broad risk-weight categories to the far more sophisticated, model-based approach introduced under Basel II.

Basel I sought to strengthen bank capital and improve the alignment between regulatory capital requirements and portfolio risk by assigning risk weights ranging from 0% to 100% to on- and off-balance-sheet exposures, while requiring banks to maintain total regulatory capital

---

[6] Keynote address by Mr Stefan Ingves, Chairman of the Basel Committee on Banking Supervision and Governor of Sveriges Riksbank, to the 10th Asia-Pacific High-Level Meeting on Banking Supervision, jointly organised by the Basel Committee on Banking Supervision (BCBS), the Financial Stability Institute (FSI), and the Executives' Meeting of East Asia-Pacific Central Banks Working Group on Banking Supervision (EMEAP WGBS), Auckland, New Zealand, 25-27 February 2014.

[7] See Goodhart, C. (2011), The Basel Committee on Banking Supervision: A History of the Early Years, 1974-1997, pp. 146-285, for an in-depth account of capital requirements from 1974 to 1997, with particular emphasis on the 1988 Basel Capital Accord and the 1996 Market Risk Amendment.

equal to at least 8% of risk-weighted assets (RWAs). These risk weights were fixed and therefore unaffected by changes in macroeconomic or financial conditions (Brei and Gambacorta, 2016, p. 365). Basel II substantially increased the risk sensitivity of the capital framework.[8] Following the 1996 Market Risk Amendment, internal models were first introduced for market risk and subsequently extended to credit risk through the Internal Ratings-Based (IRB) approaches under Basel II (BCBS, 1996; BCBS, 2004, 2006). Regulatory capital requirements were therefore determined either through a standardised approach based on external credit ratings or through banks' internal risk models. Compared with Basel I's flat capital requirements, Basel II was intended to align capital more closely with underlying portfolio risks, reduce pricing distortions across asset classes, and strengthen banks' incentives for prudent risk management (Brei and Gambacorta, 2016, p. 365).

Despite these advantages, the greater risk sensitivity of Basel II also introduced important weaknesses. Because regulatory capital requirements became closely linked to estimated default probabilities, they tended to decline during economic expansions as measured risks fell and to increase during downturns as credit quality deteriorated. This feature created a procyclical capital regime, whereby banks could expand lending during booms but were compelled to contract credit during periods of stress, thereby amplifying fluctuations in the business cycle (Brei and Gambacorta, 2016, p. 365). As Haldane and Madouros (2012, p. 8) aptly observed, "the regulatory backstop had been lifted, replaced by a complex, commercial judgement." Greater reliance on internal risk models not only increased the complexity of the framework but also reduced capital requirements for many institutions and created opportunities for model risk and regulatory arbitrage. The GFC exposed these shortcomings by

[8] See Tarullo, D.K. (2008), Banking on Basel: The Future of International Financial Regulation, pp. 87 - 223, for a comprehensive review of the Basel II framework, beginning with the release of the first consultative paper in June 1999 that initiated its development.

demonstrating that banks could accumulate excessive leverage while continuing to report apparently strong risk-weighted capital ratios.

Basel III was introduced to address these deficiencies by strengthening both the microprudential and macroprudential dimensions of capital regulation. To mitigate the procyclicality inherent in Basel II, the framework introduced the countercyclical capital buffer (CCyB), which requires banks to accumulate additional capital during periods of excessive credit growth so that it can be released during periods of financial stress (BCBS, 2011; Brei and Gambacorta, 2016, p. 365). Complementing these risk-based reforms, Basel III also introduced a simple, transparent, non-risk-based leverage ratio to serve as a credible backstop to the risk-weighted capital framework (BCBS, 2011, p. 61; BCBS, 2017, p. 140). Consequently, the leverage ratio has become a central pillar of Basel III, supporting both microprudential and macroprudential objectives, including the implementation of countercyclical policy measures (Tarullo, 2023, p. 2; Ingves, 2014, p. 2; D'Hulster, 2009, p. 3).

The principal objective of the leverage ratio is to constrain the excessive accumulation of leverage during periods of rapid balance-sheet expansion while mitigating the destabilising effects of abrupt deleveraging during episodes of financial stress, as witnessed during the GFC (BCBS, 2011, p. 61; BCBS, 2017, p. 140; BCBS, 2022, p. 7). As Brei and Gambacorta (2016, pp. 365–366) argue, the supplementary leverage ratio complements the risk-sensitive Basel II framework by addressing weaknesses associated with internal models and external credit ratings. Because it is based on total exposures rather than risk-weighted exposures, the leverage ratio is unaffected by risk-weight compression during economic booms arising from improved borrower ratings or optimistic model estimates. As banks expand their balance sheets during upswings, the leverage ratio naturally declines, causing the regulatory minimum to become increasingly binding irrespective of measured risk. Banks approaching the minimum leverage requirement must therefore either raise additional equity capital or restrain further balance-sheet expansion,[9] thereby limiting the build-up of excessive leverage and enhancing the resilience of the banking system over the financial cycle.

Conceptually, the risk-weighted capital ratio measures a bank's capacity to absorb losses relative to the risk profile of its assets, as reflected in RWAs. By contrast, the leverage ratio measures the extent to which a bank's equity can absorb losses across its total exposures, irrespective of regulatory risk weights (Gambacorta and Karmakar, 2018, p. 154). Rather than relying on model-based assessments of risk, the leverage ratio establishes a minimum capital floor by requiring banks to maintain a specified level of eligible capital against total exposures regardless of the complexity or potential shortcomings of risk-weighting methodologies (Kellermann and Schlag, 2013, p. 355). Under Basel III, the numerator comprises Tier 1 capital, consisting primarily of Common Equity Tier 1 (CET1) and Additional Tier 1 instruments, while the denominator is a comprehensive exposure measure incorporating both on-balance-sheet and off-balance-sheet exposures on a non-risk-weighted basis (BCBS, 2017, p. 140). The minimum leverage ratio is set at 3%, implying that, in principle, a bank can support total exposures of approximately 33 times its Tier 1 capital (Haldane and Madouros, 2012, p. 20).

Although the leverage ratio became a Pillar 1 requirement in 2018, public disclosure requirements were introduced progressively from 2015 onwards (BCBS, 2022, p. 7). By establishing this non-risk-based capital floor, the leverage ratio constrains excessive balance-sheet growth, limits opportunities for regulatory arbitrage under the risk-weighted framework, and provides protection against the systematic underestimation of asset risk (BCBS, 2011, p. 4). Beyond its role as a microprudential safeguard, the leverage ratio performs an important

[9] When a minimum capital requirement becomes binding–that is, when regulated banks cannot avoid or offset its effects–it is expected to have a greater impact on institutions whose capital ratios lie below or close to the regulatory threshold than on banks holding capital comfortably above the minimum requirement (Wagster, 1996, p. 1325).

macroprudential function by limiting system-wide leverage and strengthening the resilience of the banking system. According to the ECB (2015, p. 123), it restrains excessive balance-sheet expansion, enhances banks' loss-absorbing capacity, and improves resilience to rare but severe shocks, particularly where institutions hold substantial portfolios of low risk-weighted assets. During periods of financial optimism, such assets can accumulate without triggering commensurate increases in regulatory capital, masking vulnerabilities that may materialise abruptly when market conditions deteriorate (Tarullo, 2023, p. 7).

This dynamic is consistent with Minsky's Financial Instability Hypothesis, which argues that prolonged periods of stability encourage greater leverage and risk-taking, gradually transforming the financial system into an increasingly fragile structure (Minsky, 1982; 2016, p. 68).[10] The GFC provides a clear illustration of this mechanism, as banks heavily exposed to highly rated mortgage-backed securities appeared well capitalised under the risk-weighted framework despite carrying substantial underlying risks (CRS, 2023). In this regard, the leverage ratio serves as a robust prudential constraint by limiting leverage irrespective of the regulatory risk weights assigned to individual assets, thereby complementing the risk-weighted capital framework and strengthening overall financial stability (Tarullo, 2023, p. 4).

[10] Hyman Minsky's Financial Instability Hypothesis offers a dynamic explanation of systemic risk by arguing that prolonged periods of economic and financial stability encourage increasingly speculative behaviour, excessive leverage, and rising risk-taking. As these financial imbalances accumulate, the system becomes progressively more fragile, culminating in a sudden and disorderly correction – often described as a "Minsky moment" (Cook, 2025, p. 4).

#### 2.3.2.2 Should the Basel III leverage ratio function as a “Backstop” or a “Frontstop”?

Under the Basel III framework, the leverage ratio is intended to complement the risk-based capital framework by capturing vulnerabilities that may not be fully reflected in risk-weighted assets. Together, these measures seek to constrain excessive leverage while preserving incentives for prudent risk-taking and sound risk management (Gruenberg, 2023).[11] In practice, however, banks are required to comply simultaneously with multiple regulatory capital standards, with the binding capital constraint determined by the requirement that generates the highest capital requirement (CRS, 2023). A capital requirement is considered binding when regulated institutions cannot avoid or offset its effects through alternative regulatory adjustments (Wagster, 1996, p. 1325).[12]

Within this regulatory architecture, the BCBS envisages the risk-weighted capital framework as the primary prudential constraint–or "frontstop"–with the leverage ratio serving as a supplementary "backstop" against excessive leverage and deficiencies in risk measurement (Haldane and Madouros, 2012, p. 19). Consistent with this design, the BCBS expects the risk-based capital requirement to constitute the binding constraint for most banks under normal conditions, while the leverage ratio becomes binding only in cases where leverage accumulates despite apparently robust risk-weighted capital ratios (Ingves, 2014, p. 5; BCBS, 2022, p. 7). Evidence from a BCBS survey supports this expectation, indicating that, relative to the Tier 1 risk-weighted capital ratio, the leverage ratio is binding for only a relatively small proportion of internationally active banks (BCBS, 2022, p. 14).

Nevertheless, a growing body of academic and policy literature argues that confining the leverage ratio to a purely secondary role may undermine its effectiveness. As Ingves (2014,

[11] Remarks by FDIC Chairman Martin J. Gruenberg on the Basel III Endgame at the Peterson Institute for International Economics. June 22, 2023.

[12] Under such circumstances, the requirement is expected to have a greater impact on banks whose capital ratios lie below or close to the regulatory minimum than on institutions maintaining capital buffers comfortably above the prescribed threshold.

p. 5) observes, a backstop can only be credible if it is calibrated at a sufficiently stringent level to become binding under appropriate circumstances. Conversely, a leverage requirement that never constrains banks provides little prudential value. This perspective has fuelled a broader debate over whether the leverage ratio should evolve beyond its traditional role as a regulatory backstop and, under appropriate conditions, operate alongside–or even as–the primary binding capital constraint. This argument has become increasingly influential in the post-crisis literature. While the risk-weighted framework may appropriately remain the primary binding capital constraint for most institutions under normal conditions, the leverage ratio should bind periodically for a broader set of banks and may need to constitute the principal constraint for institutions characterised by persistently high leverage or elevated model uncertainty. Haldane and Madouros (2012, pp. 19–20), for example, argue that for the largest and most complex global banks, the leverage ratio's simplicity, transparency, and superior predictive performance make it a compelling candidate to serve as the regulatory frontstop.

Although critics contend that a binding leverage ratio could encourage banks to increase the riskiness of individual assets, thereby weakening risk sensitivity, Haldane and Madouros (2012) argue that this concern is best addressed by placing the leverage ratio and the risk-weighted framework on a more equal regulatory footing, rather than subordinating one to the other.[13] Such an approach reduces opportunities for regulatory arbitrage while strengthening the overall resilience of the banking system. Similar arguments have emerged in more recent policy discussions. For example, Le Quang and Scialom (2022, p. 409) contend that the leverage ratio should assume a more prominent role within Pillar 1 because its simplicity substantially limits opportunities for capital optimisation through internal risk modelling. By

[13] For example, Acosta-Smith et al. (2024) develop a Basel III model demonstrating that the leverage ratio and the risk-weighted capital ratio function as complementary regulatory instruments operating on an equal footing. Rather than serving as substitutes, each measure offsets the shortcomings of the other, thereby strengthening the effectiveness and robustness of the overall capital framework.

imposing a binding minimum equity requirement against total exposures, the leverage ratio directly constrains the excessive build-up of leverage – the very vulnerability that contributed significantly to the GFC. Consequently, the appropriate question is not whether the leverage ratio should replace the risk-weighted framework, but rather under what circumstances each measure should become the binding regulatory constraint. Allowing the binding capital requirement to vary with banks' balance-sheet characteristics, risk profiles, and macro-financial conditions would produce a more adaptive and resilient regulatory framework.

This issue is particularly relevant for highly dollarised Sub-Saharan African low- and lower-middle-income countries. In these banking systems, exchange-rate depreciation and the rapid expansion of foreign-currency-denominated balance sheets can substantially increase leverage while simultaneously encouraging banks to rebalance towards assets attracting low or zero regulatory risk weights, such as government securities and foreign exchange reserves. Under such conditions, risk-weighted capital ratios may continue to appear comfortably above regulatory minima even as leverage rises and systemic vulnerabilities accumulate. A sufficiently stringent leverage ratio therefore has the potential to function not merely as a passive backstop, but as an active frontstop that directly constrains excessive balance-sheet expansion and strengthens macroprudential resilience. This proposition forms the central hypothesis examined in this chapter.

#### 2.3.2.3 Basel III framework: Addressing excessive leverage and procyclicality

Basel III represents a fundamental overhaul of the international regulatory framework, extending well beyond the recalibration of capital requirements under earlier Basel accords to introduce a comprehensive set of measures aimed at strengthening the resilience and stability of the global banking system (Van Der Weide and Zhang, 2019, p. 721). In addition to enhancing microprudential standards designed to improve the resilience of individual banks, the framework incorporates a distinct macroprudential dimension that seeks to address system-wide vulnerabilities and limit the procyclical amplification of financial shocks over the credit cycle (BCBS, 2011, p. 2).

Recognising that excessive on- and off-balance-sheet leverage was a defining feature of both the GFC and previous episodes of financial instability, the BCBS introduced the leverage ratio as a non-risk-based capital requirement to constrain the accumulation of excessive leverage and mitigate the destabilising effects of abrupt deleveraging. Such deleveraging episodes can amplify losses, erode bank capital, and curtail the supply of credit to the real economy (BCBS, 2011, p. 4). Beyond the leverage ratio, Basel III also introduced a range of macroprudential measures to reduce procyclicality and strengthen banking sector resilience during periods of financial expansion. These reforms pursue two complementary objectives: reducing the cyclicality of minimum capital requirements and enhancing the banking system's capacity to withstand periods of excessive credit growth (BCBS, 2011, p. 5). A key instrument in this regard is the countercyclical capital buffer (CCyB), which is activated when excessive aggregate credit growth is judged to be contributing to the build-up of systemic risk. By requiring banks to accumulate additional capital during boom periods, the CCyB increases their capacity to absorb future losses and sustain the provision of financial intermediation during periods of stress (BCBS, 2011, p. 57).

#### 2.3.2.3.1 Leverage

Leverage refers to the extent to which a financial institution finances its assets with debt rather than equity (Ingves, 2014, p. 1). Among its various forms–including balance sheet, economic, and embedded leverage–balance sheet leverage is the most transparent, readily observable, and widely applied measure in banking analysis (D'Hulster, 2009, p. 1).[14] A bank is considered leveraged whenever its total assets exceed its equity capital, reflecting its reliance on borrowed funds to finance its balance sheet. Consequently, a higher debt-to-equity ratio indicates greater leverage, increasing the institution's vulnerability to insolvency. Excessive leverage weakens a bank's capacity to absorb losses, reducing its resilience to adverse shocks and heightening the risk of financial distress. These risks become particularly acute when high leverage accumulates across the banking system, as demonstrated in the period preceding the GFC (ECB, 2015, p. 123).

In the absence of effective regulatory constraints, banks tend to operate with leverage levels that exceed the socially optimal level, particularly during economic expansions when incentives for risk-taking are strongest (Adrian et al., 2015, p. 358). Admati et al. (2012, p. i) identify three principal channels through which banks can reduce leverage: (i) pure recapitalisation, whereby new equity is raised to repay debt without altering the size of the balance sheet; (ii) deleveraging through asset sales, with the proceeds used to retire debt; and (iii) equity-financed asset expansion, which lowers leverage by increasing equity relative to total assets. From a macroprudential perspective, however, reducing leverage through asset disposals or contractions in credit supply–often associated with undercapitalisation or debt overhang–may generate inefficient credit tightening and adverse spillovers to the broader economy (Admati et al., 2012, p. ii). Consequently, prudential regulation increasingly favours

[14] Balance sheet leverage is also referred to as accounting leverage, i.e., leverage based on accounting amounts (Amel-Zadeh et al., 2017, p. 1429 and footnote 8).

recapitalisation through the raising of new equity, enabling banks to strengthen their loss-absorbing capacity while preserving financial intermediation and supporting economic activity.

**2.3.2.3.2 Procyclicality**

The Committee on the Global Financial System (CGFS) defines procyclicality as the tendency for interactions between the financial sector and the real economy to amplify business cycle fluctuations, thereby reinforcing economic booms and intensifying downturns (CGFS, 2010, pp. 8–9). Such amplification increases financial instability and was a defining feature of the GFC. Structural developments within the financial system–including the greater use of direct and embedded leverage, increased reliance on short-term wholesale funding, the rapid expansion of tradable financial assets, and the widespread adoption of fair value accounting practices–have further strengthened these procyclical dynamics (FSF, 2009, p. 5).

Within the banking sector, procyclicality is most evident through leverage cycles. During economic expansions, banks increase leverage by expanding their balance sheets more rapidly than their equity capital, thereby increasing risk exposures. Conversely, during downturns, banks often respond by deleveraging through asset sales and contractions in credit supply, actions that can amplify financial stress and deepen economic recessions (Adrian and Shin, 2010, p. 419; D'Hulster, 2009, p. 1). Importantly, these balance-sheet adjustments are frequently driven not by changes in economic fundamentals, but by fluctuations in measured risk, collateral valuations, and regulatory capital constraints. Recognising these amplification mechanisms, Basel III introduced a macroprudential dimension that complements the traditional microprudential focus of earlier Basel frameworks.

A central innovation is the countercyclical capital buffer (CCyB), which requires banks to accumulate additional capital during periods of strong credit growth and favourable economic conditions, when measured risks are typically low. The objective is to strengthen banks' resilience during subsequent downturns while limiting the build-up of excessive leverage and credit booms that can culminate in systemic crises (BCBS, 2011, pp. 5–7). Basel III also addresses the procyclical effects of accounting and market practices, including fair value accounting and collateral margining, which can reinforce feedback loops between asset prices, regulatory capital, and credit supply. As asset prices decline, reductions in bank capital may trigger forced deleveraging, further depressing asset prices and transmitting financial distress to the broader economy. By requiring banks to build capital buffers in advance of periods of stress, Basel III seeks to moderate the amplitude of leverage and credit cycles, weaken the link between periods of perceived low risk and excessive balance-sheet expansion, and enhance the resilience of the financial system throughout the business cycle. More broadly, these reforms reflect a shift from a predominantly reactive regulatory framework towards a forward-looking macroprudential approach that recognises and seeks to mitigate the endogenous amplification mechanisms inherent in modern financial systems.

### 2.3.3 Basel III: Implementation priorities and challenges in SSA LMICs

Although the Basel regulatory framework was originally developed by supervisory authorities from the world's major financial centres, it has progressively diffused across jurisdictions well beyond its original membership, reflecting its status as the global benchmark for banking regulation and prudential supervision (Jones and Zeitz, 2017). While emerging and developing economies, including the SSA LMICs, are under no formal obligation to implement Basel III, the framework is widely regarded as the international standard for sound banking regulation (FSB, 2013, p. 3). Accordingly, multilateral institutions such as the IMF and the World Bank have actively encouraged its adoption among non-member jurisdictions, viewing Basel III as an important mechanism for strengthening banking sector resilience and promoting financial stability in developing economies (Jones and Zeitz, 2017; Ferreira et al., 2019). Despite this broad international endorsement, implementation of Basel II and Basel III across SSA remains relatively limited (World Bank, 2020). Progress has been constrained by structural challenges, including limited supervisory capacity, underdeveloped regulatory infrastructure, and inadequate access to the granular, high-frequency data required to support effective risk-based and macroprudential supervision (e.g., Jones et al., 2018, p. 7). These constraints highlight the practical difficulties of fully implementing an increasingly sophisticated regulatory framework in many low-capacity jurisdictions.

Against this backdrop, the policy debate has increasingly shifted from advocating uniform implementation towards promoting a proportionate, risk-based application of the Basel standards. Beck et al. (2019, p. 1108) argue that a "best-fit" regulatory approach – one that aligns prudential requirements with domestic financial sector characteristics, institutional capacity, and national development priorities – is likely to be more effective than the wholesale transplantation of international "best practice." In a similar vein, Kay (2016, p. 124) contends that regulators should have sufficient flexibility to implement the spirit, rather than the strict letter, of global regulatory standards. Consistent with this perspective, Pablo Hernández de Cos, Chair of the Basel Committee on Banking Supervision between 2019 and 2024, advocated a proportional and risk-sensitive implementation of Basel III across African jurisdictions, emphasising that while regulatory frameworks should be tailored to local conditions, they must remain sufficiently robust to preserve financial stability.[15] At the same time, he stressed that the broader global benefits of Basel III ultimately depend on its timely, consistent, and credible implementation across jurisdictions.

#### 2.3.3.1 Basel III's risk-based capital framework and its implications for SSA LMICs

The effective implementation of Basel's risk-weighted capital framework in SSA LMICs is constrained by deep-rooted structural and institutional challenges. These include shallow financial and capital markets, limited supervisory capacity, underdeveloped regulatory infrastructure, and pervasive financial dollarisation, all of which complicate accurate risk measurement and reduce the effectiveness of risk-based capital regulation. Originally designed for sophisticated financial systems with internationally active banks, the Basel II and III frameworks are often poorly aligned with the institutional and market characteristics of many LMICs, where supervisory capacity remains limited and financial markets remain underdeveloped (Beck et al., 2019b, pp. 2–3; Jones et al., 2018, pp. 2–7). Even the standardised Basel approaches require reliable credit rating agencies, comprehensive financial disclosures, and high-quality supervisory data – conditions that are frequently absent across many SSA LMICs. Moreover, the Basel II/III frameworks do not adequately address several region-specific sources of risk, including commodity price volatility, exchange-rate shocks, financial

[15] Keynote address by Pablo Hernández de Cos, Chair of the Basel Committee on Banking Supervision from 2019 to 2024 and Governor of the Bank of Spain from 2018 to June 2024, at the 15th BCBS-FSI High-level Meeting for Africa on Strengthening financial sector supervision and current regulatory priorities, Cape Town, 30 January 2020.

dollarisation, and external spillovers, while simultaneously imposing supervisory and reporting requirements that often exceed the institutional capacity of national regulators.

Despite these implementation challenges, banks across most SSA LMICs report risk-weighted capital ratios that comfortably exceed the Basel III minimum requirements (Beck et al., 2019b, p. 3). For example, the European Investment Bank (EIB, 2022, p. 45) reports that the average regulatory capital-to-risk-weighted assets ratio in Sub-Saharan Africa was approximately 17.0%, nearly three times the Basel III minimum Tier 1 capital requirement of 6.0%. However, these apparently strong capital positions largely reflect the composition of banks' balance sheets rather than unusually high levels of resilience. Two structural characteristics are particularly important. First, lending to the private sector remains relatively low by international standards, reflecting heightened risk aversion arising from persistently high and volatile non-performing loans, limited bankable investment opportunities, political uncertainty, and weak legal frameworks for enforcing creditor rights (Eyraud et al., 2021; Tyson, 2021). Consequently, banks maintain relatively high levels of liquidity and capital while extending comparatively little private-sector credit. Second, heightened macroeconomic uncertainty encourages banks to allocate a substantial proportion of their balance sheets to domestic government securities and foreign-currency liquid assets. While such conservative portfolio strategies may reduce short-term solvency risk, they also strengthen the sovereign-bank nexus, increasing banking sector exposure to sovereign distress (Hardy and Zhu, 2023; Dell'Ariccia et al., 2018). This nexus creates a mutually reinforcing feedback mechanism whereby deteriorating sovereign creditworthiness weakens bank balance sheets, while banking sector distress further undermines public finances through slower economic growth, reduced private credit, potential bank recapitalisations, and increased fiscal pressures (Dell'Ariccia et al., 2018, pp. 1–2).

The euro area sovereign debt crisis – and particularly the Greek sovereign debt crisis of 2012 – illustrated how concentrated holdings of government securities can rapidly transmit fiscal stress to the banking sector, ultimately requiring large-scale public intervention (Hardouvelis and Vayanos, 2023; Wezel et al., 2026). These concerns have become increasingly relevant in SSA. Following the COVID-19 pandemic, rising public debt and tighter global financial conditions substantially increased domestic banks' holdings of sovereign securities, particularly in emerging and developing economies (Wezel et al., 2026, p. 4). Domestic sovereign exposures have grown faster in Sub-Saharan Africa than in any other region (IMF, 2025b, p. 4), while public-sector credit has increasingly displaced private-sector lending (IMF, 2026, p. 7). This trend is especially pronounced within the West African Economic and Monetary Union, where government securities account for approximately 43% of banks' total assets. Such developments reinforce the sovereign-bank feedback loop, increasing the likelihood that fiscal crises evolve into banking crises while simultaneously crowding out credit to the private sector (Wezel et al., 2026).

Financial dollarisation further amplifies these vulnerabilities. Sub-Saharan Africa remains one of the world's most highly dollarised regions, with foreign-currency-denominated deposits and loans accounting for more than 30% of banking sector deposits and credit in many countries (Ajide et al., 2019; Asongu et al., 2018; Corrales et al., 2016; IMF, 2015). In addition to holding large volumes of domestic government securities, banks in highly dollarised economies typically maintain substantial foreign-currency cash balances and liquid assets to hedge against exchange-rate volatility and broader macroeconomic uncertainty (Corrales et al., 2016; IMF, 2015). Consequently, banks often hold balance sheets dominated by assets that receive zero or very low regulatory risk weights. Under the Basel standardised approach, domestic sovereign securities denominated in local currency generally receive preferential regulatory treatment – including, in many jurisdictions, a zero risk weight regardless of sovereign credit quality – while liquidity regulations further reinforce incentives to hold government securities (Dell'Ariccia et al., 2018; Wezel et al., 2026). Foreign-currency cash and reserve assets similarly attract low regulatory capital charges. The combined effect is a structurally low level of risk-weighted assets relative to total on- and off-balance-sheet exposures.[16] As a result, regulatory capital ratios may overstate banks' true loss-absorbing capacity by understating effective leverage and broader macro-financial risks. The GFC exposed this weakness, as highly rated mortgage-backed securities assigned favourable regulatory risk weights ultimately generated substantial losses, highlighting important shortcomings in model-based risk measurement and the reliance on RWAs alone as indicators of resilience (Tarullo, 2023).

Taken together, these structural characteristics suggest that apparently robust risk-weighted capital ratios in SSA LMICs may conceal significant underlying vulnerabilities, particularly in highly dollarised banking systems. This disconnect is further compounded by supervisory weaknesses, including deficiencies in loan classification, inadequate provisioning, and gaps in consolidated supervision that have been repeatedly identified in IMF–World Bank financial sector assessments (FSB, 2013, p. 3). These considerations call into question the suitability of risk-weighted capital ratios as stand-alone measures of financial resilience and strengthen the case for complementing them with simpler, non-risk-based capital requirements. In the context of SSA LMICs, a binding Basel III leverage ratio could serve this role by constraining excessive exposures to domestic sovereign securities, foreign-currency reserves, and other low-risk-weighted assets that may nevertheless generate significant macro-financial vulnerabilities. As Ferreira et al. (2019, p. 24) argue, because the leverage ratio is independent

[16] The tendency toward structurally low RWAs is further reinforced by the Basel credit risk mitigation framework, under which exposures secured by zero- or low-risk-weighted collateral – particularly foreign-currency cash and domestic government securities – receive preferential regulatory capital treatment, further compressing risk-weighted assets relative to total exposures.

of regulatory risk weights, it provides an effective safeguard against excessive concentration in assets that receive preferential regulatory treatment under the risk-weighted framework. Consequently, a binding leverage ratio has the potential to strengthen financial stability in SSA LMICs by limiting excessive balance-sheet expansion while complementing the existing risk-based capital regime.

**2.3.3.2 Regulatory-mandated equity recapitalisation: Addressing limitations of the Basel risk-weighted framework**

A recurring challenge in many highly dollarised SSA LMICs is that episodes of exchange-rate depreciation and financial stress often expose weaknesses in the Basel risk-weighted capital framework precisely when banking sector resilience is most critical. As macroeconomic conditions deteriorate, banks frequently rebalance their portfolios away from private-sector lending towards assets attracting low or zero regulatory risk weights, particularly domestic government securities and foreign-currency reserves. Consequently, risk-weighted capital ratios may continue to indicate adequate capitalisation even as leverage rises and underlying systemic vulnerabilities intensify.

To address this disconnect, a number of regulators have often relied on regulatory-mandated recapitalisation programmes, requiring substantial increases in minimum paid-up equity capital specified as fixed nominal amounts in domestic currency (e.g., see Appendix A1). Although formally denominated in local currency, these requirements are frequently calibrated with reference to prevailing exchange rates in order to preserve a targeted level of capital in U.S. dollar terms. In practice, such measures seek to offset the apparent expansion of bank balance sheets resulting from exchange-rate depreciation, whereby foreign-currency-denominated assets and liabilities increase mechanically in domestic-currency terms through translation effects, inflating reported exposures and weakening capital adequacy. Although regulatory-driven equity recapitalisation can strengthen capital buffers and reduce leverage by increasing the equity base, fixed minimum capital requirements are inherently insensitive to differences in banks' size, business models, risk profiles, and funding structures. These characteristics materially influence insolvency risk (Dewatripont and Tirole, 1994, pp. 20–21) and should therefore be reflected in the design of prudential capital requirements. Applying uniform capital thresholds across heterogeneous institutions may distort competitive incentives, encourage inefficient consolidation, and weaken financial intermediation.

Nigeria's 2004–2005 banking sector recapitalisation programme provides a notable example. A substantial increase in minimum paid-up capital reduced the number of banks from 89 to 24 through an extensive wave of mergers and acquisitions (BIS, 2014, pp. 84–85). While the reform initially strengthened bank solvency, the newly consolidated institutions subsequently expanded into increasingly risky activities, particularly oil-sector lending and stock market margin financing, without corresponding improvements in corporate governance and risk management. Combined with concentrated sectoral exposures, these weaknesses significantly increased banking sector vulnerability during the Global Financial Crisis (CBN, 2010a, pp. 40, 69; IMF, 2013, p. 13). This experience illustrates that recapitalisation policies centred solely on raising minimum capital requirements may generate unintended consequences if they fail to address governance, incentive structures, and portfolio risk concentrations.

More fundamentally, recapitalisation frameworks based on uniform minimum capital requirements disregard important differences in banks' balance-sheet size, complexity, and systemic importance. Such approaches may inadvertently encourage the emergence of institutions that are "too big to fail," potentially increasing rather than reducing systemic risk. Reflecting these concerns, post-crisis regulatory reforms have increasingly favoured proportionate capital requirements calibrated to banks' size, interconnectedness, and complexity (Van Der Weide and Zhang, 2019, p. 723). From a macroprudential perspective, capital regulation should therefore be aligned with each institution's marginal contribution to systemic risk rather than relying on uniform capital thresholds applied indiscriminately across banks (Borio, 2003, pp. 253–254). This principle is embodied in the Basel Committee's framework for Domestic Systemically Important Banks (D-SIBs), which focuses on the systemic consequences of bank failure rather than solely on the probability of default (BCBS, 2014).

Uniform recapitalisation requirements may also generate unintended distributional effects within the banking sector. Foreign-owned banks – which frequently account for a substantial share of banking sector assets in SSA LMICs – generally have easier access to equity through parent institutions and international capital markets, enabling them to meet higher capital requirements more readily. Smaller domestically owned banks, by contrast, often face significant constraints in raising additional equity. This asymmetry can reduce institutional diversity, accelerate market concentration, and widen disparities in access to financial services (D'Erasmo, 2018, p. 1). Empirical evidence supports this concern. Oduor et al. (2017, p. 47), for example, show that tighter capital requirements tend to intensify competition among foreign-owned banks while weakening the competitive position of domestic institutions because of unequal access to external capital.

A further limitation of regulatory-mandated recapitalisation is its inherently discretionary and procyclical nature. In practice, considerable time often elapses between the emergence of systemic vulnerabilities, the formulation of regulatory responses, and the implementation of higher capital requirements (e.g., Masson, 2014, p. 66). As a result, recapitalisation measures are frequently introduced only after banks' capital positions have already deteriorated, reducing their effectiveness as macroprudential stabilisation tools. Moreover, because required increases in minimum capital are often substantial, regulators typically allow lengthy transition periods to facilitate compliance (e.g., Ghana: BOG, 2017a;

Zambia: BOZ, 2012a; Kenya: CBK, 2024). Although such transition arrangements reduce adjustment costs, they also weaken the timeliness of policy implementation. In rapidly changing macroeconomic environments, economic conditions may deteriorate further before banks complete the recapitalisation process, necessitating additional capital increases and effectively requiring both regulators and banks to pursue a moving target.

The GFC highlighted the limitations of such static and discretionary recapitalisation strategies, particularly when financial systems are confronted by rapidly evolving shocks, whether financial, pandemic-related, geopolitical, or climate-induced. These experiences underscore the importance of prudential frameworks that incorporate automatic stabilisers and dynamic macroprudential mechanisms capable of responding to evolving systemic risks. For SSA LMICs, this suggests that recapitalisation frameworks should move beyond fixed nominal capital thresholds towards approaches that are proportionate to banks' size, risk profile, leverage, and systemic importance, while adapting over time as macro-financial conditions evolve. Although regulatory-driven recapitalisation remains an important prudential instrument, it should be complemented by a regulatory framework that combines risk-based capital requirements with a binding Basel III leverage ratio, ensuring that capital adequacy is strengthened through genuine equity accumulation rather than balance-sheet contraction. Such a framework would harness the complementary strengths of both regulatory approaches, better align capital requirements with banks' systemic relevance and total exposures, and more effectively support both microprudential resilience and macroprudential financial stability objectives.

### 2.3.4 Contemporary perspectives on the Basel III macroprudential framework

The post-Global Financial Crisis policy consensus has increasingly recognised that safeguarding financial stability requires a macroprudential framework capable of addressing both the structural and cyclical dimensions of systemic risk. Drawing on the IMF's Global Macroprudential Policy Instruments Survey, Cerutti et al. (2017, pp. 205–206) identify capital-based instruments – including the Basel III leverage ratio, the countercyclical capital buffer (CCyB), and systemic risk surcharges – as central pillars of modern macroprudential regulation.

These instruments are designed to strengthen the resilience of the financial system by mitigating vulnerabilities arising both from the cross-sectional distribution of risk across institutions and from the time-varying build-up of leverage and credit over the financial cycle (Pfeifer et al., 2016, p. 141; Fender and Lewrick, 2015, p. 45). From a structural (cross-sectional) perspective, they seek to correct distorted incentives and reduce systemic externalities within the financial system, while from a cyclical perspective they restrain excessive credit growth, leverage accumulation, and balance-sheet expansion during economic booms. By requiring banks to maintain adequate capital against the expansion of credit and other balance-sheet exposures (including leverage and foreign-currency-related exposures), these macroprudential tools help curb the build-up of systemic vulnerabilities and enhance the resilience of the banking system to future shocks.

#### 2.3.4.1 Basel III: Macroprudential framework considerations for SSA LMICs

Recent advances in macroprudential policy have important implications for the design and calibration of the Basel III framework in SSA LMICs. The structural characteristics of these economies, together with their distinctive channels of systemic risk transmission, require macroprudential frameworks that are tailored to local conditions rather than direct adaptations of those developed for advanced financial systems. Consequently, understanding the determinants of systemic risk and evaluating the effectiveness of prudential capital instruments in SSA LMICs requires context-specific empirical approaches that adequately capture the region's institutional and macro-financial realities.

Unlike advanced economies, where systemic risk is often driven by complex financial intermediation, interconnected institutions, and financial innovation (e.g., Frait and Tomšík, 2016; Jones and Zeitz, 2017), banking sector vulnerabilities in SSA LMICs are more closely linked to structural economic characteristics and external macroeconomic shocks. Kasekende et al. (2012) identify four principal channels through which systemic risk propagates within African banking systems: external financial contagion, credit procyclicality, highly concentrated lending in undiversified economies, and exposure to volatile international capital flows. Many banking systems in the region remain dependent on short-term foreign funding, which can reverse abruptly during episodes of global financial stress, generating liquidity shortages and tightening domestic financial conditions. Exchange-rate depreciation during such episodes further aggravates balance-sheet mismatches, particularly where borrowers hold foreign-currency liabilities while earning predominantly domestic-currency income (Kasekende et al., 2012, pp. 17, 21).

These vulnerabilities are amplified by the widespread prevalence of financial dollarisation, with Sub-Saharan Africa recording among the highest levels of foreign-currency-denominated deposits and loans globally (Ajide et al., 2019; Raheem and Asongu, 2018; Corrales et al., 2016). In particular, high levels of deposit dollarisation increase the risk of system-wide liquidity pressures and bank runs during periods of foreign exchange shortages (Kasekende et al., 2012, p. 21). Banking systems in SSA LMICs are also highly exposed to fluctuations in global commodity prices because many economies remain heavily dependent on primary commodity exports (Ftiti et al., 2016; Kablan et al., 2017; Masson, 2014). More recently, climate-related shocks have emerged as an increasingly important source of systemic risk, with more frequent droughts, floods, heatwaves, and other extreme weather events posing growing threats to macro-financial stability across the region. Geopolitical developments have further intensified these vulnerabilities. For example, the conflict in the Middle East has contributed to higher global oil and gas prices, reducing fuel availability in many SSA countries and disrupting electricity generation, transportation, and mining activities. At the same time, heightened commodity price volatility and disruptions to fertiliser supply chains have adversely affected agricultural production and food security. In addition, escalating global trade tensions, together with declining official development assistance (ODA) and other external aid flows, pose significant challenges for many SSA LMICs that remain highly dependent on external financing and development support (IMF, 2024b; IMF, 2025a; IMF, 2025b; IMF, 2026).

The structural characteristics of SSA LMICs complicate the direct application of macroprudential frameworks developed for advanced economies. A uniform implementation of Basel III may therefore prove ineffective (or, in some circumstances, counterproductive) if it fails to reflect local institutional capacity and the region's distinctive sources of systemic risk. Instead, the calibration of macroprudential instruments should adopt a proportionate and risk-sensitive approach that explicitly accounts for the structural features of SSA LMICs, including financial dollarisation, commodity dependence, shallow financial markets, and supervisory constraints. At the same time, evaluating the effectiveness of macroprudential policies in these environments presents important empirical challenges. Limited time-series data, regulatory-induced structural breaks, and endogeneity among credit growth, macroeconomic conditions, financial development, and prudential policy interventions complicate both policy calibration and econometric identification. These considerations reinforce the need for context-specific empirical evidence to inform the design and implementation of Basel III in SSA LMICs.

#### 2.3.4.2 The CCyB: from a cyclical to a resilience-based macroprudential instrument

Macroprudential policy encompasses a wide range of regulatory instruments designed to safeguard financial stability, although there is no universally accepted definition of which measures constitute the macroprudential toolkit. Consequently, the selection, scope, and calibration of macroprudential instruments vary considerably across jurisdictions (Baudino et al., 2024, p. 5). Within this diverse policy framework, the countercyclical capital buffer (CCyB) occupies a distinctive position as one of the few instruments with an explicit and narrowly defined macroprudential mandate under the Basel III framework. Introduced as part of the Basel III reforms, the CCyB is a time-varying capital requirement designed to strengthen banks' loss-absorbing capacity during periods of excessive credit growth while mitigating the procyclical interaction between credit expansion, leverage, and regulatory capital requirements (BCBS, 2010c; 2011, pp. 5, 7).

The framework delegates responsibility for activating the buffer to national authorities, which are encouraged to raise capital requirements when signs of excessive credit expansion and the build-up of systemic risk emerge in domestic financial markets (BCBS, 2011, pp. 57–60; Van Der Weide and Zhang, 2019, p. 722). In practice, calibration relies primarily on the credit-to-GDP gap, defined as the deviation of the credit-to-GDP ratio from its long-run trend, which the BCBS recommends as the principal reference indicator for assessing the notion of "excessive credit" growth (BCBS, 2014, p. 6). The underlying premise is that regulators can identify emerging systemic vulnerabilities sufficiently early to allow banks to accumulate additional capital before financial conditions deteriorate (Simon, 2021, p. 2). By increasing capital requirements during expansionary phases of the financial cycle, the CCyB seeks to strengthen banking sector resilience, sustain the supply of credit during periods of stress, and moderate excessive lending and leverage during economic booms (Badarau and Roussel, 2022, p. 451). Despite its central role within the Basel III macroprudential framework, the CCyB has been criticised for its predominantly cyclical orientation. Behn et al. (2023) argue that its design focuses principally on systemic risks arising from domestic credit booms, potentially overlooking the broader role that releasable capital buffers can play in enhancing resilience to non-cyclical shocks.

The COVID-19 pandemic highlighted this limitation by demonstrating that severe systemic disruptions may originate independently of the financial cycle, yet still require substantial capital buffers to absorb losses and sustain financial intermediation. Reflecting the lessons from the COVID-19 pandemic, Behn et al. (2025, pp. 4–5) document an important shift in macroprudential practice, whereby several jurisdictions began increasing capital buffers pre-emptively not only in response to rapid credit growth but also to strengthen resilience against exogenous shocks, including pandemics, geopolitical conflicts, climate-related events, and other sources of systemic uncertainty. This evolution signals a broader transition in macroprudential policy – from a framework primarily focused on managing financial and credit cycles towards one centred on enhancing the resilience of the financial system to a wider range of systemic risks. Under the original Basel III framework, the CCyB was designed with a zero-default setting, meaning that the buffer would remain at zero for most of the financial cycle and would be activated only when systemic vulnerabilities associated with excessive credit growth emerged (Stojkov, 2020, p. 115). More recently, however, several jurisdictions have adopted a positive neutral (default) CCyB, a practice the BCBS considers consistent with the flexibility embedded in the Basel III framework (Stojkov, 2020, p. 115). Although the default buffer setting differs, the underlying objectives, activation criteria, and implementation procedures remain unchanged. Following the COVID-19 pandemic, several European authorities introduced a positive neutral CCyB even in the absence of elevated cyclical risks, allowing capital buffers to be accumulated more gradually over the financial cycle, thereby reducing implementation costs and enhancing policy effectiveness (Herrera et al., 2024).

Conceptually, this approach seeks to make capital requirements more countercyclical rather than permanently increasing their overall level, as any higher default CCyB can be offset through adjustments to other elements of the capital framework, including other capital buffers or risk weights (Stojkov, 2020, p. 115). More broadly, the pandemic demonstrated that releasable macroprudential capital buffers should extend beyond addressing cyclical systemic risks associated with domestic credit booms. Severe shocks – including pandemics, wars, natural disasters, climate-related events, political instability, and technological disruptions – can occur at any stage of the financial cycle and may significantly impair financial intermediation and broader economic activity (Behn et al., 2023). Given the limited usability of structural buffers such as the capital conservation buffer (CCoB) during periods of stress, releasable buffers play a particularly important role by enabling banks to absorb losses while maintaining the provision of credit.

The primary purpose of regulatory capital buffers is not merely to increase banks' capital levels, but to ensure that capital can be drawn down during periods of stress to absorb losses and sustain the provision of credit and other essential financial services to the real economy. Accordingly, all regulatory buffers – including the Pillar 2 buffer, the countercyclical capital buffer, systemic risk buffers, and the capital conservation buffer – are intended to be usable when adverse shocks materialise, thereby reducing the need for banks to preserve capital through procyclical deleveraging and credit contraction (e.g., BOE, 2026, pp. 15–20). Where regulatory, market, or supervisory impediments discourage banks from drawing down these buffers, institutions may instead seek to maintain capital ratios by curtailing lending to otherwise creditworthy households and businesses, amplifying financial stress and its adverse effects on the real economy. However, because the CCyB remains primarily calibrated to indicators of excessive domestic credit growth, it may not adequately address systemic shocks that arise independently of the financial cycle, such as pandemics, climate-related events, geopolitical conflicts, or external commodity price shocks. The growing adoption of precautionary and releasable capital buffers across several jurisdictions therefore reflects a broader evolution in macroprudential policy – from managing cyclical credit fluctuations towards strengthening the resilience of the financial system against a wider range of systemic risks. This shift also mitigates the longstanding challenge that many macroprudential instruments are inherently endogenous to prevailing macro-financial conditions, thereby improving both their operational effectiveness and their empirical evaluation (Behn et al., 2025, pp. 4–5).

#### 2.3.4.2.1 Basel III's countercyclical capital buffer and its relevance for SSA LMICs

The implementation of the Basel III Countercyclical Capital Buffer presents significant operational challenges in emerging market and developing economies (EMDEs). Although the CCyB is intended to be activated during periods of excessive credit growth to strengthen banking sector resilience, its effectiveness in these economies is constrained by volatile macroeconomic conditions, underdeveloped financial systems, and limited data availability. These structural characteristics reduce the reliability of the credit-to-GDP gap – the principal indicator recommended under Basel III for activating the buffer – as a timely and accurate measure of systemic risk (FSB, 2013; BCG, 2014; Frait and Tomšík, 2016; Jones et al., 2018). In many EMDEs, including SSA LMICs, periods of rapid credit growth frequently reflect financial deepening, structural transformation, and expanding financial inclusion rather than the speculative credit booms and leverage cycles typically observed in advanced economies (Frait and Tomšík, 2016; Jones and Zeitz, 2017).

Consequently, a mechanical application of the credit-to-GDP gap as the principal trigger for activating the CCyB may generate misleading policy signals. This challenge is particularly acute in SSA, where private-sector credit remains among the lowest globally, averaging only 15.9% of GDP in 2018 (Eyraud et al., 2021, p. 17), while financial systems continue to be relatively shallow, concentrated, and bank-based (Beck et al., 2019, p. 1077). In such environments, macroprudential policy must balance the objective of safeguarding financial stability with the equally important goal of promoting sustainable financial deepening. Strict adherence to the Basel III activation rule could inadvertently constrain credit expansion and financial innovation in economies where improving access to finance remains a key development priority (Beck et al., 2019, pp. 1079–1109). Moreover, greater financial inclusion can itself strengthen financial stability by broadening the deposit base, mobilising stable retail funding, and reducing dependence on more volatile wholesale sources of finance (Reddy, 2012, p. 40).

Recognising these challenges, the Basel Consultative Group (BCG) advocates a more flexible approach to implementing the CCyB in EMDEs (BCG, 2014, p. 7). Rather than relying exclusively on the credit-to-GDP gap, supervisors are encouraged to complement this indicator with informed supervisory judgement, country-specific assessments, and additional macro-financial indicators that more accurately capture domestic sources of systemic risk.[17] The BCG also recommends the use of sectoral countercyclical measures and other complementary macroprudential instruments as part of a broader, more adaptable policy framework. For SSA LMICs, such flexibility is particularly important given the prominence of structural vulnerabilities – including financial dollarisation, commodity-price dependence, exchange-rate volatility, shallow financial markets, and climate-related risks – that may not be adequately reflected in aggregate credit indicators. These considerations suggest that the Basel III macroprudential framework should be calibrated to the structural and institutional characteristics of SSA LMICs, ensuring that countercyclical capital policy not only enhances

[17] The gap indicator was adopted as a common reference point under Basel III to guide the build-up of countercyclical capital buffers. Authorities are expected, however, to apply judgment in the setting of the buffer in their jurisdiction after using the best information available to gauge the build-up of system-wide risk rather than relying mechanistically on the credit-to-GDP guide. [Credit-to-GDP gaps - overview | BIS Data Portal . Available on: https://data.bis.org/topics/CREDIT_GAPS ].

financial resilience but also supports sustainable financial development and economic transformation.

#### 2.3.4.3 The macroprudential role of the Basel III leverage ratio

Within the Basel III macroprudential framework, systemic risk is commonly viewed as comprising both cyclical and structural dimensions (Carney, 2021; Pfeifer et al., 2016). Cyclical systemic risk arises from the tendency for leverage, credit, and asset prices to expand during economic upswings before contracting sharply during downturns. Structural systemic risk, by contrast, reflects persistent vulnerabilities that exist largely independently of the business cycle, including interconnectedness, concentration, common exposures, and weaknesses embedded within financial market structures or regulatory frameworks (Carney, 2021, pp. 202–203).

From a macroprudential perspective, capital regulation should therefore operate countercyclically – becoming more restrictive during periods of rapid balance-sheet expansion and more accommodative during periods of financial stress (Brei and Gambacorta, 2016, p. 364). However, because Basel's risk-weighted capital requirements rely on measured default risk, they tend to decline when credit conditions are favourable and increase when economic conditions deteriorate. Consequently, banks may be encouraged to expand lending during booms while being forced to curtail credit during downturns, reinforcing rather than dampening financial cycles. The Basel III leverage ratio was introduced to address these shortcomings. Unlike risk-based capital requirements, it provides a simple, transparent, and non-risk-sensitive constraint on total leverage, independent of internal risk models or external credit ratings (BCBS, 2011; BCBS, 2017). As such, it serves both microprudential and macroprudential objectives by limiting excessive balance-sheet expansion while reducing vulnerabilities arising from model risk, regulatory arbitrage, and risk-weight compression (D'Hulster, 2009, p. 3; BOE, 2026, p. 21). Its principal objective is to constrain the excessive accumulation of leverage throughout the financial cycle and reduce the likelihood of destabilising deleveraging during periods of stress (BCBS, 2011, p. 61; BCBS, 2017, p. 140; BCBS, 2022, p. 7). The GFC Crisis demonstrated the importance of this safeguard, as many institutions accumulated substantial on- and off-balance-sheet leverage despite reporting apparently robust risk-weighted capital ratios.

The macroprudential value of the leverage ratio extends beyond its role as a simple backstop. Because it is based on total exposures rather than risk-weighted assets, it remains largely unaffected by cyclical fluctuations in measured credit risk. During economic expansions, when declining default probabilities compress regulatory risk weights and reduce measured capital requirements, the leverage ratio becomes an increasingly binding constraint as banks expand their balance sheets. Conversely, during downturns, when measured risks increase and risk-weighted capital requirements tighten, the leverage ratio changes relatively little, thereby providing a more stable regulatory benchmark over the financial cycle (Fender and Lewrick, 2015; Gambacorta and Karmakar, 2018). This characteristic enables the leverage ratio to complement the risk-weighted framework by mitigating the inherent procyclicality of model-based capital requirements.

Empirical evidence broadly supports this role. Using an international sample of banks headquartered in fourteen advanced economies, Brei and Gambacorta (2016) show that the Basel III leverage ratio behaves significantly more countercyclically than risk-weighted capital ratios. Whereas risk-weighted requirements become less restrictive during booms owing to declining measured risks, the leverage ratio becomes increasingly binding as leverage rises. Their findings also suggest that banks facing regulatory pressure often improve their reported risk-weighted capital ratios primarily by reducing risk-weighted assets rather than by raising new equity or reducing total leverage. This implies a reallocation towards assets carrying lower regulatory risk weights rather than a genuine strengthening of capital positions. Similarly, Fender and Lewrick (2015) find that while risk-weighted capital ratios exhibit pronounced procyclical behaviour, the leverage ratio provides a more consistent constraint on balance-sheet expansion throughout the financial cycle.

Beyond its cyclical role, the leverage ratio also addresses important structural weaknesses in the risk-weighted capital framework. In particular, it limits excessive exposures to assets receiving preferential regulatory treatment regardless of their underlying contribution to systemic risk. Examples include domestic sovereign securities, foreign-currency reserve assets, and, prior to the Global Financial Crisis, highly rated mortgage-backed securities. Although such assets attract zero or very low regulatory risk weights, they can nevertheless generate substantial losses or contribute to systemic instability under adverse conditions. The euro area sovereign debt crisis and the U.S. subprime mortgage crisis both illustrated how apparently low-risk assets can become important channels of systemic risk. By constraining total balance-sheet leverage irrespective of regulatory risk weights, the leverage ratio provides an important safeguard against these structural vulnerabilities while limiting opportunities for regulatory arbitrage (Fender and Lewrick, 2015; Frait and Tomšík, 2016; Tarullo, 2023).

When embedded within a macroprudential framework, the leverage ratio can itself be calibrated dynamically through a countercyclical leverage buffer, allowing minimum leverage requirements to vary with evolving macro-financial conditions and systemic risk (Christensen and Meh, 2011, p. 9; Pfeifer et al., 2016, p. 138). Rather than operating as a static prudential constraint, the leverage ratio can be tightened during periods of excessive leverage accumulation and relaxed temporarily during episodes of financial stress, thereby supporting the continued provision of credit while avoiding destabilising deleveraging. As D'Hulster (2009, p. 4) cautions, maintaining a rigid leverage ceiling during severe downturns may force banks to contract balance sheets precisely when capital is most constrained, amplifying rather than mitigating financial stress. A time-varying leverage requirement therefore offers greater macroprudential flexibility while preserving the leverage ratio's role as a safeguard against excessive balance-sheet expansion.

These considerations are particularly relevant for highly dollarised SSA LMICs, where exchange-rate movements can generate pronounced fluctuations in measured leverage through the domestic-currency revaluation of foreign-currency assets and liabilities. In such environments, a countercyclical leverage ratio buffer (CCLB) could be calibrated to respond not only to aggregate credit conditions but also to exchange-rate dynamics, financial dollarisation, and other macro-financial indicators that influence systemic risk.[18] Such a framework would extend the resilience-based orientation of Basel III by recognising that systemic vulnerabilities in SSA LMICs arise not solely from domestic credit booms but also from commodity price shocks, exchange-rate volatility, sovereign risk, climate related financial shocks, and other external financial disturbances. As Borio and Shim (2007, pp. 5–6) argue, the central objective is to build prudential buffers during periods when systemic imbalances emerge so that they can be released when those imbalances unwind, thereby moderating financial cycles and strengthening macro-financial stability.

[18] Further guidance on the policy design, calibration, and macroprudential application of the leverage ratio and leverage ratio buffers is provided by the Bank of England (BOE, 2026, pp. 21–28) and the Basel Committee on Banking Supervision (BCBS, 2017, pp. 140–142).

#### 2.3.4.4 Effective capital regulation: promoting genuine equity recapitalisation

The effectiveness of macroprudential capital regulation depends not only on the calibration of capital requirements but also on how banks achieve compliance. During, or in anticipation of, periods of financial stress, higher regulatory capital requirements are intended to strengthen banking sector resilience while preserving the flow of credit to the real economy. However, higher capital ratios do not necessarily require banks to raise new equity. Institutions may instead comply by reducing their asset base – a process commonly referred to as contractionary deleveraging – which can restrict credit supply, amplify economic downturns, and undermine the objectives of macroprudential policy (Aiyar et al., 2015; Gross et al., 2016). Accordingly, an important objective of prudential regulation is to promote expansionary deleveraging, whereby improvements in capital ratios are achieved through new equity issuance or retained earnings rather than through balance-sheet contraction (Blundell-Wignall and Atkinson, 2012; Gross et al., 2016).

International experience following the GFC illustrates the contrasting outcomes of alternative recapitalisation strategies. During the European Banking Authority's (EBA) 2011 capital exercise, systemically important banks were required to meet higher Core Tier 1 capital requirements in response to mounting concerns over sovereign debt exposures (Lane, 2012; Barth et al., 2012; Arnold, 2012; Mésonnier, 2014; Berrospide, 2015). Evidence suggests that many institutions responded primarily by reducing risk-weighted assets rather than raising additional equity (e.g., Gropp et al., 2019). While this approach improved reported regulatory capital ratios, it also contributed to a contraction in bank lending and intensified macroeconomic stress (Gross et al., 2016). Moreover, alternative measures of bank resilience, including market-based leverage ratios and Z-scores, indicated a deterioration in underlying solvency despite the improvement in regulatory capital ratios (Bostandzic et al., 2022). These findings highlight the limitations of recapitalisation strategies that rely predominantly on asset reduction rather than genuine capital strengthening.

By contrast, the 2009 Supervisory Capital Assessment Program (SCAP) in the United States provides an example of a pre-emptive, equity-based recapitalisation strategy. Conducted between February and May 2009, the SCAP assessed whether large U.S. bank holding companies possessed sufficient capital to continue lending under macroeconomic conditions substantially more adverse than those anticipated at the time (Hirtle et al., 2009). Institutions identified as undercapitalised were required to raise additional capital through private market issuance or, where necessary, through the U.S. Treasury's Capital Assistance Program, which provided mandatory convertible preferred securities. By November 2009, all ten bank holding companies identified with capital shortfalls had successfully raised more than US$77 billion in Tier 1 common equity (Hirtle et al., 2009). By requiring genuine equity recapitalisation rather than permitting balance-sheet contraction, the SCAP substantially reduced systemic deleveraging pressures and contributed to restoring confidence in the banking system.

These contrasting experiences demonstrate that macroprudential recapitalisation policies should be designed to encourage equity strengthening rather than asset contraction. Promoting recapitalisation through retained earnings or external equity issuance reduces the likelihood of simultaneous balance-sheet contraction across institutions, thereby limiting credit shortages and mitigating the fire-sale dynamics that often accompany systemic banking crises (Hanson et al., 2011, pp. 5–6). To reinforce these incentives, Hanson et al. (2011, p. 10) propose modifying regulatory capital requirements by measuring capital against the maximum of current and lagged total assets, rather than current assets alone. Under this approach, banks cannot restore compliance simply by shrinking their balance sheets. For example, a bank with US$100 in assets and US$8 in capital at the end of period t that subsequently incurs a US$4 loss would ordinarily satisfy a 6% capital requirement by reducing assets to US$66.7. Under the proposed framework, however, the capital requirement continues to reference the higher historical asset level (US$100), requiring the bank to raise US$2 in new equity to restore compliance rather than relying on balance-sheet contraction (Hanson et al., 2011). More broadly, incorporating such leverage-sensitive features into capital regulation can substantially reduce the procyclical effects of regulatory tightening, particularly in SSA LMICs where banking systems play a dominant role in financial intermediation. By ensuring that higher capital requirements are met primarily through genuine equity recapitalisation rather than contractionary deleveraging, macroprudential policy can simultaneously strengthen bank resilience, preserve credit intermediation, and enhance financial stability during periods of systemic stress.

### 2.3.5 Theoretical Framework

#### 2.3.5.1 Procyclicality in banking systems

Procyclicality in the banking system refers to the self-reinforcing interactions both within the financial sector and between the banking system and the real economy, whereby financial conditions amplify business cycle fluctuations by fuelling excessive credit expansion during booms and intensifying contractions during downturns (Athanasoglou et al., 2014, p. 59).[19] Such amplification distorts the efficient allocation of credit, increases systemic risk, and weakens macroeconomic resilience. A defining characteristic of modern financial systems has been the repeated occurrence of credit and asset-price booms followed by sharp corrections, often accompanied by rapid changes in real investment and, in many instances, culminating in systemic banking crises (White, 2005, p. 6).

Prudential regulation can itself contribute to these procyclical dynamics. Regulatory instruments such as minimum capital requirements and loan-loss provisioning rules influence banks' risk-taking behaviour and lending decisions over the financial cycle (Moreno, 2011, p. 9; White, 2005, p. 18). A longstanding concern is that, when minimum capital requirements become binding during economic downturns, banks may respond by reducing lending rather than raising new capital, thereby reinforcing the contraction in economic activity (Catarineu-Rabell et al., 2005, p. 538). Similarly, higher loan-loss provisions, particularly for capital-constrained institutions, can further restrict credit supply and amplify cyclical downturns (Huizinga and Laeven, 2019, p. 496). Although the Basel II and Basel III frameworks significantly improved the risk sensitivity of capital regulation by aligning capital requirements more closely with borrower risk profiles and incorporating off-balance-sheet exposures, they

[19] The financial cycle refers to fluctuations in economic activity that are driven by, or amplified through, the financial system (ECB, 2017, pp. 24-27). It is typically characterised by the co-movement of credit aggregates and asset prices, with potential spillovers to the real economy. While not all business cycles coincide with financial cycles, their alignment tends to produce more pronounced downturns, often associated with financial crises.

also introduced an inherent source of regulatory procyclicality (BCBS, 2011, p. 5). During periods of economic expansion, declining estimates of default risk reduce capital requirements, thereby facilitating further credit growth. Conversely, during downturns, rising probabilities of default increase required capital precisely when banks' capital positions are under pressure, intensifying constraints on credit supply (Catarineu-Rabell et al., 2005, p. 539).

Even under the simplified standardised approach, which, like Basel I, applies fixed regulatory risk weights that do not vary over the business cycle (Brei and Gambacorta, 2016, p. 365), banks may respond to tighter capital constraints by shifting their portfolios towards assets carrying lower regulatory risk weights – for example, sovereign securities with a 0% risk weight rather than corporate loans with a 100% risk weight (e.g., Amel-Zadeh et al., 2017). Rather than strengthening capital through new equity issuance, institutions may improve regulatory capital ratios by reducing risk-weighted assets, thereby crowding out private-sector lending. Similar forms of regulatory-induced credit contraction were documented during the early implementation of Basel I (Ediz et al., 1998, p. 15; Masera, 2020, p. 22) and remain especially relevant in SSA LMICs, where banks frequently exhibit a structural preference for domestic government securities and foreign-currency assets that attract zero or low regulatory risk weights. Moreover, with the exception of South Africa, most SSA LMIC jurisdictions rely on the simplified standardised approach to credit risk capital requirements, largely because the absence of external credit ratings precludes full implementation of the Basel standardised approach.

Procyclicality may also arise through the interaction between prudential regulation, asset valuation, and leverage. Capital frameworks that rely on measured risk, particularly when combined with fair value accounting, can amplify cyclical fluctuations where asset valuations and risk assessments are themselves procyclical or subject to measurement error (CGFS, 2010, p. 9). Market prices influence financial reporting, regulatory capital calculations, and internal risk models, either directly or indirectly through model-based valuation techniques (CGFS, 2009, p. 7). Consequently, valuation gains during economic expansions strengthen reported capital positions and encourage further balance-sheet growth, while valuation losses during downturns erode capital and accelerate deleveraging. The interaction between leverage and valuation effects therefore creates a powerful feedback mechanism capable of amplifying both financial and business cycles (FSF, 2009, p. 5). Taken together, these mechanisms highlight a fundamental challenge for the Basel III framework: preserving the benefits of risk-sensitive capital regulation while preventing regulatory requirements from reinforcing cyclical fluctuations in credit, leverage, and asset prices. Addressing this challenge requires macroprudential instruments capable of mitigating both the cyclical amplification arising from risk-based capital requirements and the structural vulnerabilities embedded within the financial system.

#### 2.3.5.1.1 Theoretical foundations of bank procyclicality

The procyclical behaviour of banks is theoretically rooted in deviations from the Efficient Markets Hypothesis (EMH), which assumes that market participants process all available information efficiently, enabling credit to be allocated in a manner that smooths rather than amplifies economic fluctuations (Fama, 1970; Athanasoglou et al., 2014, pp. 60–61). Under such conditions, credit supply would respond countercyclically, mitigating business cycle volatility. In reality, however, financial markets are characterised by information frictions, incentive distortions, and behavioural biases that give rise to pronounced credit and leverage cycles. Athanasoglou et al. (2014)[20] identify three principal theoretical mechanisms that explain procyclicality within the banking system.

[20] For an extensive review of the literature, see Athanasoglou, Daniilidis, and Delis (2014), who provide a comprehensive discussion of bank procyclicality across leverage, credit, and output dimensions.

First, asymmetric information, arising from adverse selection and moral hazard, plays a central role in shaping banks' lending behaviour (e.g., Akerlof, 1978; Darrough and Stoughton, 1986; Guesnerie et al., 1989; Dell'Ariccia, 2001). During economic expansions, stronger borrower balance sheets, rising collateral values, and lower perceived default risk encourage banks to extend credit more aggressively. Conversely, during downturns, deteriorating borrower quality, heightened uncertainty, and higher monitoring costs lead banks to tighten lending standards and contract credit supply. These informational frictions also affect provisioning decisions, as banks may postpone recognising expected losses to avoid adverse market signals regarding portfolio quality or earnings performance. Second, principal–agent conflicts between bank managers and shareholders can amplify cyclical risk-taking (e.g., Rees, 1985; Laffont and Martimort, 2002). Compensation structures linked to short-term profitability or share-price performance may encourage managers to increase leverage and assume greater risk during boom periods, particularly where shareholders face difficulties in effectively monitoring managerial decisions. Such incentive distortions contribute to excessive balance-sheet expansion during favourable economic conditions and heighten banking sector vulnerability when conditions deteriorate.

Third, herding behaviour contributes to correlated lending decisions and the accumulation of systemic risk (e.g., Banerjee, 1992; Avery and Zemsky, 1998; Bikhchandani and Sharma, 2000; Rook, 2006). Rather than relying solely on their own information, bank managers often imitate the strategies of peer institutions to minimise reputational risk, especially when institutions share similar information sets, employ comparable risk assessment models, or anticipate regulatory support during periods of financial distress. Such behaviour reinforces synchronised credit expansion during booms and widespread retrenchment during downturns, thereby amplifying systemic vulnerability. Collectively, these theories demonstrate how information asymmetries, agency conflicts, and herd behaviour generate self-reinforcing credit cycles in which lending expands excessively during economic upswings and contracts sharply during downturns. By amplifying fluctuations in credit, leverage, and asset prices, these mechanisms contribute to systemic risk and provide a strong theoretical justification for macroprudential policies – particularly countercyclical capital regulation – designed to moderate financial cycles and strengthen banking sector resilience.

#### 2.3.5.1.2 Theoretical foundations of bank leverage cycles

A natural theoretical starting point for analysing bank leverage cycles is Minsky's Financial Instability Hypothesis. Minsky (1982; 1992; 2016 [reprint], pp. 12–166; see also Paulus, 2014, pp. 4–24; Knell, 2015, pp. 295–296) argues that capitalist financial systems are inherently prone to cyclical instability, driven by endogenous dynamics within the financial system rather than solely by exogenous shocks. Periods of sustained economic growth, low default rates, and apparent macroeconomic stability gradually foster optimism among borrowers and lenders alike. As perceptions of risk diminish, banks expand credit, leverage increases, and financing structures become progressively more fragile.

Minsky characterises this evolution through three financing regimes. Under hedge finance, borrowers generate sufficient cash flows to meet both interest and principal repayments. In the speculative finance regime, borrowers can service interest payments but rely on refinancing to roll over principal. At the most fragile end of the spectrum lies Ponzi finance, where borrowers are unable to meet either interest or principal obligations from current cash flows and instead depend on continuously rising asset prices to refinance existing debt. This progression illustrates how leverage and systemic vulnerability accumulate endogenously over the financial cycle. Rising asset prices inflate collateral values and strengthen borrowers' apparent creditworthiness, encouraging lenders to ease credit standards, reduce capital and liquidity buffers, and extend additional credit. At the same time, declining default rates and subdued market volatility lower measured risk, reinforcing further leverage expansion.

Competitive pressures among financial institutions often intensify this process, encouraging greater reliance on short-term wholesale funding and increasing vulnerability to liquidity shocks.

The expansionary phase eventually culminates in what has become known as a "Minsky moment" (Paulus, 2014, pp. 25–26; Carney, 2021, p. 186), when an adverse shock – such as rising interest rates, declining asset prices, or a deterioration in market confidence – reveals the fragility of highly leveraged balance sheets. Margin calls, funding pressures, and falling collateral values trigger forced asset sales and tighter lending conditions, initiating a deleveraging spiral. As financing structures unwind from Ponzi through speculative to hedge finance, defaults increase, credit contracts, and banks become increasingly risk-averse. Because banks are the primary creators of credit, these adjustments amplify both the expansion and contraction phases of the financial cycle. In the absence of effective countercyclical policy tools or credible regulatory backstops, the financial system becomes susceptible to recurring episodes of excessive leverage followed by severe credit contractions.

Building on these insights, Nuno and Thomas (2017, pp. 42–68) develop a dynamic stochastic general equilibrium (DSGE) model in which bank leverage cycles arise endogenously through the interaction of balance-sheet constraints, changing risk perceptions, and costly equity adjustment. In their framework, banks finance long-term risky assets using a combination of short-term debt and equity, thereby creating maturity mismatches. A key friction is that bank equity adjusts only gradually and is costly to raise, implying that banks respond to shocks primarily by adjusting asset holdings rather than issuing new capital. Banks are further subject to an occasionally binding leverage constraint that links the size of their balance sheets to their net worth. During economic expansions, rising asset prices and compressed risk premia strengthen bank balance sheets and relax leverage constraints, enabling banks to expand lending and increase leverage. This balance-sheet expansion stimulates investment, output, and further asset price appreciation, generating a self-reinforcing feedback loop. Conversely, adverse shocks reduce asset values, tighten leverage constraints, and force banks to deleverage rapidly through asset sales and credit contraction. Because equity cannot be replenished quickly, deleveraging becomes abrupt and asymmetric, amplifying declines in credit supply, investment, and economic activity.

Taken together, Minsky's Financial Instability Hypothesis and the dynamic model of Nuno and Thomas provide a coherent theoretical explanation for the endogenous nature of bank leverage cycles. Both frameworks demonstrate how balance-sheet interactions, changing risk perceptions, and leverage constraints can amplify macro-financial fluctuations, thereby providing a strong theoretical rationale for macroprudential policies – including countercyclical capital buffers and leverage ratio requirements – designed to restrain excessive leverage during booms and preserve credit intermediation during periods of financial stress.

**2.3.5.1.3 Theoretical foundations of excessive leverage and the rationale for higher equity requirements**

A substantial body of theoretical literature identifies excessive bank leverage as a fundamental source of financial instability, with debt overhang representing a major impediment to timely recapitalisation. Admati et al. (2012) formalise this problem by demonstrating that, when banks are highly leveraged, existing shareholders have little incentive to inject new equity, even when doing so would improve the institution's solvency. This is because the benefits of recapitalisation accrue largely to creditors through lower default risk, while shareholders bear the costs of equity dilution. Consequently, distressed banks may delay or avoid raising new equity, choosing instead to maintain high leverage or reduce assets, thereby increasing systemic vulnerability.

To address these agency distortions, Admati et al. (2012) advocate substantially higher equity capital requirements than those prescribed under Basel III, arguing that stronger equity buffers reduce the social costs of bank failure, improve loss-absorbing capacity, and discourage excessive risk-taking. Within this framework, regulatory recapitalisation requirements that explicitly mandate genuine equity increases play an important role in overcoming debt-overhang incentives and strengthening financial stability. Building on this work, Admati et al. (2018) develop a dynamic capital structure model incorporating corporate taxation, bankruptcy costs, and financing frictions. They identify three reinforcing mechanisms – the default option value of leverage, equity dilution concerns, and the loss of debt-related tax advantages – that together generate a leverage ratchet effect, whereby leverage increases readily during favourable economic conditions but declines only reluctantly thereafter. This path dependence is particularly pronounced in banking, where shareholders frequently prefer additional borrowing, asset sales, or balance-sheet contraction to issuing new equity, even when institutions are financially distressed. The resulting persistence of high leverage increases both individual bank fragility and systemic risk.

A complementary explanation is provided by Rochet (1992), who shows that limited liability creates asymmetric incentives for bank shareholders. Because shareholders capture the full upside from successful investments while transferring a substantial portion of downside losses to creditors, deposit insurers, or ultimately taxpayers, they are encouraged to undertake excessive risk. This moral hazard problem is particularly acute in highly leveraged institutions and may not be adequately constrained by risk-weighted capital requirements alone. Rochet (1992) therefore argues that effective prudential regulation requires binding minimum capital floors,[21] expressed as absolute capital requirements, to limit excessive leverage, mitigate moral hazard, and strengthen financial stability. Taken together, these theoretical contributions provide a strong rationale for higher equity capital requirements and regulatory frameworks

[21] Blum (2008, p. 1701, footnote 10) notes that many regulatory frameworks incorporate absolute capital floors, such as minimum capital requirements for bank licensing, which are set regardless of bank size or portfolio risk.

that promote genuine equity recapitalisation rather than balance-sheet contraction. By addressing debt-overhang incentives, reducing leverage persistence, and limiting moral hazard, stronger equity requirements enhance the resilience of individual institutions while reducing systemic risk. These insights also reinforce the broader macroprudential objective of ensuring that banks maintain sufficient loss-absorbing capacity throughout the financial cycle.

#### 2.3.5.1.4 Leverage procyclicality and equity stickiness in bank balance sheets

Adrian and Shin (2010, 2011) provide one of the most influential analytical explanations of bank leverage procyclicality, highlighting the dynamic interaction between asset prices, balance-sheet adjustments, and financial instability. In mark-to-market financial systems, changes in asset prices are immediately reflected in banks' balance sheets, directly affecting their net worth. Given the inherently leveraged nature of banking, relatively small changes in asset values can generate disproportionately large changes in equity and leverage. Rather than passively accepting these fluctuations, banks actively manage their balance sheets to maintain or increase target leverage, resulting in a strong positive relationship between asset growth and leverage over the financial cycle. This behaviour contrasts sharply with that of households and non-financial firms, whose leverage typically responds more passively to changes in asset values.

A central insight of Adrian and Shin's framework is that bank equity behaves as a relatively "sticky" or predetermined variable, adjusting much more slowly than total assets. While equity is constrained by retained earnings and the costs of raising new capital, banks can expand or contract their balance sheets relatively quickly by adjusting borrowing and asset holdings. Consequently, leverage becomes inherently procyclical. During economic expansions, rising asset prices and favourable funding conditions allow balance sheets to expand more rapidly than equity, causing leverage to increase. Conversely, during periods of financial stress, falling asset prices and tighter funding conditions force banks to contract their balance sheets, reducing leverage primarily through asset sales rather than through new equity issuance. This asymmetric adjustment mechanism generates powerful feedback effects that amplify financial cycles. During booms, stronger balance sheets support additional borrowing and asset purchases, further boosting asset prices and encouraging additional leverage. During downturns, declining asset values trigger deleveraging, fire sales, tighter credit conditions, and further reductions in asset prices, reinforcing the downward spiral.

Adrian and Shin's empirical evidence further shows that commercial banks, like investment banks, exhibit pronounced procyclical leverage behaviour. The persistence of these cycles reflects the slow adjustment of equity, which is constrained by financing frictions such as debt overhang, adverse selection, and the high cost of issuing new capital, particularly during periods of financial distress. Consequently, equity stickiness prevents banks from recapitalising rapidly, reinforcing leverage cycles and increasing systemic vulnerability. Taken together, these insights provide a strong theoretical explanation for why leverage expands during periods of financial optimism yet contracts abruptly during crises. They also reinforce the macroprudential rationale for policies that promote timely equity recapitalisation and constrain excessive leverage, including higher equity requirements, binding leverage ratios, and other countercyclical capital measures designed to strengthen banking sector resilience over the financial cycle.

#### 2.3.5.2 Leverage procyclicality and the role of the Basel III leverage ratio

The GFC exposed fundamental weaknesses in relying exclusively on risk-weighted capital ratios to safeguard financial stability, prompting a major shift in international banking regulation under the Basel III framework. One of the framework's most significant innovations was the introduction of the leverage ratio (LR), a simple, transparent, and non-risk-based capital requirement designed to complement the risk-weighted capital framework by constraining the excessive accumulation of leverage across both on- and off-balance-sheet exposures. By requiring banks to maintain a minimum level of equity relative to total exposures irrespective of regulatory risk weights, the leverage ratio strengthens the resilience of the capital framework against model risk, regulatory arbitrage, and the systematic underestimation of asset risk.

Beyond its microprudential role, the leverage ratio is intended to mitigate leverage procyclicality by limiting excessive balance-sheet expansion during periods of economic optimism and reducing the likelihood of abrupt deleveraging during periods of financial stress. Unlike risk-weighted capital requirements, whose stringency varies with measured risk, the leverage ratio provides a stable and transparent capital floor that remains largely unaffected by changes in risk perceptions or modelling assumptions. Consequently, it acts as an important macroprudential safeguard in financial systems where measured risks may underestimate the build-up of systemic vulnerabilities. Nevertheless, the introduction of the leverage ratio has rekindled a broader policy debate regarding its effectiveness as a prudential instrument. A principal criticism concerns its lack of risk sensitivity. By applying the same capital requirement to all exposures regardless of their underlying risk, a binding leverage ratio may encourage banks to reallocate their portfolios towards higher-yielding and potentially riskier assets in an effort to preserve profitability and optimise returns on equity (Acosta-Smith et al., 2024, p. 2; Choi et al., 2020, p. 244; ECB, 2015, p. 123).

This potential trade-off between leverage and risk-taking is well documented in the banking literature. When leverage constraints become binding, banks may treat leverage and portfolio risk as substitute margins of adjustment, reducing leverage while simultaneously increasing the riskiness of their asset portfolios to maintain target returns or internal risk objectives (Shrieves and Dahl, 1992, pp. 442–443). Although such behaviour may partially offset the prudential benefits of tighter leverage regulation, it does not diminish the leverage ratio's role as an essential complement to the risk-weighted capital framework. Rather, it underscores the importance of implementing the leverage ratio alongside risk-based capital requirements, ensuring that the strengths of one framework compensate for the limitations of the other (Acosta-Smith et al., 2024). This complementary role is particularly important in highly dollarised and institutionally constrained banking systems, such as those in many SSA LMICs, where regulatory risk weights may inadequately capture underlying balance-sheet risks. In such environments, the leverage ratio provides an important safeguard against excessive leverage arising from low-risk-weighted sovereign securities, foreign-currency reserve assets, and other exposures that may conceal growing systemic vulnerabilities. Consequently, a well-calibrated and, where appropriate, binding leverage ratio can play a central role in strengthening financial resilience by limiting leverage procyclicality while complementing the risk-sensitive objectives of the Basel III capital framework.

**2.3.5.2.1 Risk substitution and portfolio reallocation: Theoretical perspectives**

A substantial body of theoretical literature cautions that flat, non-risk-sensitive capital requirements, such as minimum leverage ratios, may generate unintended behavioural responses by regulated banks.[22] Seminal contributions by Kahane (1977), Koehn and Santomero (1980), and Kim and Santomero (1988) provide the theoretical foundations for

[22] For a more comprehensive discussion of the theoretical literature on the effects of capital regulation on bank risk, see the detailed surveys by VanHoose (2007) and Santos (2001).

understanding how non-risk-based capital regulation can induce risk substitution and distort banks' portfolio allocation decisions. Using a mean-variance portfolio framework, Kahane (1977) demonstrates that flat capital requirements designed to reduce insolvency risk may, paradoxically, increase the probability of bank failure unless accompanied by explicit constraints on portfolio risk. When capital requirements become binding, banks have incentives to shift towards higher-risk assets to preserve expected returns, particularly where all assets are subject to the same capital charge regardless of their underlying risk. Building on this insight, Koehn and Santomero (1980) model banks as expected utility maximisers operating under binding capital constraints. They show that tighter capital-to-asset requirements reduce expected profitability and may induce banks to increase portfolio risk in an attempt to restore target returns, thereby offsetting part of the prudential benefits of higher capital requirements.

Kim and Santomero (1988) extend this analysis by jointly modelling endogenous capital and portfolio risk choices within a single-period optimisation framework. Their principal contribution is to demonstrate that flat leverage constraints limit balance-sheet expansion but fail to account for differences in banks' risk preferences. Consequently, institutions with a greater appetite for risk may respond by increasing portfolio risk, weakening the stabilising effects of higher capital requirements. By contrast, appropriately calibrated risk-based capital requirements internalise differences in asset risk, reducing the attractiveness of excessively risky portfolios and producing more efficient solvency outcomes across heterogeneous banks. Taken together, these studies identify an important limitation of non-risk-based capital regulation. Although leverage requirements effectively constrain balance-sheet growth, they may also encourage risk substitution unless complemented by risk-sensitive capital measures. The literature therefore provides a strong theoretical justification for combining leverage-based and risk-weighted capital requirements within an integrated prudential framework.

#### 2.3.5.2.2 Leverage ratio versus risk-weighted capital frameworks: Theoretical perspectives

The relative merits of leverage-based and risk-weighted capital regulation have long been debated in the banking literature. A central theme is the trade-off between risk sensitivity and regulatory robustness. While risk-weighted capital requirements seek to align capital with the underlying riskiness of bank assets, they remain susceptible to model risk, measurement error, and regulatory arbitrage. Conversely, leverage ratios provide a simple and transparent capital constraint that is largely immune to these shortcomings but sacrifice risk sensitivity. A number of theoretical and simulation-based studies examine these competing characteristics (e.g., Cordell and King, 1995; Gjerde and Semmen, 1995; Cuoco and Liu, 2006; Blum, 2008).

Cordell and King (1995, pp. 548–559) compare Basel I regulatory capital requirements with market-based estimates of required capital and find only weak correspondence between the two, particularly with respect to asset risk. Their findings suggest that Basel I's simplified risk weights inadequately captured the true economic risk of bank portfolios, partly because they omitted important sources of risk, including interest rate risk and portfolio concentration. These shortcomings created opportunities for inefficient capital allocation and regulatory arbitrage. Cuoco and Liu (2006, pp. 368–387) examine bank behaviour under Basel I's Internal Models Approach for market risk using a dynamic stochastic model. Although internal Value-at-Risk (VaR) models can improve risk measurement and reduce default probabilities when supported by credible supervisory penalties, the authors demonstrate that banks may strategically understate VaR estimates to reduce regulatory capital requirements where supervisory oversight is imperfect. Their analysis therefore highlights the importance of limiting dependence on internally generated risk measures.

Similarly, Gjerde and Semmen (1995, pp. 1164–1167) compare leverage-based and risk-based capital regulation within a unified theoretical framework. They show that risk-based requirements can improve capital allocation and financial stability when risk weights accurately reflect underlying economic risk. However, where risk weights are imperfectly calibrated – as is frequently the case in practice – they may distort banks' portfolio choices and weaken regulatory effectiveness. Under such circumstances, the authors conclude that the optimal prudential framework combines both leverage-based and risk-weighted capital requirements, with each instrument compensating for the weaknesses of the other. Finally, Blum (2008, pp. 1701–1705) examines Basel II's Internal Ratings-Based (IRB) approach through an adverse selection framework. Because supervisors cannot perfectly verify banks' internal risk models, institutions with riskier portfolios have incentives to understate measured risk in order to reduce capital requirements. Blum (2008) demonstrates that a binding leverage ratio, operating independently of regulatory risk weights, limits the regulatory gains from such strategic behaviour and thereby mitigates the incentives for model manipulation. In this sense, the leverage ratio strengthens prudential regulation by addressing information asymmetries and reducing opportunities for regulatory arbitrage.

Collectively, these theoretical contributions demonstrate that neither leverage-based nor risk-weighted capital regulation is sufficient in isolation. Risk-weighted capital requirements provide greater sensitivity to underlying asset risk but remain vulnerable to model error, calibration weaknesses, and strategic manipulation. Conversely, leverage ratios offer simplicity, transparency, and robustness but may encourage risk substitution if implemented alone. These complementary strengths provide a strong theoretical rationale for the Basel III framework, in which the leverage ratio serves as a credible non-risk-based backstop to the risk-weighted capital framework, enhancing financial resilience by simultaneously constraining excessive leverage and mitigating weaknesses inherent in risk-sensitive capital regulation.

#### 2.3.5.2.3 Basel III as an integrated capital framework: Theoretical rationale for combining risk-based and leverage standards

Basel III represents a fundamental departure from earlier bank capital regimes by explicitly integrating risk-based and non-risk-based (leverage) capital requirements within a single prudential framework. Rather than treating these approaches as substitutes, Basel III recognises that each addresses important limitations of the other. Risk-weighted capital requirements promote risk-sensitive capital allocation but remain susceptible to model risk, measurement error, and regulatory arbitrage. By contrast, the leverage ratio provides a simple, transparent, and model-independent capital floor that constrains excessive leverage irrespective of asset risk. A growing body of theoretical research argues that combining these two approaches produces a more robust and resilient capital framework than relying on either instrument in isolation (e.g., Dermine, 2015; Acosta-Smith et al., 2024; Fatouh et al., 2024). These insights are particularly relevant for banking systems characterised by supervisory constraints, limited data availability, and imperfect information, conditions that prevail in many low- and lower-middle-income countries in Sub-Saharan Africa.

**Dermine (2015): The leverage ratio as a credibility-enhancing backstop under asymmetric information**

Dermine (2015, pp. 268–274) develops a one-period credit risk model to examine how capital regulation can mitigate bank-run risk in the presence of asymmetric information. Within the Basel II/III framework, lower portfolio risk or greater diversification ordinarily results in lower regulatory capital requirements. However, where depositors cannot accurately observe banks' underlying asset quality, lower capital ratios may be interpreted as evidence of financial weakness rather than improved risk management, increasing the likelihood of depositor panic despite objectively safer portfolios. To address this information problem, Dermine (2015) proposes a two-tier capital framework comprising: (i) a risk-sensitive capital requirement aligned with portfolio risk; and (ii) a non-risk-based leverage ratio that establishes a minimum capital floor independent of risk assessments. The leverage ratio therefore serves as a credibility-enhancing mechanism by reducing reliance on complex risk models and reinforcing depositor confidence. This argument is particularly relevant for SSA LMICs, where limited supervisory capacity, opaque asset quality, and constrained disclosure practices reduce the effectiveness of sophisticated risk-based capital regulation.

**Acosta-Smith et al. (2024): Complementarity between risk-based capital and the leverage ratio**

Acosta-Smith et al. (2024, pp. 3–15) develop a microeconomic model of bank capital optimisation under simultaneous risk-weighted capital requirements and the Basel III leverage ratio. Their analysis demonstrates that the leverage ratio is not behaviourally neutral. When binding, it constrains total balance-sheet expansion and limits excessive leverage independently of measured portfolio risk. However, because the leverage ratio reduces the capital efficiency associated with low-risk assets, banks may respond by reallocating their portfolios towards higher-yielding and riskier assets – a form of risk substitution. Importantly, the model also shows that this potential increase in portfolio risk is partly offset by the higher equity buffers required under a binding leverage ratio, which strengthen banks' loss-absorbing capacity and reduce the probability of financial distress. Conversely, where the leverage ratio is non-binding, it has little influence on banks' portfolio decisions.

Using a panel of 655 European banks over the period 2005–2014, the authors provide empirical support for these theoretical predictions. Although a binding leverage ratio may modestly increase portfolio risk, it significantly improves capital resilience, lowers bank distress, and increases shareholders' "skin in the game." Most importantly, the study demonstrates that leverage and risk-based capital requirements operate as complementary rather than competing regulatory instruments. While the leverage ratio constrains excessive leverage regardless of the accuracy of risk measurement, risk-weighted capital requirements continue to differentiate capital according to underlying asset risk. Together, they reduce opportunities for model manipulation and regulatory arbitrage, issues that are particularly important in jurisdictions with limited supervisory capacity.

**Fatouh et al. (2024): Portfolio allocation under dual capital constraints**

Fatouh et al. (2024, pp. 34–35) further examine how banks adjust their asset portfolios when simultaneously subject to leverage and risk-based capital requirements. Their theoretical model considers a representative bank allocating its balance sheet between risk-free government securities and risky loans while satisfying both regulatory constraints. Under a purely risk-weighted regime, banks maximise capital efficiency by increasing holdings of low-risk assets that attract favourable regulatory treatment. Once a leverage ratio becomes binding, however, this strategy becomes less effective because capital must support total exposures irrespective of asset class. Consequently, the leverage ratio constrains overall balance-sheet expansion but may also encourage banks to increase the average riskiness of their portfolios where the return differential between risky and safe assets is sufficiently large.

The authors demonstrate that the overall impact on financial stability depends on the relative strength of these opposing effects. If the reduction in leverage outweighs any increase in portfolio risk, bank resilience improves. Conversely, if risk substitution dominates, the overall risk profile may deteriorate. Their analysis concludes that the most stable regulatory configuration combines a leverage ratio with appropriately calibrated risk-based capital requirements, thereby preserving incentives for prudent portfolio allocation while preventing excessive leverage. Furthermore, where returns across asset classes are relatively compressed – as often occurs during periods of low interest rates or financial stress – the incentives for risk substitution become considerably weaker.

**Synthesis and policy implications**

Taken together, these theoretical contributions provide a compelling justification for Basel III's integrated capital framework. Rather than serving as substitutes, leverage and risk-based capital requirements perform complementary regulatory functions. The leverage ratio strengthens the resilience of the capital framework by mitigating model risk, information asymmetries, under-reporting of risk, and regulatory arbitrage. Risk-weighted capital requirements, in turn, preserve risk sensitivity by ensuring that capital requirements continue to reflect differences in portfolio risk across asset classes. This complementarity is particularly important in highly dollarised SSA LMICs, where supervisory capacity remains constrained, asset risk is often difficult to measure accurately, and large holdings of sovereign securities and foreign-currency assets can cause risk-weighted capital ratios to overstate banks' true resilience. In such environments, the leverage ratio provides a robust safeguard against excessive balance-sheet expansion while the risk-based framework continues to promote prudent risk differentiation.

From a policy perspective, these theoretical insights support the adoption of a context-specific Basel III framework that combines the simplicity and robustness of the leverage ratio with the risk sensitivity of the Basel capital adequacy regime. When appropriately calibrated, the leverage ratio can function simultaneously as a microprudential safeguard against excessive leverage and as a macroprudential instrument that enhances resilience over the financial cycle. By increasing both the quantity and quality of loss-absorbing capital, while reducing reliance on complex supervisory judgements and imperfect risk measurement, the integrated Basel III framework offers a particularly valuable regulatory approach for developing economies where supervisory and institutional capacity remains limited (World Bank, 2020, p. 82).

**2.3.5.2.4 Static risk weights and leverage procyclicality: A Theoretical perspective**

Amel-Zadeh et al. (2017, pp. 1428–1434) develop a theoretical framework demonstrating that bank leverage procyclicality arises not primarily from fair value accounting, but from the interaction between static regulatory risk weights and binding capital constraints. Their model considers banks as return-on-equity maximisers operating under risk-weighted capital requirements, such as those embedded in Basel I and the simplified standardised approaches to credit risk of Basel II/III. Under these regulatory frameworks, broad asset classes are assigned fixed risk weights – for example, 0%, 20%, 50%, or 100% – that remain unchanged despite fluctuations in market conditions or underlying asset risk.

A central implication of the model is that leverage becomes inherently procyclical when regulatory capital requirements are binding. During economic expansions, banks approaching their minimum capital requirements can continue expanding their balance sheets by reallocating their portfolios towards assets carrying lower regulatory risk weights, such as sovereign securities. This strategy reduces average risk-weighted assets (RWAs) while allowing total assets – and therefore leverage – to increase without breaching regulatory capital requirements. Conversely, during downturns, declining asset values or increases in measured portfolio risk (e.g., more provisions for loan losses) tighten regulatory constraints, forcing banks either to contract their balance sheets or to shift towards higher-quality, lower-risk assets in order to restore compliance. The resulting balance-sheet adjustment reinforces deleveraging and amplifies the contraction in credit supply.

Importantly, the authors show that fair value accounting is not, in itself, the primary source of leverage procyclicality. Rather, valuation changes act mainly as a catalyst that triggers banks' portfolio adjustments in response to regulatory incentives. Significant leverage cycles emerge only when banks actively exploit fixed regulatory risk weights by increasing exposures to assets attracting zero or low capital charges following favourable valuation gains. For institutions that are not constrained by regulatory capital requirements, leverage may still fluctuate with changes in asset values through mark-to-market effects, but these adjustments are largely passive and considerably less pronounced.

More broadly, Amel-Zadeh et al. (2017) highlight an important limitation of static risk-weighted capital frameworks. By assigning fixed regulatory risk weights that do not evolve with changing macro-financial conditions, these frameworks create incentives for banks to optimise regulatory capital through portfolio reallocation rather than through genuine increases in equity. As average portfolio risk weights decline during economic expansions and rise during downturns, regulatory capital requirements themselves can amplify leverage and credit cycles, reinforcing systemic risk.

These theoretical insights provide a strong rationale for complementing static risk-weighted capital requirements with macroprudential instruments that are less susceptible to regulatory arbitrage. In particular, the Basel III leverage ratio constrains balance-sheet expansion irrespective of regulatory risk weights, thereby limiting opportunities for capital optimisation through portfolio reallocation. This complementarity is especially relevant for highly dollarised SSA LMICs, where banks typically maintain large holdings of sovereign securities and foreign-currency reserve assets that attract zero or low regulatory risk weights. In such settings, reliance on risk-weighted capital measures alone may understate leverage-related vulnerabilities, strengthening the case for a binding leverage ratio as a safeguard against excessive balance-sheet expansion and the procyclical effects of static risk weights.

#### 2.3.5.3 Theoretical foundations of countercyclical capital requirements

Countercyclical capital requirements (CCRs) are a central component of modern macroprudential regulation, designed to strengthen the resilience of the banking system over the financial cycle. Their primary objective is to ensure that banks accumulate additional capital during periods of strong credit growth and favourable macro-financial conditions, creating loss-absorbing buffers that can be drawn down during periods of financial stress. By encouraging capital accumulation in good times and permitting its release in downturns, CCRs seek to moderate excessive credit expansion, reduce leverage procyclicality, preserve the flow of credit to the real economy, and limit the amplification of financial shocks (BCBS, 2010c; 2011; 2017). The theoretical rationale for countercyclical capital regulation extends beyond enhancing the resilience of individual institutions. It reflects the recognition that banking systems are inherently procyclical, with credit supply, leverage, and risk-taking often reinforcing business cycle fluctuations.

Consequently, effective macroprudential regulation requires capital requirements that vary over time in response to evolving systemic risk, rather than remaining fixed throughout the financial cycle. The theoretical literature examines countercyclical capital regulation through two complementary approaches: risk-based capital requirements and leverage-based capital requirements. The first centres on risk-sensitive instruments, notably the Basel III Countercyclical Capital Buffer (CCyB), which adjusts capital requirements in response to changes in measured credit risk and the build-up of systemic vulnerabilities (e.g., Jokivuolle et al., 2014; Kashyap and Stein, 2004). The second focuses on countercyclical leverage constraints, implemented through the Basel III leverage ratio, which operate independently of regulatory risk weights by limiting excessive balance-sheet expansion through a simple, non-risk-based capital requirement (e.g., Fender and Lewrick, 2015; Gambacorta and Karmakar, 2018). Together, these complementary approaches seek to enhance the resilience of the banking system while mitigating the procyclicality of credit and leverage over the financial cycle.

#### 2.3.5.3.1 Risk-based countercyclical capital requirements: Theoretical foundations

The theoretical case for risk-based countercyclical capital requirements is grounded in a growing body of literature that attributes banking sector procyclicality to information asymmetries, credit market imperfections, and financial frictions. Rather than viewing capital regulation solely as a safeguard against bank insolvency, these models emphasise its broader macroprudential role in stabilising credit supply and mitigating the amplification of business cycle fluctuations. The contributions of Jokivuolle et al. (2014) and Kashyap and Stein (2004), for example, provide two complementary theoretical justifications for state-contingent capital requirements that vary systematically over the financial cycle.

Jokivuolle et al. (2014, pp. 58–71) develop a theoretical model in which asymmetric information between banks and borrowers gives rise to adverse selection, particularly during economic downturns when the average probability of project success declines. Under such conditions, banks face increasing difficulty distinguishing between high- and low-risk borrowers, creating incentives either to ration credit excessively or to extend credit inefficiently to riskier borrowers. Static capital requirements, characteristic of the Basel I framework, exacerbate these distortions by tightening capital constraints uniformly during recessions. By contrast, the authors show that dynamic, risk-sensitive capital requirements – such as those embedded in the Internal Ratings-Based (IRB) approach under Basel II/III – can improve allocative efficiency by allowing capital requirements to vary across borrower risk classes and over the business cycle. Such a framework preserves access to finance for creditworthy firms while restraining lending to riskier borrowers, thereby reducing credit market inefficiencies arising from informational frictions.

Kashyap and Stein (2004) reinforce this argument by demonstrating that capital regulation based on a single, static relationship between borrower default risk and regulatory capital requirements is inherently procyclical. As economic conditions deteriorate, rising default probabilities automatically increase required capital, forcing banks to curtail lending precisely when external finance becomes most valuable. To overcome this problem, they propose replacing a single regulatory risk schedule with a family of risk curves, allowing capital requirements to adjust systematically over the financial cycle. Under this approach, capital requirements increase during economic expansions to restrain excessive credit growth and decline during downturns to sustain lending to productive borrowers. Their simulations show that such time-varying capital requirements reduce fluctuations in credit supply and mitigate the amplification effects associated with static regulatory capital rules.

Taken together, these contributions establish a strong theoretical foundation for countercyclical, risk-sensitive capital regulation. Rather than serving solely as ex post protection against bank insolvency, countercyclical capital requirements enhance macro-financial stability by correcting credit market imperfections, moderating credit cycles, and preserving efficient financial intermediation. These theoretical insights are particularly relevant for emerging and developing economies, where financial systems are generally more susceptible to procyclical lending behaviour and macroeconomic volatility.

**2.3.5.3.2 Countercyclical leverage constraints: A Theoretical framework**

While risk-based countercyclical capital requirements address the procyclicality inherent in measured credit risk, a complementary strand of the literature argues that effective macroprudential regulation also requires countercyclical leverage constraints. The principal justification for such constraints lies in their ability to offset the inherent limitations of risk-weighted capital requirements by providing a stable, non-risk-sensitive capital floor that constrains excessive leverage throughout the financial cycle. The conceptual and quantitative contributions of Fender and Lewrick (2015) and Gambacorta and Karmakar (2018) provide the principal theoretical foundations for this approach.

Fender and Lewrick (2015, pp. 45–55) develop a conceptual framework for calibrating the Basel III leverage ratio within a macroprudential setting. They contrast the cyclical behaviour of risk-weighted capital requirements – which fluctuate with internal risk models and market-based measures of risk – with the leverage ratio's fixed exposure-based design. During economic expansions, declining measured risks reduce risk-weighted capital requirements and may encourage excessive balance-sheet expansion. Because the leverage ratio is independent of regulatory risk weights, it provides a more stable and consistent capital constraint, thereby limiting the build-up of leverage during boom periods. The authors identify three key principles for effective leverage ratio design. First, the leverage ratio should provide a capital buffer that operates independently of risk-weighted measures, thereby mitigating leverage procyclicality. Second, it should complement rather than replace risk-based capital requirements. Third, its calibration should balance the long-run financial stability benefits of stronger capital against any short-run effects on economic activity. Their empirical analysis confirms that risk-weighted capital requirements display pronounced procyclical behaviour, whereas leverage ratios remain comparatively stable over time. Accordingly, they argue that the Basel III minimum leverage ratio of 3 percent may be insufficient and advocate a higher range of approximately 4–5 percent, particularly for institutions with elevated leverage or more opaque risk exposures.

Gambacorta and Karmakar (2018, pp. 165–186) extend this analysis using a dynamic stochastic general equilibrium (DSGE) model that explicitly incorporates both leverage and risk-weighted capital requirements. Their results demonstrate that leverage constraints naturally exhibit countercyclical properties, becoming more restrictive during economic expansions and less binding during downturns. This feature dampens excessive credit growth in booms while reducing the severity of credit contractions during periods of financial stress. Their simulations indicate that introducing a leverage constraint results in only modest long-run output costs – estimated at between 0.7 and 1.7 percent – but generates substantial macroprudential benefits, including reductions of approximately 24–28 percent in the volatility of bank lending and aggregate output. These benefits are particularly pronounced in banking systems characterised by highly procyclical financial conditions or relatively weak supervisory institutions. Their analysis further shows that the optimal calibration of leverage requirements depends not only on macroeconomic conditions but also on banks' underlying portfolio risk, implying that institutions with riskier asset portfolios require correspondingly tighter leverage constraints.

Collectively, these studies provide a strong theoretical justification for incorporating countercyclical leverage constraints within the broader macroprudential capital framework. Whereas risk-weighted capital requirements align regulatory capital with portfolio risk, they remain inherently procyclical and vulnerable to model uncertainty and regulatory arbitrage. Countercyclical leverage constraints complement these measures by limiting excessive balance-sheet expansion independently of risk assessments, thereby strengthening the resilience of the banking system over the financial cycle. When appropriately calibrated, they operate as both microprudential safeguards against excessive leverage and macroprudential stabilisers that moderate financial cycles. This complementary role is particularly important in highly dollarised SSA LMICs, where supervisory capacity is often limited, risk measurement remains challenging, and large holdings of low-risk-weighted sovereign and foreign-currency assets may cause risk-weighted capital ratios to understate underlying leverage-related vulnerabilities. In such environments, countercyclical leverage constraints provide an additional and potentially more robust mechanism for promoting financial stability.

### 2.3.6 Empirical evidence on Basel III

A substantial body of empirical research has examined the macroeconomic, behavioural, and financial stability implications of the Basel III framework, with particular attention to the trade-offs between stronger banking sector resilience and the transitional costs of higher capital requirements. Foundational studies by the Basel Committee on Banking Supervision (BCBS, 2010a, 2010b), Allen et al. (2012), and Angelini et al. (2015) consistently conclude that the principal long-run benefit of Basel III is a lower probability and fiscal cost of systemic banking crises, together with reduced macroeconomic volatility during normal economic conditions. These long-term gains, however, are accompanied by short- to medium-term adjustment costs as banks adapt to more stringent capital and liquidity requirements. Model-based simulations and empirical studies document temporary reductions in economic output (e.g., Slovik and Cournède, 2011), slower credit growth (e.g., Berrospide and Edge, 2010; Cosimano and Hakura, 2011; Bridges et al., 2014; Naceur et al., 2018), and lower bank efficiency in liquidity creation (Distinguin et al., 2013; Fu et al., 2016; Casu et al., 2019), particularly during the transition to the new regulatory regime.

Empirical evidence on banks' behavioural responses to higher capital requirements is more nuanced. Some studies find that stronger capital standards encourage greater risk-taking or portfolio reallocation (Dias, 2021; Beccalli et al., 2018; Nguyen et al., 2019), whereas others report lower portfolio risk, stronger capital positions, and improved banking sector resilience (Ashraf et al., 2016; Adesina and Mwamba, 2016; Chalermchatvichien et al., 2014). Similarly, evidence on the cyclical behaviour of Basel III capital buffers remains mixed. While several studies find that capital buffers operate in a countercyclical manner, others document procyclical adjustment patterns, suggesting that institutional quality, supervisory practices, regulatory design, and banks' internal capital management strategies significantly influence their effectiveness (Guidara et al., 2013; Hessou, 2017; Kanga et al., 2020). Evidence on the efficiency effects of Basel III capital measures is likewise inconclusive. For example, Korein et al. (2021) report that the Capital Conservation Buffer (CCB) and leverage ratio reduced bank efficiency in Middle East and North African (MENA) countries, whereas Obadire et al. (2022) find that stronger capital buffers improved operating and investment efficiency among selected African banks.

By comparison, the empirical literature on the Basel III leverage ratio presents a more consistent picture. Most studies identify the leverage ratio as an effective complement to the risk-weighted capital framework, particularly in constraining excessive leverage and strengthening banking sector resilience (Acosta-Smith et al., 2024; Choi et al., 2020; Barth and Miller, 2018). Nevertheless, concerns remain that a binding leverage ratio may encourage banks to substitute towards higher-risk assets. Kiema and Jokivuolle (2014) and Choi et al. (2020) document evidence of portfolio reallocation towards riskier assets following the introduction of binding leverage constraints, although without materially increasing overall bank risk. Similarly, Acosta-Smith et al. (2024), using a panel of 655 European Union banks over the period 2005–2014, identify a trade-off between stronger capitalisation and modest increases in portfolio risk. Despite this, they conclude that the leverage ratio improves overall financial stability by strengthening banks' loss-absorbing capacity and reducing the likelihood of distress. Likewise, Fatouh et al. (2024) find no evidence of significant risk shifting among United Kingdom banks subject to a binding leverage ratio between 2016 and 2020. Instead, affected banks modestly reduced regulatory risk weights and experienced narrower credit default swap (CDS) spreads, indicating enhanced resilience and stronger market confidence in their solvency.

Despite the extensive international evidence, empirical research on Basel III within Sub-Saharan Africa remains limited. The uneven implementation of Basel II/III across the region (World Bank, 2020), together with limited availability of granular supervisory data and detailed risk information, has constrained rigorous empirical evaluation of the framework's effectiveness. Caggiano and Calice (2011) emphasise the need for substantially more research on the design, calibration, and behavioural effects of capital regulation within African banking systems. This gap is particularly important because many SSA financial systems differ fundamentally from those in advanced economies, exhibiting high levels of financial dollarisation, concentrated banking sectors, shallow financial markets, and relatively limited supervisory capacity. These structural characteristics suggest that the effectiveness of Basel III capital standards – and especially the interaction between risk-weighted capital requirements and the leverage ratio – may differ materially from that observed in advanced jurisdictions. Consequently, further empirical research is needed to develop context-specific evidence capable of informing the design and calibration of macroprudential capital regulation in SSA low- and lower-middle-income economies.

### 2.3.7 A Conceptual framework for analysing leverage procyclicality and the role of the Basel III-style leverage ratio in highly dollarised SSA LMICs

The preceding review highlights an important limitation of the existing Basel III literature. Most theoretical and empirical analyses of leverage, procyclicality, and macroprudential regulation are developed within the context of advanced economies, where financial cycles are largely driven by domestic credit expansion and asset price movements. In contrast, banking systems in many Sub-Saharan African low- and lower-middle-income countries (SSA LMICs) operate within a markedly different macro-financial environment characterised by commodity dependence, persistent financial dollarisation, exchange rate volatility, and relatively shallow financial markets. These structural features suggest that the transmission mechanisms underlying leverage dynamics may differ fundamentally from those assumed in the conventional Basel III framework.

This section develops a conceptual framework that incorporates the distinctive structural characteristics of highly dollarised SSA LMIC banking systems into the analysis of leverage procyclicality. Building on Minsky's Financial Instability Hypothesis and the Basel III macroprudential framework, it explains how commodity price cycles, exchange rate fluctuations, financial dollarisation, IAS 21 accounting valuation effects,[23] and Basel's risk-weighted capital framework interact to shape leverage dynamics over the financial cycle. In particular, the interaction between exchange rate volatility and accounting valuation effects highlights an important macroprudential concern: the combined influence of exchange-rate revaluations, pervasive financial dollarisation, and commodity dependence can generate structural financial imbalances that are not fully captured by conventional risk-weighted capital measures (e.g., FSB, 2009, p. 5). Against this background, the framework provides the

[23] **IAS 21** (**The Effects of Changes in Foreign Exchange Rates**) prescribes how to account for foreign currency transactions and operations in financial statements. It dictates that entities measure their transactions in their primary economic environment (functional currency) and translate the results into their chosen reporting currency (presentation currency).

conceptual foundation for assessing whether the Basel III-style leverage ratio should evolve beyond its traditional role as a regulatory backstop to become a binding macroprudential instrument capable of strengthening financial resilience in highly dollarised banking systems across SSA LMICs.

#### 2.3.7.1 Conceptual framework for leverage procyclicality in SSA LMICs: Stylised facts

The conceptual framework begins with the observation that macro-financial conditions in many SSA LMICs are heavily influenced by commodity price cycles (Masson, 2014, pp. 60-62). Because these economies depend on a narrow range of primary commodity exports (IMF, 2024, p. vi),[24] fluctuations in global commodity prices generate substantial movements in export earnings, exchange rates, capital flows, fiscal conditions, and domestic liquidity. Calderón et al. (2022, p. 44) estimate that commodity price shocks account for almost one-half of business cycle fluctuations across African economies. Consequently, financial cycles in these economies are shaped less by domestic credit conditions than by external commodity and exchange rate shocks. These macroeconomic shocks have important implications for banking sector behaviour.

Commodity price booms generally stimulate economic activity, improve liquidity conditions, and attract foreign capital inflows, thereby encouraging banks to expand credit and deepen financial intermediation (e.g., Ftiti et al., 2016; Kablan et al., 2017). They also tend to strengthen macroeconomic fundamentals and increase foreign investor participation in domestic sovereign bond markets (Makoni, 2020). The associated capital inflows often increase banks' foreign currency liabilities, which are commonly matched by higher holdings

[24] According to the International Monetary Fund's Regional Economic Outlook for Sub-Saharan Africa (IMF, 2024, p. vi), numerous countries in the region are heavily reliant on commodity exports. Oil-exporting nations include Angola, Cameroon, Chad, Republic of Congo, Equatorial Guinea, Gabon, Nigeria, and South Sudan. Other resource-intensive countries encompass Botswana, Burkina Faso, Central African Republic, Democratic Republic of Congo, Eritrea, Ghana, Guinea, Liberia, Mali, Namibia, Niger, Sierra Leone, South Africa, Tanzania, Zambia, and Zimbabwe.

of foreign exchange reserves as a natural hedge against currency risk. Conversely, declines in commodity prices weaken economic activity, reduce foreign exchange inflows, and heighten macro-financial uncertainty.

Commodity-driven downturns are typically accompanied by deteriorating asset quality, declining profitability, weaker capital positions, and tighter lending conditions as banks become more risk averse (Ftiti et al., 2016, p. 313). Rising non-performing loans and credit losses erode equity capital, prompting banks to rebalance their portfolios away from private-sector lending towards domestic government securities and foreign currency assets. While these defensive portfolio adjustments may improve short-term liquidity and support regulatory capital positions, they often constrain credit to the private sector and reinforce the sovereign-bank nexus. Moreover, because government securities and foreign currency reserve assets generally attract low or zero regulatory risk weights, banks may continue to report strong risk-weighted capital ratios despite rising leverage and increasing underlying systemic vulnerabilities.

These dynamics closely align with Minsky's Financial Instability Hypothesis, which posits that prolonged periods of favourable economic and financial conditions encourage the accumulation of leverage and the gradual evolution of increasingly fragile financing structures (Minsky, 1977, p. 25; Minsky, 1982b, p. 6). During commodity booms, stronger macroeconomic fundamentals, rising asset prices, and sustained foreign capital inflows stimulate credit expansion and greater leverage by both banks and borrowers. Consequently, the normal functioning of financial markets during prolonged expansionary periods can itself generate the financial imbalances that ultimately give rise to systemic instability (e.g., Afanasyeva et al., 2024). When commodity prices subsequently decline, exchange rates depreciate, and foreign capital inflows reverse, these accumulated vulnerabilities are exposed, triggering rapid balance-sheet deterioration, tighter financial conditions, and heightened systemic risk (Kasekende et al., 2012, pp. 17–21).

Financial dollarisation further amplifies these macro-financial dynamics. Many SSA LMICs maintain substantial foreign-currency-denominated assets and liabilities, making their banking systems particularly sensitive to exchange rate fluctuations. Consequently, financial dollarisation heightens systemic vulnerability, especially in the presence of the pronounced exchange rate volatility that characterises many emerging and developing economies (e.g., Fofanah, 2022; Barguellil et al., 2018; Senadza and Diaba, 2017). Exchange rate volatility reinforces self-amplifying feedback loops both within the banking sector and between the financial system and the real economy. These transmission mechanisms operate through several channels, including tighter monetary policy in response to inflationary pressures, deteriorating financial conditions, and balance-sheet valuation effects. Currency depreciation increases the debt-servicing burden of borrowers whose incomes are denominated in domestic currency but whose liabilities are denominated in foreign currency (Bitar, 2021, pp. 4–5).

An additional transmission channel operates through IAS 21, which requires foreign-currency-denominated assets and liabilities to be translated into the domestic reporting currency using prevailing exchange rates. Consequently, exchange rate movements are transmitted directly into banks' financial statements, influencing reported balance-sheet values, regulatory capital measures, and leverage metrics independently of changes in underlying lending activity. In this way, IAS 21 can contribute to leverage procyclicality by amplifying the effects of exchange rate volatility on reported financial positions (Athanasoglou et al., 2014, p. 71). During commodity-driven expansions, currency appreciation reduces the domestic-currency value of foreign-currency-denominated assets and liabilities, mechanically compressing reported balance-sheet size and book leverage. Conversely, currency depreciation during downturns increases the domestic-currency value of these exposures, mechanically expanding reported balance sheets and raising measured leverage even when credit growth is weak or contracting. As a result, reported leverage may become partially disconnected from underlying credit creation and the economic risk profile of banks, reflecting accounting valuation effects rather than fundamental changes in financial intermediation.

Finally, exchange rate volatility and accounting valuation effects interact closely with Basel's risk-weighted capital framework, creating an additional source of leverage procyclicality. During periods of financial stress, banks typically rebalance their portfolios towards domestic government securities and foreign-currency reserve assets, both of which generally attract preferential regulatory treatment through low or zero risk weights. Consequently, risk-weighted assets (RWAs) increase more slowly than total balance-sheet exposures, allowing banks to continue reporting relatively strong risk-based capital ratios even as leverage rises and underlying balance-sheet vulnerabilities intensify. In highly dollarised banking systems, this divergence between risk-weighted capital measures and actual leverage can become particularly pronounced, weakening the ability of conventional risk-based metrics to accurately reflect banks' true loss-absorbing capacity and systemic risk.

Zambia provides an instructive case study of these macro-financial transmission mechanisms. The country's vulnerability to external shocks was vividly demonstrated when it became the first African sovereign to default on its Eurobond obligations during the COVID-19 pandemic in 2020 (Brautigam, 2022). As a highly dollarised (e.g., Ajide et al., 2019, p. 401; Asongu et al., 2018, p. 234; Raheem and Asongu, 2018, p. 108), commodity-dependent lower-middle-income economy (IMF, 2024), Zambia's macro-financial conditions are closely tied to developments in the global copper market, given that copper is both the country's principal export commodity and that Zambia is Africa's second-largest copper producer. [25,26] Commodity price cycles have historically exerted a strong influence on Zambia's financial system. Periods of rising copper prices are typically associated with exchange rate appreciation, stronger foreign capital inflows, expanding credit, higher equity market valuations, and adjustments in short-term interest rates. Conversely, declines in copper prices are generally accompanied by currency depreciation, tighter financial conditions, weaker economic activity, and heightened stress within the banking sector (e.g., Chipili, 2016, pp. 881–884; Kablan et al., 2017, pp. 221–228; Ndlovu and Schaling, 2017; Mudenda et al., 2020).

These dynamics are further amplified by the high degree of financial dollarisation within Zambia's banking system. In 2025, for example, foreign-currency-denominated loans accounted for approximately 41.8 percent of total loans and advances, while foreign-currency deposits represented about 52.0 percent of total deposits (BOZ, 2025b, pp. 18, 20). The banking sector's asset composition also exhibits a pronounced concentration in government securities and foreign-currency-related assets. At end-2024, net loans constituted only 28.7 percent of total assets (2023: 28.6 percent), compared with 22.3 percent invested in government securities (2023: 25.9 percent). In addition, balances with foreign financial institutions – largely reflecting foreign-currency reserve assets – accounted for 15.0 percent of total assets (2023: 13.4 percent) (BOZ, 2024, p. 48). This balance-sheet structure provides a clear illustration of the mechanisms discussed in this chapter. The combination of high financial dollarisation, substantial holdings of low- or zero-risk-weighted assets, and exposure to exchange-rate fluctuations creates conditions under which risk-weighted capital ratios may overstate banking

[25] For example, refer to: https://african-miningweek.com/news/record-copper-prices-fuel-accelerated-project-development-africa

[26] https://www.france24.com/en/live-news/20260215-world-copper-rush-promises-new-riches-for-zambia

sector resilience while leverage and underlying systemic vulnerabilities continue to accumulate.

Taken together, commodity dependence, financial dollarisation, exchange rate volatility, accounting valuation effects, and Basel's risk-weighted capital framework generate a distinctive form of leverage procyclicality. Unlike advanced economies, where leverage cycles are primarily driven by domestic credit conditions, leverage dynamics in SSA LMICs are strongly influenced by external shocks and accounting revaluations. These characteristics suggest that conventional macroprudential indicators based primarily on domestic credit growth may not adequately capture the build-up of systemic vulnerabilities. This conceptual framework therefore provides the theoretical foundation for the empirical analysis undertaken in this thesis. It argues that macroprudential regulation in highly dollarised SSA LMICs should explicitly account for embedded leverage arising from foreign-currency exposures and exchange-rate-induced valuation effects. In this setting, the Basel III leverage ratio assumes a more important role than originally envisaged within the Basel framework. Rather than functioning solely as a non-binding backstop to risk-weighted capital requirements, a sufficiently calibrated leverage ratio can serve as a binding macroprudential constraint that limits excessive balance-sheet expansion irrespective of regulatory risk weights. Moreover, complementing the leverage ratio with countercyclical calibration and releasable capital buffers could improve the resilience of banking systems exposed to recurrent external shocks, commodity price volatility, and persistent financial dollarisation.[27] Figure A1 in Appendix A2 summarises these transmission mechanisms and illustrates the conceptual framework underpinning the empirical analysis developed in this thesis.

[27] A detailed discussion of the conceptual framework underpinning the Basel III-style leverage ratio is presented in Section 2.3.7.2.

#### 2.3.7.1.1 Structural specification of the leverage procyclicality conceptual model

The conceptual framework developed above can be formalised as a structural representation of the mechanisms through which leverage procyclicality emerges in SSA LMICs' highly dollarised banking systems. Specifically, the model captures how financial dollarisation, exchange-rate volatility, accounting valuation effects under IAS 21, and regulatory capital incentives jointly influence banks' leverage dynamics. The framework proposes that exchange-rate shocks affect bank leverage through two complementary channels.

The first is an accounting valuation channel, whereby IAS 21 requires foreign-currency-denominated assets and liabilities to be translated into the domestic reporting currency, causing exchange-rate movements to mechanically alter reported balance-sheet values. Because bank equity is typically denominated in domestic currency and adjusts only gradually, exchange-rate movements create asymmetric balance-sheet effects (e.g., Adrian and Shin, 2011, pp. 297-298). During commodity-driven expansionary periods, exchange-rate appreciation reduces the domestic-currency value of foreign-currency-denominated assets and liabilities, compressing reported balance-sheet size and measured leverage. Conversely, exchange-rate depreciation during downturns inflates the domestic-currency value of these exposures, increasing reported leverage even where banks are reducing lending and contracting their balance sheets. The second is a regulatory channel, through which exchange rate volatility and changes in capital constraints induce banks to rebalance their portfolios towards assets carrying low or zero regulatory risk weights. Together, these interacting mechanisms create a volatility–leverage transmission channel, whereby exchange rate fluctuations can produce substantial movements in reported leverage without corresponding changes in underlying lending activity or the economic risk profile of banks (e.g., Nuno and Thomas, 2017, pp. 52–69).

Although accounting valuation effects may temporarily dampen measured leverage during expansionary periods, the overall leverage cycle remains procyclical. Commodity booms generally stimulate credit expansion, foreign-currency intermediation, and increased holdings of government securities and foreign exchange reserves, thereby expanding total exposures. During downturns, weaker lending and balance-sheet contraction are often offset by exchange-rate revaluation effects, causing reported leverage to remain elevated or increase further. Consequently, leverage dynamics in highly dollarised SSA LMICs differ fundamentally from those observed in conventional credit-cycle models and warrant empirical investigation. The proposed leverage process may be summarised as:

$$Y_t = k_\mathrm{t} f\,(\tau_t,\ \sigma_t,\ \phi_t,\ \omega_t)$$

where:

- $Y_t$ denotes bank book leverage, measured as total assets relative to equity.
- $\tau_t$ represents the degree of financial dollarisation, measured by the proportion of foreign-currency-denominated assets and liabilities.
- $\sigma_t$ captures exchange-rate volatility arising primarily from commodity-price and other external shocks.
- $\phi_t$ denotes accounting valuation effects resulting from IAS 21 translation of foreign-currency balance-sheet items.
- $\omega_t$ represents regulatory capital incentives, particularly portfolio adjustments under Basel's risk-weighted capital framework.
- $k_\mathrm{t}$ denotes bank equity capital, which is assumed to adjust gradually over the short run.

#### 2.3.7.1.2 Testable hypotheses

The conceptual framework gives rise to the following empirically testable hypotheses.

***Hypothesis 1 (Leverage procyclicality)***

In highly dollarised banking systems, bank leverage exhibits procyclical behaviour, with balance-sheet expansion associated with higher leverage primarily through banks' balance-sheet management decisions rather than changes in underlying real economic activity.

***Hypothesis 2 (Dollarisation-exchange rate channel)***

Financial dollarisation amplifies leverage procyclicality by increasing the sensitivity of bank balance sheets and reported leverage to exchange-rate fluctuations.

***Hypothesis 3 (IAS 21 accounting channel)***

Accounting valuation effects arising from IAS 21 systematically influence reported leverage through the translation of foreign-currency-denominated assets and liabilities, independently of changes in underlying lending activity.

***Hypothesis 4 (Risk-weighted capital channel)***

Risk-weighted capital regulation reinforces leverage procyclicality by encouraging portfolio reallocation towards low-risk-weight assets, thereby reducing risk-weighted assets relative to total exposures and masking the accumulation of embedded leverage.

#### 2.3.7.2 Basel III-style leverage ratio framework for highly dollarised SSA LMICs

Highly dollarised banking systems, characteristic of many SSA LMICs, present structural features that are not fully captured by the conventional Basel III capital framework. Commodity price cycles, exchange-rate volatility, and extensive foreign-currency intermediation generate balance-sheet dynamics that differ markedly from those observed in advanced economies, where the Basel framework was originally developed (e.g., Beck et al., 2019b, pp. 2–3; Jones et al., 2018, pp. 2–7). In these environments, exchange rate appreciation during commodity booms mechanically lowers the domestic-currency value of foreign-currency-denominated assets and liabilities through IAS 21 translation effects, whereas bank equity – largely denominated in domestic currency – remains relatively sticky and adjusts only gradually (e.g., Adrian and Shin, 2011, pp. 297–298).

Consequently, reported leverage may appear to improve even as banks expand balance sheets and accumulate leverage. When commodity prices subsequently decline and exchange rates depreciate, these valuation effects reverse abruptly. The domestic-currency value of foreign-currency exposures increases, causing reported leverage to rise even where underlying lending activity weakens. Therefore, measured capital adequacy becomes increasingly disconnected from underlying balance-sheet risk, reducing the effectiveness of regulatory measures that rely primarily on risk-weighted assets. This disconnect is further reinforced by banks' portfolio behaviour. During periods of macroeconomic uncertainty, banks frequently increase holdings of government securities and foreign-currency reserves, both of which generally attract low or zero regulatory risk weights. Although such portfolios strengthen reported risk-weighted capital ratios, they simultaneously reduce the ratio of risk-weighted assets to total exposures, allowing embedded leverage to accumulate without a corresponding increase in regulatory capital. In highly dollarised banking systems, exclusive reliance on risk-weighted capital requirements may therefore underestimate systemic vulnerability and weaken macroprudential effectiveness.

These limitations extend to the Basel III countercyclical capital buffer (CCyB). The CCyB is primarily designed to address cyclical systemic risk associated with excessive domestic credit growth through adjustments based on risk-weighted assets (Herrera et al., 2024). However, in many SSA LMICs, systemic risk arises not only from credit cycles but also from persistent structural vulnerabilities, including financial dollarisation, concentrated holdings of government securities, commodity dependence, and exchange rate volatility. Consequently, in such an environment, macroprudential frameworks must effectively address both the cyclical build-up of systemic risk and its structural distribution across the financial system (e.g., Carney, 2021, pp. 202-203; Baudino et al., 2024, p. 5). During commodity booms, the slower expansion of RWAs relative to total exposures diminishes the effectiveness of RWA-based capital requirements, causing the CCyB to operate largely as a capital conservation mechanism rather than as a binding macroprudential constraint on leverage accumulation (e.g., Pfeifer and Pikhart, 2019, p. 133).

Consequently, declining RWAs relative to total exposures can create the appearance of excess capital above regulatory buffer requirements, reducing banks' incentives to restrain balance-sheet growth or curb leverage during periods of financial expansion. Against this background, the Basel III leverage ratio assumes particular importance. Unlike risk-weighted capital requirements, the leverage ratio links capital directly to total on- and off-balance-sheet exposures irrespective of regulatory risk weights (Dermine, 2015, pp. 266-267; CRS, 2023, p. 3). Consequently, it provides a transparent capital floor that remains unaffected by model risk or preferential regulatory treatment of particular asset classes. At the microprudential level, the leverage ratio operates as a backstop to risk-weighted capital requirements, while at the macroprudential level it can constrain excessive balance-sheet expansion throughout the financial cycle (D'Hulster, 2009, p. 3; CGFS, 2010, p. 25; Pfeifer et al., 2016, p. 138).

For highly dollarised SSA LMICs, the leverage ratio also offers important structural advantages. Because it captures total exposures rather than risk-weighted assets, it automatically reflects exchange-rate-induced changes in foreign-currency exposures and constrains leverage accumulation irrespective of asset composition. During commodity-driven expansions, when total exposures typically increase faster than RWAs, the leverage ratio becomes a more binding cyclical capital constraint than the risk-weighted framework (Gambacorta and Karmakar, 2018, p. 162; Fender and Lewrick, 2015, p. 45). It therefore provides a more effective safeguard against embedded leverage arising from exchange-rate valuation effects and portfolio shifts towards low-risk-weight assets.

Although Basel III prescribes a minimum leverage ratio of 3 percent, this threshold may be inadequate for many SSA LMICs, where prudential capital requirements are typically more conservative than international minimum standards (Ferreira et al., 2019, p. 24). The calibration of the leverage ratio should therefore reflect domestic financial structures and systemic vulnerabilities, including financial dollarisation, exchange rate volatility, and concentrated sovereign exposures. By constraining excessive balance-sheet expansion irrespective of asset risk weights, the leverage ratio can also mitigate banks' incentives to substitute private-sector lending with preferentially treated government securities, thereby helping to contain the sovereign-bank nexus and preserve the financial system's core intermediation function. Accordingly, beyond serving as a simple capital backstop, the leverage ratio has the potential to operate as a binding macroprudential instrument that strengthens financial resilience and supports sustainable credit intermediation in SSA LMICs.

#### 2.3.7.2.1 A Macroprudential leverage ratio-based recapitalisation framework

The conceptual framework advocates replacing the predominantly discretionary recapitalisation approaches commonly adopted across SSA LMICs with a rule-based macroprudential framework anchored in a Basel III-style leverage ratio. Historically, countries such as Ghana, Kenya, Nigeria, Uganda, and Zambia have responded to exchange-rate-induced increases in bank leverage by implementing substantial increases in minimum paid-up capital requirements. While these interventions strengthen bank solvency, they are typically introduced only after systemic vulnerabilities have materialised and generally impose uniform capital charges irrespective of differences in banks' size, risk profile, or systemic importance. As a result, they may generate welfare-reducing outcomes by overcapitalising smaller institutions while leaving larger banks relatively undercapitalised (e.g., Badarau and Roussel, 2022, p. 456). More broadly, inadequate capital buffers encourage the accumulation of systemic risk and necessitate more forceful regulatory intervention, whereas excessively high capital requirements may unduly tighten financial conditions and constrain credit provision and economic activity.

A leverage ratio-based framework addresses these limitations by linking required equity capital directly to total balance-sheet exposure. Unlike fixed nominal capital requirements, the leverage ratio adjusts automatically as total exposures evolve, ensuring that capital requirements increase in line with balance-sheet expansion. In doing so, it serves both as an early-warning indicator of leverage build-up and as a binding macroprudential constraint that curbs excessive balance-sheet growth by aligning capital accumulation with the financial cycle (CGFS, 2009, p. 16). This framework could be further strengthened by complementing the minimum leverage ratio with a higher long-run target ratio (e.g., Badarau and Roussel, 2022), requiring banks to build capital buffers during expansionary periods and permitting their drawdown during periods of stress. The gap between the minimum requirement and the long-run target would therefore provide an explicit countercyclical capital margin, enhancing the leverage ratio's role in promoting financial resilience across the cycle.

Alternatively, the framework proposes complementing the minimum Pillar 1 leverage ratio with a countercyclical leverage ratio buffer (CCLB) calibrated to exchange rate volatility and the degree of financial dollarisation. Unlike the conventional countercyclical capital buffer (CCyB), which is designed to address cyclical systemic risk through external indicators such as the credit-to-GDP gap, the proposed CCLB provides an endogenous balance-sheet safeguard against structural systemic vulnerabilities. By automatically adjusting to changes in total exposures, it directly mitigates volatility-driven leverage procyclicality arising from exchange rate fluctuations, financial dollarisation, and related balance-sheet valuation effects (e.g., Badarau and Roussel, 2022, p. 452; Athanasoglou et al., 2014, p. 71). During commodity-driven expansions, when currency appreciation mechanically compresses the domestic-currency value of foreign-currency exposures, banks would be required to accumulate additional leverage buffers to offset the underlying build-up of leverage concealed by accounting valuation effects and the risk of subsequent valuation reversals.[28] These buffers could subsequently be released during periods of financial stress, when currency depreciation inflates reported foreign-currency exposures and erodes capital, thereby absorbing losses, supporting credit intermediation, and mitigating destabilising deleveraging.

---

[28] This is because accounting valuation-induced distortions in reported balance-sheet size can undermine the effectiveness of capital requirements – particularly risk-weighted capital ratios – by weakening the relationship between measured capital adequacy (i.e., required capital) and underlying risk exposures. Within this context, regulatory interventions such as mandatory increases in capital requirements can operate as de facto risk-based capital adjustments by reinforcing the positive relationship between capital buffers and asset risk during commodity-driven expansions. This is particularly relevant when exchange rate appreciation mechanically compresses the domestic-currency value of foreign-currency exposures, improving reported leverage without a corresponding reduction in underlying risk (e.g., Shrieves and Dahl, 1992, p. 443). Such interventions are consistent with the central objective of the Basel capital framework, which requires increases in asset risk – and the associated probability of default – to be matched by commensurate increases in capital buffers (e.g., Prescott, 2004, p. 47; Bhattacharya et al., 1998, p. 757).

This approach is conceptually aligned with the stress capital buffer framework proposed by Greenwood et al. (2017, pp. 522–527). Specifically, a time-varying capital buffer would be layered above the Basel III-style Pillar 1 leverage ratio requirement and calibrated to reflect exchange rate volatility and the extent of financial dollarisation (e.g., Christensen et al., 2011, pp. 9–10).[29] By linking capital buffer requirements to the domestic-currency valuation of foreign-currency exposures under stress scenarios, the framework requires banks to build additional capital during periods of exchange rate appreciation (i.e., when IAS 21 translation effects compress measured exposures and may mask leverage accumulation) and permits the release of these buffers following adverse exchange rate shocks to sustain lending and enhance financial system resilience (Coelho and Restoy, 2024, p. 2).

The framework further proposes integrating leverage ratio requirements with forward-looking recapitalisation mechanisms. Rather than allowing banks to restore compliance primarily through asset contraction, regulatory requirements should encourage genuine equity increases through retained earnings or new capital issuance. For instance, linking leverage requirements to the maximum of current and historical balance-sheet size prevents banks from meeting regulatory requirements simply by shrinking assets (e.g., Hanson et al., 2011, p. 10). This implementation framework thus encourages adjustment through equity issuance rather than asset contraction, thereby mitigating procyclical deleveraging (Galati and Moessner, 2013, p. 854). More broadly, the framework supports the emerging international shift towards positive neutral macroprudential capital buffers (Stojkov, 2020; Smaga, 2024; Herrera et al., 2024). Rather than relying on large discretionary recapitalisations introduced after

[29] Christensen et al. (2011) provide a theoretical framework that supports the implementation of such a stress-based capital buffer in highly dollarised financial systems. In their model, regulated leverage consists of a fixed steady-state component and a time-varying component linked to an economic variable (e.g., exchange-rate volatility and the degree of financial dollarisation). The latter operates countercyclically, requiring banks to reduce leverage during upswings and permitting higher leverage during downturns.

vulnerabilities have materialised, regulators would encourage gradual capital accumulation throughout the financial cycle, improving resilience against commodity-price shocks, exchange-rate volatility, pandemics, climate events, and geopolitical disruptions (Behn et al., 2023).

Importantly, the proposed framework does not advocate replacing minimum paid-up capital requirements. Rather, fixed capital thresholds remain an integral component of a Basel III-style capital framework. They provide a non-risk-sensitive absolute capital floor that complements ratio-based capital requirements by addressing their inherent limitations. In particular, they ensure that bank shareholders maintain sufficient "skin in the game", thereby discouraging excessive risk-taking by severely undercapitalised banks arising from limited liability and the convex payoff structure of equity (e.g., Rochet, 1992). Fixed capital requirements also help mitigate debt overhang and the "leverage ratchet" effect, both of which discourage voluntary recapitalisation (e.g., Admati et al., 2012; Admati et al., 2018). In addition, they support prudential licensing by reducing information asymmetries and deterring lower-quality entrants from entering the banking system (e.g., Thakor, 1996; Morrison and White, 2005). Under the proposed framework, minimum paid-up capital requirements operate as a non-risk-sensitive capital floor, while the leverage ratio and risk-weighted capital requirements jointly determine banks' ongoing regulatory capital requirements in accordance with their balance-sheet exposures and risk profiles (e.g., Acosta-Smith et al., 2024). Accordingly, the binding regulatory capital constraint for most banks within a jurisdiction is expected to be either the leverage ratio or the risk-weighted capital requirements, whereas minimum paid-up capital requirements are more likely to constrain smaller banks or those that are already severely undercapitalised.

The foregoing analysis further gives rise to the following conceptual proposition regarding the macroprudential role of the Basel III-style leverage ratio. Although this proposition is not tested directly in the empirical analysis, it follows from the conceptual framework developed in this chapter and is expected to receive indirect support from the empirical findings associated with Hypotheses 1– 4. Figure A2 in Appendix A3 illustrates the proposed conceptual framework linking leverage procyclicality to the Basel III leverage ratio in highly dollarised SSA LMICs. Formally,

***Conceptual proposition: Leverage ratio as a macroprudential frontstop***

A binding Basel III-style leverage ratio can reduce leverage procyclicality by constraining total exposures independently of regulatory risk weights, thereby mitigating accounting valuation effects, limiting incentives for regulatory risk-weight optimisation, and strengthening macroprudential resilience in highly dollarised banking systems.

### 2.3.7.2.2 Summary of the proposed regulatory capital framework

The proposed framework combines three complementary Pillar 1 capital regimes:

- Risk-weighted capital requirements (RWR);
- Leverage ratio capital requirements (LRC); and
- Fixed nominal paid-up capital requirements (FAC).

The risk-weighted and leverage ratio frameworks each comprise minimum capital requirements together with associated regulatory buffers (e.g., BCBS, 2017, pp. 140-142). Banks must therefore satisfy the binding requirement generated by either the risk-weighted or leverage framework while simultaneously maintaining the minimum fixed paid-up capital requirement. Formally,

$$K \geq \max\{K_{RWR}, K_{LRC}\}, \text{ subject to } K \geq K_{FAC}$$

where K denotes the regulatory capital requirement under each regime, expressed in monetary terms. This structure reflects the complementary relationship between the risk-weighted framework and the leverage ratio under Basel III (e.g., Acosta-Smith et al., 2024), while preserving an absolute capital floor through fixed nominal equity requirements (e.g., Admati et al., 2012; Admati et al., 2018; Rochet, 1992). The two ratio-based requirements are defined as:

$$K_{RWR} = 0.06 \sum_{i=1}^{k} (RW_i \times EA_i),$$

and

$$K_{LRC} = 0.03\sum_{i=1}^{k}(E\,A_i),$$

where $RW_i$ denotes the regulatory risk weight assigned to exposure $i$, $EA_i$ represents the corresponding exposure amount, and the leverage ratio assigns a unit weight to all exposures. The regulator's objective is to calibrate these complementary requirements so that banks maintain sufficient capital to support financial intermediation while limiting excessive leverage, reducing insolvency risk, and enhancing financial stability across the financial cycle (e.g., Diamond and Dybvig, 1986; Greenwood et al., 2017).

## 2.4 Data sample and methodology

### 2.4.1 Empirical strategy and hypotheses

Consistent with the core objective outlined in Section 2.1, and guided by the conceptual framework and hypotheses developed in Section 2.3.7, the empirical strategy is designed to identify the key drivers of leverage procyclicality in highly dollarised banking systems of SSA LMICs, while also assessing the effectiveness of alternative macroprudential capital instruments. Financial systems in these economies are characterised by recurrent macroeconomic and financial shocks, which give rise to persistent exchange-rate volatility. This volatility is transmitted directly to bank balance sheets and leverage dynamics, primarily through accounting revaluation effects. To operationalise the conceptual framework, each theoretical mechanism is mapped onto observable empirical proxies. This approach enables direct testing of the amplification channels implied by the framework and facilitates identification of the underlying mechanisms through which leverage procyclicality emerges in highly dollarised banking systems. The empirical analysis places emphasis on balance-sheet dynamics rather than credit aggregates, reflecting the structural characteristics of SSA LMICs, where leverage cycles are often weakly aligned with domestic credit growth.

#### 2.4.1.1 Procyclical leverage and balance-sheet dynamics

In highly dollarised banking systems, leverage exhibits procyclical behaviour, characterised by a positive relationship between balance-sheet expansion and changes in leverage. This relationship is driven primarily by banks' active balance-sheet management decisions rather than underlying real economic activity (**Hypothesis 1: Leverage procyclicality**). Empirical evidence from Adrian and Shin (2010), based on U.S. commercial bank data, documents a strong positive association between changes in balance-sheet size and book leverage. Their findings suggest that financial intermediaries actively adjust their balance sheets in response to fluctuations in asset prices and perceived risk, leading to procyclical leverage dynamics –

expanding during upswings and contracting in downturns. This pattern is consistent with broader empirical evidence indicating that bank balance sheets tend to grow during expansions and contract during recessions, with asset growth largely financed through increased debt (Acharya and Ryan, 2016, p. 316).

However, in highly dollarised Sub-Saharan African economies, leverage dynamics are further complicated by the interaction between exchange rate movements, foreign-currency-denominated balance-sheet exposures and the accounting (IAS 21) valuation effects. Economic upswings are typically accompanied by currency appreciation, whereas downturns are often associated with sharp depreciations. Ceteris paribus, an appreciation reduces the domestic-currency value of foreign-currency-denominated assets and liabilities, mechanically lowering reported leverage. This, in turn, creates balance-sheet capacity, enabling banks to expand assets–such as lending–without a commensurate increase in actual equity. By contrast, currency depreciation increases the domestic-currency value of these exposures, even in periods of credit contraction, thereby raising measured leverage. This dynamic reflects the fact that bank equity is largely denominated in local currency and adjusts only gradually, rendering it relatively sticky in the short run. As a result, leverage fluctuations observed in highly dollarised banking systems under conditions of persistent foreign exchange volatility reflect not only underlying changes in financial activity–such as credit expansion or deposit growth–but also exchange rate-driven valuation effects.

In such contexts, the dominant transmission mechanism is more accurately characterised as a volatility-leverage channel (e.g., Nuno and Thomas, 2017, pp. 52-54), rather than the GDP–credit–leverage channel underlying the Basel III countercyclical capital buffer (BCBS, 2011, pp. 57-60). These mechanical currency revaluation effects can introduce significant volatility into both total assets and reported leverage, potentially distorting assessments of underlying financial conditions. To address this, the empirical strategy complements the leverage analysis with regressions of changes in total assets on real GDP growth, following Laux and Rauter (2017, p. 245). This approach enables a clearer distinction between genuine macro-financial linkages and valuation-driven fluctuations in balance-sheet size. Moreover, Acharya and Ryan (2016, p. 316) caution that measuring leverage procyclicality using changes in book asset size–as in Adrian and Shin (2010)–provides only an indirect proxy relative to broader macroeconomic indicators such as GDP growth. Banks may expand their balance sheets during downturns or contract them during upswings, thereby obscuring the true relationship between leverage dynamics and the business cycle. Macroeconomic conditions influence bank asset values through multiple channels, including changes in borrower creditworthiness, asset prices, and collateral valuations. These effects are particularly pronounced during prolonged expansions, which tend to foster excessive optimism and underpricing of risk, thereby increasing vulnerability to subsequent reversals (Miles et al., 2013, p. 32). Accordingly, building on the approach of Laux and Rauter (2017), we augment the baseline model to examine the interaction between leverage dynamics and macroeconomic conditions. In particular, real GDP growth is included as an explanatory variable to assess the extent to which leverage is tied to the broader economic cycle.

#### 2.4.1.2 Procyclical leverage and risk-based capital regulation

Under risk-weighted capital regulation, banks may respond to binding capital constraints by reallocating their portfolios toward low-risk-weight assets, thereby reinforcing leverage procyclicality and obscuring the accumulation of embedded leverage (**Hypothesis 4: Risk-weighted capital channel**). Amel-Zadeh et al. (2017, pp. 1428-1434) develop a theoretical framework in which leverage procyclicality emerges primarily when regulatory leverage constraints become binding. In their model, banks seeking to maximise return on equity adjust portfolio composition subject to a regulatory leverage constraint defined by the inverse of the regulatory capital ratio.

Within risk-based regulatory regimes such as Basel I and the standardised Basel II/III approaches, assets are assigned to fixed risk-weight categories (e.g., 0%, 20%, 50%, and 100%). When operating close to regulatory limits, banks have incentives to accumulate assets carrying low risk weights – particularly government securities and foreign-currency reserves – during expansionary periods, thereby increasing leverage without breaching capital requirements. This behaviour intensifies leverage procyclicality, especially where newly acquired assets carry lower average risk weights than the existing portfolio. Importantly, these dynamics arise primarily from regulatory incentives associated with portfolio optimisation rather than from fair-value accounting itself. Although fair-value adjustments may influence measured asset values, leverage procyclicality is driven mainly by banks' active debt-financed portfolio reallocations in response to changing regulatory conditions, particularly when capital constraints are binding. These insights underscore the central role played by the interaction between regulatory capital rules and portfolio risk-weighting in shaping leverage dynamics. This has important implications for SSA LMICs, where both the structure of bank balance sheets and the design of prudential regulation influence the extent to which leverage amplifies macro-financial shocks.

Unlike advanced economies, where leverage typically rises during periods of economic expansion, highly dollarised SSA banking systems exhibit more complex dynamics. In these environments, leverage fluctuations are also shaped by exchange-rate volatility, as banks actively adjust their foreign-currency positions, particularly during episodes of sharp currency depreciation, usually associated with economic downturns. During downturns, rising non-performing loans and provisioning-related capital erosion weaken credit growth, while the domestic-currency value of foreign-currency exposures expands. Faced with limited access to fresh equity capital, banks often rebalance their portfolios toward low-risk-weight assets – such as foreign-currency reserves and government securities – in order to preserve regulatory capital ratios as equity buffers deteriorate. This defensive portfolio reallocation reinforces leverage procyclicality by further increasing the degree of financial dollarisation within the banking system. Accordingly, higher levels of financial dollarisation amplify leverage procyclicality by increasing the sensitivity of reported balance-sheet size and leverage to exchange-rate movements (**Hypothesis 2: Dollarisation–exchange rate channel**).

#### 2.4.1.3 Leverage procyclicality and accounting valuation dynamics

Accounting valuation effects arising under IAS 21 mechanically influence reported leverage through exchange-rate-induced revaluations of foreign-currency-denominated assets and liabilities, often independently of underlying lending activity (**Hypothesis 3: IAS 21 accounting channel**). A substantial strand of the literature has examined how accounting valuation practices – particularly fair value accounting[30] – affect the procyclicality of bank leverage, building on the balance-sheet framework developed by Adrian and Shin (2010, 2011) (see, for example, Acharya and Ryan, 2016, pp. 315-318). Empirical studies such as Amel-Zadeh et al. (2017) and Laux and Rauter (2017), focusing primarily on the U.S. banking

[30] Guided globally by standards like IFRS 13 (Fair Value Measurement) and U.S. GAAP's ASC 820 (Fair Value Measurement).

system, demonstrate how fair value accounting interacts with leverage dynamics and balance-sheet adjustments.

By contrast, in highly dollarised and relatively underdeveloped financial systems – such as those of SSA LMICs, where persistent exchange-rate volatility is a defining structural characteristic – the more relevant accounting valuation transmission mechanism operates through IAS 21.[31] Under this accounting standard, foreign-currency-denominated assets and liabilities are retranslated into domestic currency at each reporting date, thereby transmitting exchange-rate shocks directly onto bank balance sheets. From the perspective of book (accounting) leverage – defined as total assets relative to equity – these translation adjustments introduce important asymmetries. For instance, a currency depreciation raises the domestic-currency value of foreign-currency assets, while appreciation has the opposite effect. The net impact on leverage, however, depends critically on the structure and composition of foreign-currency exposures. In the special case where foreign-currency assets and liabilities are perfectly matched, translation gains on assets are exactly offset by corresponding losses on liabilities, leaving equity broadly unchanged. However, because both sides of the balance sheet expand in domestic-currency terms during a depreciation, total assets and liabilities increase while equity remains relatively stable. As a result, book leverage increases mechanically, even in the absence of any genuine expansion in debt financing.

In practice, banks seldom achieve perfect matching of their foreign-currency positions and therefore typically maintain a net open foreign-currency exposure. Differences in maturity

[31] International Financial Reporting Standards: IAS 21 - The Effects of Changes in Foreign Exchange Rates.
IAS 21 sets out how entities should: (1) record transactions denominated in foreign currencies; (2) translate the financial statements of foreign operations into the entity's functional currency; and (3)convert financial statements into a presentation currency when it differs from the functional currency. Under IAS 21, an entity may present its financial statements in any currency of its choosing (However, this choice is overridden by relevant national regulations). The functional currency is defined as the currency of the primary economic environment in which the entity operates, namely, where it principally earns and spends cash. All other currencies are classified as foreign currencies.

structure, currency composition, or balance-sheet scale imply that translation gains and losses do not fully offset. Consequently, valuation effects on equity – and hence leverage – become ambiguous, depending on the relative size and composition of foreign-currency assets and liabilities. These dynamics become particularly pronounced during periods of economic distress – such as adverse commodity price shocks – when currencies experience sharp depreciations. In such episodes, leverage may increase mechanically as the domestic-currency value of foreign-currency assets rises, even if underlying lending activity contracts. Although asset-side translation gains may, in principle, support capital and mitigate leverage increases, their overall effect depends on the extent to which they are offset by liability-side revaluations. Accordingly, in highly dollarised SSA banking systems, leverage procyclicality is driven not only by actual balance-sheet expansion and regulatory risk-weight optimisation, but also by accounting translation effects mandated under IAS 21. This introduces an additional amplification channel through which exchange-rate shocks influence balance-sheet size, capital adequacy, leverage dynamics, and overall financial stability.

To empirically assess the contribution of IAS 21 valuation effects to leverage procyclicality, we include a measure of positive translation gains on foreign-currency-denominated assets, scaled alternatively by total assets and equity. While comprehensive data on total foreign-currency assets are not available in the SSA dataset, information on foreign-currency loans and liabilities is reported. Given that loans constitute the largest component of bank balance sheets, foreign-currency loans provide a suitable proxy for capturing asset-side IAS 21 valuation effects. In Appendix A4, we construct a variable that isolates changes in outstanding foreign-currency-denominated loans attributable specifically to exchange-rate movements and accounting translation effects (e.g., Quirk, 2022), thereby disentangling valuation effects from genuine changes in underlying exposures. This measure, denoted IAS21Effect, retains only positive values for use in the empirical analysis.

### 2.4.2 Data sample and variable measurements

#### 2.4.2.1 Data sources and sample selection

This study utilises secondary data obtained from the International Monetary Fund's (IMF) Financial Soundness Indicators (FSI) database and the World Bank's World Development Indicators (WDI), covering the period 2005 to 2024. The dataset comprises unbalanced panel of 30 Sub-Saharan African countries (see Appendix A5), predominantly classified as low- and lower-middle-income economies (LMICs).

The empirical analysis draws on annual panel data, with key banking sector balance sheet variables sourced from the IMF's FSI database, and macroeconomic controls, such as real GDP growth and exchange rate series, extracted from the WDI. Country selection was guided by three main criteria: (i) the availability of FSI-based aggregate banking sector data, (ii) consistent annual reporting across the sample period, and (iii) the presence of foreign-currency-denominated assets and liabilities (dollarisation), alongside (iv) sufficient data on regulatory capital and risk-weighted assets. The analysis is conducted at the level of national banking systems, using country-level aggregate data rather than individual bank observations, reflecting the structure of FSI reporting.

#### 2.4.2.2 Variable definitions

Table 1 summarises the key variables employed in the empirical analysis. **Panel A** reports the dependent variable, **Panel B** lists the main explanatory variables, and **Panel C** includes the control variables. **Panel D** presents the dummy variables capturing the regulatory-driven recapitalisation episodes.

##### 2.4.2.2.1 Dependent variables

The primary dependent variable employed in this study is the annual change in banking sector book leverage, measured using accounting-based balance-sheet data. Consistent with Adrian and Shin (2010, p. 427; 2011, p. 294) and Laux and Rauter (2017, p. 244), the change in book leverage (ΔLeverage) is defined as the change in log total assets minus the change in log equity.[32] Accordingly, the measure captures changes in the overall balance-sheet structure independently of risk-weight adjustments. Book leverage itself is defined as the ratio of total assets to equity (Adrian and Shin, 2010, p. 420).[33] The analysis relies on book equity – defined as the difference between total assets and total liabilities – rather than market capitalisation, which reflects the market value of banks' traded shares (Nuno and Thomas, 2017, p. 40). The relevance of each equity concept depends on the analytical context and the research question under consideration. Although Adrian and Shin (2014, p. 378) argue that the ideal measure of equity should be fully marked-to-market, this is less practical in the context of SSA LMICs, where financial systems remain relatively underdeveloped, capital markets are shallow, and many financial assets are illiquid (e.g., Tyson, 2021; Allen and Giovannetti, 2011).

In highly dollarised banking systems, part of the foreign-currency-denominated balance sheet may reflect market-based valuations. However, where a large proportion of bank assets consists of relatively illiquid instruments – particularly loans – accounting values may diverge materially from underlying market valuations. For the purposes of this study, book equity provides a more appropriate measure for analysing bank balance-sheet management decisions (e.g., Damar et al., 2013, pp. 643-644; Adrian and Shin, 2014, p. 380; Nuno and Thomas, 2017, p. 40). First, book equity constitutes the primary buffer against losses in asset values and therefore directly influences banks' portfolio allocation and risk-management decisions.

[32] Logarithmic transformations are used because they approximate percentage changes, reduce skewness in financial variables, and allow leverage dynamics to be interpreted in proportional rather than absolute terms. This is particularly useful in cross-country banking datasets characterised by substantial differences in banking system size and balance-sheet scale.

[33] Although total assets form part of the definition of book leverage, the relationship between changes in book leverage and changes in total assets is not purely mechanical. For example, if total assets increase by 1% and both equity and debt also rise proportionally by 1%, the leverage ratio (total assets divided by equity) remains unchanged. In this case, asset growth does not generate a change in leverage. By contrast, leverage increases when asset growth is financed disproportionately through debt relative to equity – for instance, when debt rises by more than 1% while equity grows by less than 1% (Laux and Rauter, 2017, p. 244-245)

Second, prudential regulations – including minimum capital and leverage requirements – are generally calibrated with reference to book equity, albeit with limited market-value adjustments to assets. Consequently, book equity is more relevant for analysing leverage dynamics and regulatory behaviour within banking systems.

#### 2.4.2.2.2 Covariates

The principal explanatory variables include the log change in total assets (ΔTotal Assets), real GDP growth (ΔGDP), and the ratio of risk-weighted assets to total assets (ΔRWATA). The ΔRWATA variable serves as a proxy for changes in the average regulatory risk composition of banks' balance sheets (Amel-Zadeh et al., 2017). Total assets capture the aggregate on-balance-sheet exposures of each national banking system, while real GDP growth is included to control for prevailing domestic macroeconomic conditions (e.g., Acharya and Ryan, 2016; Laux and Rauter, 2017).

#### 2.4.2.2.3 Controls

To investigate the influence of financial dollarisation and exchange rate movements, the interaction models incorporate additional control variables. These include "Dollar_liab" and "Dollar_loan", which represent the proportion of banking sector liabilities and loans denominated in foreign currency, respectively. Exchange rate dynamics are captured using two indicators: "FXAppreciation", defined as the negative first difference of the natural logarithm of the average annual exchange rate (indicating local currency strengthening), and "FXDepreciation", the positive first difference of the log exchange rate (where higher values signal currency weakening). To account for regulatory-driven recapitalisation episodes, the models also include binary policy indicators ($CAP_{k,c}$) identifying years when our case study countries enforced mandatory equity recapitalisation (see, Appendix A3). These variables enable the analysis to capture how recapitalisation interacts with leverage trends under dollarisation and exchange rate volatility.

**Table 1. Description of the variables.**

This table summarises the dependent variable, key explanatory variables, and control variables employed in the empirical analysis, including their mnemonics, variable names, definitions, and corresponding references.

| **Panel A: Dependent Variable** | | | |
|---|---|---|---|
| **Mnemonic** | **Variable name** | **Definition** | **References** |
| ΔLeverage | Change in book leverage | Book leverage is calculated as the ratio of total assets to equity capital | Adrian and Shin (2010); Amel-Zadeh et al. (2017); Laux and Rauter (2017) |
| **Panel B: Explanatory Variables** | | | |
| ΔTotal Assets | Change in total assets | Total assets represent the aggregate on-balance-sheet holdings reported by each national banking sector | Adrian and Shin (2010); Amel-Zadeh et al. (2017); Laux and Rauter (2017) |
| ΔTotal Liabilities | Change in total liabilities | Total liabilities represent the aggregate on-balance-sheet holdings reported by each national banking sector | Adrian and Shin (2010); Amel-Zadeh et al. (2017); Laux and Rauter (2017) |
| ΔGDP | Annual real GDP growth | Real GDP growth serves as a macroeconomic control for domestic economic activity | Acharya and Ryan (2016); Laux and Rauter (2017) |
| ΔRWATA | Change in RWA to total assets | Changes in the average regulatory risk profile of banks' balance sheets | Amel-Zadeh et al. (2017) |
| IAS21Effect - loans | IAS 21 valuation effects on FX loans | The positive translation gains associated with foreign-currency-denominated loans, scaled alternatively by total assets and by total equity | Quirk, 2022 |
| IAS21Effect - liabs | IAS 21 valuation effects on FX liabilities | The positive translation gains associated with foreign-currency-denominated liabilities, scaled alternatively by total assets and by total equity | Quirk, 2022 |
| **Panel C: Controls** | | | |
| Dollar_liab | Dollarisation - liabilities | The share of foreign-currency denominated liabilities in the banking sector | Sosa and Garcia-Escribano (2011); Corrales et al. (2016) |
| Dollar_loan | Dollarisation - loans | The share of foreign-currency denominated loans in the banking sector | Sosa and Garcia-Escribano (2011); Corrales et al. (2016) |
| FXAppreciation | Appreciation | Measures the year-on-year appreciation of the domestic currency against the U.S. dollar | |
| FXDepreciation | Depreciation | Measures the year-on-year depreciation of the domestic currency against the U.S. dollar | |
| **Panel D: Regulatory dummies** | | | |
| CAP_Ghana | A binary variable equal to one for years associated with regulatory-driven recapitalisation episodes (2009-2012, 2014-2015, and 2018-2019), and zero for all other years. | | |
| CAP_Kenya | A binary variable equal to one for years associated with regulatory-driven recapitalisation episodes (2009-2012), and zero for all other years. | | |
| CAP_Nigeria | A binary variable equal to one for years associated with regulatory-driven recapitalisation episodes (2011-2012), and zero for all other years. | | |
| CAP_Uganda | A binary variable equal to one for years associated with regulatory-driven recapitalisation episodes (2011-2013, 2022-2023), and zero for all other years. | | |
| CAP_Zambia | A binary variable equal to one for years associated with regulatory-driven recapitalisation episodes (2007-2008, 2012-2013), and zero for all other years. | | |

### 2.4.3 Summary statistics, correlation analysis and collinearity diagnostics

#### 2.4.3.1 Summary statistics

Table 2 summarizes the descriptive statistics of the main variables. The dependent variable, ΔLeverage, is tightly centered around zero (mean = 0.001) with moderate dispersion (SD = 0.119), indicating limited average changes but meaningful cross-banking sector variation. Both ΔTotal Assets and ΔTotal Liabilities have positive means (0.123 and 0.122) with SDs of 0.098 and 0.104, respectively, consistent with broad balance-sheet expansion. The change in the average risk-weighted-assets ratio (ΔRWATA) is near zero on average (mean = -0.003), suggesting little systematic reweighting.

Financial dollarisation is material on both sides of the balance sheet: the loan dollarisation ratio (asset side) averages 0.186 (SD = 0.193) and the liability side dollarisation ratio 0.235 (SD = 0.197). The IAS 21 valuation-effect series are sparse and strongly right-skewed, reflecting infrequent but occasionally large adjustments. Log of real GDP growth (ΔGDP) averages 0.039 with a comparable SD (0.039). The exchange-rate indicators exhibit substantial zero inflation: episodes of currency appreciation are relatively infrequent (mean = 0.018; SD = 0.044), while the non-zero observations are predominantly concentrated in depreciation episodes (mean = 0.071; SD = 0.096).

**Table 2. Summary statistics.**
Table 2 reports descriptive statistics for the main variables used in the empirical models (dependent and covariates). Variable definitions and references are provided in Table 1. To attenuate the influence of extreme observations, all series were Winsorized at the 1st and 99th percentiles prior to analysis.

| Variable | Mean | SD | Min | p25 | p50 | p75 | Max | N |
|---|---|---|---|---|---|---|---|---|
| ***Panel A. Balance sheet*** | | | | | | | | |
| ΔLeverage (accounting) | 0.001 | 0.119 | -0.287 | -0.063 | -0.009 | 0.051 | 0.436 | 400 |
| ΔLeverage (regulatory) | -0.003 | 0.206 | -0.943 | -0.079 | -0.008 | 0.059 | 1.007 | 393 |
| ΔTotal assets | 0.123 | 0.098 | -0.130 | 0.064 | 0.117 | 0.177 | 0.397 | 400 |
| ΔTotal liabilities | 0.122 | 0.104 | -0.149 | 0.062 | 0.117 | 0.176 | 0.446 | 400 |
| ΔAverage risk-weight | -0.003 | 0.116 | -0.462 | -0.054 | -0.001 | 0.057 | 0.341 | 399 |
| Dollarisation - loans | 0.186 | 0.193 | 0.000 | 0.010 | 0.145 | 0.280 | 0.902 | 389 |
| Dollarisation - liabilities | 0.235 | 0.197 | 0.002 | 0.055 | 0.227 | 0.329 | 0.894 | 401 |
| IAS21Effect - liabilities | 0.015 | 0.038 | -0.067 | 0.000 | 0.004 | 0.018 | 0.249 | 367 |
| IAS21Effect - loans | 0.006 | 0.015 | -0.019 | 0.000 | 0.001 | 0.007 | 0.088 | 358 |
| ***Panel B. Macro indicators*** | | | | | | | | |
| ΔGDP | 0.039 | 0.039 | -0.093 | 0.022 | 0.041 | 0.061 | 0.140 | 584 |
| FX appreciation | 0.018 | 0.044 | 0.000 | 0.000 | 0.000 | 0.001 | 0.232 | 554 |
| FX depreciation | 0.071 | 0.096 | 0.000 | 0.000 | 0.039 | 0.099 | 0.514 | 554 |

### 2.4.3.2 Correlation analysis and collinearity diagnostics

Table 3 reports the Pearson correlation coefficients among the main variables. Changes in book leverage are positively and significantly correlated with changes in total assets (r = 0.28) and total liabilities (r = 0.41), consistent with the hypothesis of leverage procyclicality (Adrian and Shin, 2010). In contrast, ΔLeverage is negatively associated with changes in average risk weights (r = −0.26), suggesting that higher leverage tends to coincide with portfolio shifts toward lower-risk-weight assets (Amel-Zadeh et al., 2017). Exchange-rate movements exhibit differentiated patterns. Currency appreciation is significantly negatively correlated with both book leverage (r = −0.14) and asset growth (r = −0.21). By comparison, currency depreciation is not significantly associated with book leverage (r = −0.02), but is positively related to asset growth (r = 0.30) and shows modest positive correlations with loan and liability dollarisation (r = 0.13 and r = 0.11, respectively).

Both IAS 21 valuation-effect measures are strongly associated with balance-sheet expansion and financial dollarisation. The liabilities-based and loans-based series display positive correlations with asset growth (r = 0.31 and r = 0.40), loan dollarisation (r = 0.29 and r = 0.41), and liability dollarisation (r = 0.36 and r = 0.35), respectively. Finally, GDP growth is positively correlated with both asset growth and liability growth (r = 0.22 and r = 0.20), reinforcing the procyclical behaviour of bank balance sheets over the economic cycle. These zero-order[34] correlations are primarily descriptive; the subsequent empirical analysis evaluates these relationships within a multivariate regression framework that controls for confounding influences and common time effects. To assess potential multicollinearity among the regressors, variance inflation factors (VIFs) were computed (Table 4). All VIF values fall below the conventional rule-of-thumb threshold of 10 (mean VIF = 3.762; range = 1.123-8.324), while all tolerance values exceed 0.10. Consistent with standard econometric guidelines (Wooldridge, 2016, pp. 84-86; Gujarati and Dawn, 2009, p. 340), these diagnostics suggest that multicollinearity is unlikely to pose a significant concern. Accordingly, the estimated coefficients are expected to remain well identified, with standard errors not materially inflated by collinearity among the explanatory variables.

[34] A zero-order correlation is the simple association between two variables, such as an independent and a dependent variable, without controlling for the effects of any other variables.

**Table 3. Pairwise correlations.**

This table reports pairwise Pearson correlation coefficients for the main variables in the sample. Variables are Winsorized at the 1st and 99th percentiles (Definitions in Table 1; summary statistics in Table 2). Correlations significance is denoted by *, **, and ***, indicating 10%, 5%, and 1% levels, respectively.

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) ΔLeverage | 1.000 | | | | | | | | | | |
| (2) ΔTotal assets | 0.282*** | 1.000 | | | | | | | | | |
| | (0.000) | | | | | | | | | | |
| (3) ΔTotal liabilities | 0.411*** | 0.945*** | 1.000 | | | | | | | | |
| | (0.000) | (0.000) | | | | | | | | | |
| (4) ΔAverage risk-weight | -0.264*** | -0.226*** | -0.216*** | 1.000 | | | | | | | |
| | (0.000) | (0.000) | (0.000) | | | | | | | | |
| (5) ΔGDP | -0.070 | 0.224*** | 0.205*** | 0.048 | 1.000 | | | | | | |
| | (0.165) | (0.000) | (0.000) | (0.340) | | | | | | | |
| (6) Dollarisation - loans | -0.008 | 0.264*** | 0.248*** | -0.024 | 0.205*** | 1.000 | | | | | |
| | (0.885) | (0.000) | (0.000) | (0.647) | (0.000) | | | | | | |
| (7) Dollarisation – liabs. | -0.011 | 0.245*** | 0.226*** | -0.061 | 0.140*** | 0.761*** | 1.000 | | | | |
| | (0.825) | (0.000) | (0.000) | (0.240) | (0.005) | (0.000) | | | | | |
| (8) FX_appreciation | -0.139*** | -0.206*** | -0.214*** | -0.070 | -0.083* | -0.071 | -0.056 | 1.000 | | | |
| | (0.005) | (0.000) | (0.000) | (0.163) | (0.051) | (0.166) | (0.269) | | | | |
| (9) FX_depreciation | -0.025 | 0.299*** | 0.291*** | 0.090* | -0.009 | 0.126** | 0.112** | -0.310*** | 1.000 | | |
| | (0.619) | (0.000) | (0.000) | (0.073) | (0.838) | (0.013) | (0.026) | (0.000) | | | |
| (10) IAS21Effect – liabs. | 0.022 | 0.310*** | 0.300*** | 0.042 | 0.065 | 0.295*** | 0.355*** | -0.336*** | 0.741*** | 1.000 | |
| | (0.679) | (0.000) | (0.000) | (0.421) | (0.211) | (0.000) | (0.000) | (0.000) | (0.000) | | |
| (11) IAS21Effect - loans | -0.012 | 0.401*** | 0.393*** | 0.047 | 0.099* | 0.411*** | 0.346*** | -0.331*** | 0.814*** | 0.824*** | 1.000 |
| | (0.820) | (0.000) | (0.000) | (0.375) | (0.062) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | |

**** p<0.01, ** p<0.05, * p<0.1*

**Table 4. Collinearity diagnostics.**
The table reports variance inflation factors (VIF) and tolerance (1/VIF) for all regressors. VIF quantifies how much a coefficient's variance is inflated by linear dependence among covariates; tolerance is its reciprocal. As a rule of thumb, VIF values above 10 - or equivalently tolerance below 0.10, signal potentially problematic multicollinearity. Values comfortably within these bounds suggest that collinearity is unlikely to distort coefficient estimates or standard errors.

| Variable | VIF | Tolerance |
|---|---|---|
| ΔTotal assets | 8.324 | 0.120 |
| ΔTotal liabilities | 8.066 | 0.124 |
| ΔAverage risk-weight | 1.142 | 0.876 |
| ΔGDP | 1.123 | 0.891 |
| Dollarisation - loans | 2.810 | 0.356 |
| Dollarisation - liabilities | 2.563 | 0.390 |
| FX_appreciation | 1.214 | 0.824 |
| FX_depreciation | 3.623 | 0.276 |
| IAS21Effect - liabilities | 3.886 | 0.257 |
| IAS21Effect - loans | 4.865 | 0.206 |
| **Mean VIF** | **3.762** | |

### 2.5 Methodology and model specification

This section outlines the methodological approach and details the econometric model specifications employed in the analysis.

#### 2.5.1 Measuring leverage procyclicality

##### 2.5.1.1 Equation (1a): Baseline model

To begin, we establish a baseline model following Adrian and Shin (2010), Amel-Zadeh et al. (2017) and Laux and Rauter (2017), examining the relationship between changes in banks' book leverage and the growth of total assets. This provides an initial test of whether leverage dynamics exhibit procyclical patterns across the SSA sample (Eq. 1a):

$$\Delta Leverage_{i,t} = \alpha + \beta \cdot \Delta Total\ Assets_{i,t} + \lambda_c + \lambda_t + \varepsilon_{i,t} \qquad \textbf{(1a)}$$

Here, $\Delta Leverage_{i,t}$ and $\Delta Total\ Assets_{i,t}$ denote the annual change in leverage and the annual change in total assets, respectively, calculated at the level of each country's banking sector for country *i* in year *t*. Following Laux and Rauter (2017), both variables are defined as the log difference, i.e., $\ln[\text{variable}_{i,t}] - \ln[\text{variable}_{i,t-1}]$. Leverage is measured as the ratio of total book assets to book equity. The term $\lambda_c$ captures country fixed effects that account for time-invariant cross-country heterogeneity, while $\lambda_t$ denotes time fixed effects that control for unobserved common shocks across periods. $\varepsilon_{i,t}$ is the vector of regression disturbances. The main parameter of interest, $\beta$, quantifies the sensitivity of leverage changes to asset changes. A significantly positive $\beta$ would provide evidence that leverage is, on average, procyclical within the sample.

### 2.5.1.2 Equation (1b): Baseline model with GDP growth control

Building on Eq. (1a), and following Laux and Rauter (2017), we extend the baseline model to investigate how leverage dynamics interact with macroeconomic conditions. Specifically, we include real GDP growth as an explanatory variable to capture the extent to which leverage is linked to the broader economic cycle (Eq. 1b):

$$\Delta Leverage_{i,t} = \alpha + \beta \cdot \Delta Total\ Assets_{i,t} + \zeta \cdot \Delta GDP_{c,t} + \lambda_c + \lambda_t + \varepsilon_{i,t} \qquad \textbf{(1b)}$$

Where $\Delta GDP_{c,t}$ represents the log change in real GDP for country c between periods t and t - 1. **Expected signs:** $\beta > 0$, as in Eq. (1a), and $\zeta > 0$, since leverage is expected to increase during economic expansions (positive real GDP growth) and fall during recessions, reinforcing procyclical dynamics. To further explore the link between asset expansion and macroeconomic fluctuations, we estimate an auxiliary regression that models changes in total assets as a function of real GDP growth (Laux and Rauter, 2017):

$$\Delta Total\ Assets_{i,t} = \alpha + \gamma \cdot \Delta GDP_{c,t} + \lambda_c + \lambda_t + \varepsilon_{i,t} \qquad \textbf{(1b\_1)}$$

**Expected sign:** $\gamma > 0$, as asset growth is expected to be positively correlated with economic growth, with banks expanding balance sheets during booms and contracting during downturns.

#### 2.5.1.3 Equation (1c): Baseline model with average risk-weighted assets

Next, we assess whether procyclical leverage patterns are influenced by regulatory leverage constraints and shifts in portfolio risk composition. Following Amel-Zadeh et al. (2017), we include the annual change in the ratio of risk-weighted assets to total assets (Eq. 1c):

$$\Delta Leverage_{i,t} = \alpha + \beta \cdot \Delta Total\ Assets_{i,t} + \gamma \cdot \Delta RWATA_{i,t} + \lambda_c + \lambda_t + \varepsilon_{i,t} \qquad \textbf{(1c)}$$

$\Delta RWATA_{i,t}$ denotes the annual log change in the ratio of risk-weighted assets to total assets, capturing changes in portfolio composition and underlying economic conditions (Amel-Zadeh et al., 2017, p. 1434). Formally, if leverage constraints are binding, the estimated coefficient $\beta$ is expected to decline in magnitude or lose statistical significance relative to the baseline specification, while the coefficient $\gamma$ should be negative. This would imply that reductions in the average portfolio risk weight – such as shifts toward lower-risk-weight assets – are associated with higher leverage, whereas increases in risk weights are expected to constrain leverage expansion.

#### 2.5.1.4 Equation (1d): The integrated model

Finally, combining the approaches of Amel-Zadeh et al. (2017) and Laux and Rauter (2017), we integrate models (1a), (1b), and (1c) by jointly including changes in total assets (ΔTotal Assets$_{i,t}$), GDP growth (ΔGDP$_{c,t}$), and average risk-weight (and ΔRWATA$_{i,t}$) as complementary indicators. This integrated specification provides the most comprehensive assessment of the procyclical behaviour of bank leverage, accounting simultaneously for balance sheet dynamics, macroeconomic fluctuations, and shifts in portfolio risk (Eq. 1d):

$$\Delta Leverage_{i,t} = \alpha + \beta \cdot \Delta Total\ Assets_{i,t} + \zeta \cdot \Delta GDP_{c,t} + \gamma \cdot \Delta RWATA_{i,t} + \lambda_c + \lambda_t + \varepsilon_{i,t} \qquad \textbf{(1d)}$$

**Expected signs:**

- $\beta > 0$, capturing the positive association between asset growth and leverage.
- $\zeta > 0$, reflecting the procyclicality of leverage with the macroeconomic cycle.
- $\gamma < 0$, indicating that a reduction in average risk weights facilitates higher leverage, while increases in risk weights constrain it.

### 2.5.2 Assessing the impact of accounting valuation on leverage procyclicality

To evaluate the role of accounting valuation, specifically under IAS 21, in driving procyclical leverage, we adopt the methodology of Amel-Zadeh et al. (2017) and estimate Equations (2a) and (2b), which build upon Equations (1a) and (1c) by incorporating an additional explanatory variable: *IAS21Effect*. This variable captures the change in foreign-currency-denominated assets attributable solely to exchange rate movements, thereby isolating accounting valuation effects from real transactional changes.

For empirical consistency, only the positive values of *IAS21Effect*, corresponding to currency depreciations, are retained. If exchange-rate-induced increases in total assets materially affect leverage dynamics, we expect the coefficient on *IAS21Effect* to be positive ($\beta_2 > 0$) in both Equation (2a) and Equation (2b). Equation (2a) augments the baseline specification by incorporating the *IAS21Effect* variable, while Equation (2b) further extends the model by jointly including both *IAS21Effect* and *RWATA*. Formally, the two specifications are expressed as follows:

$$\Delta Leverage_{i,t} = \alpha + \beta_1 \cdot \Delta Total\ Assets_{i,t} + \beta_2 \cdot IAS21Effect_{i,t} + \lambda_c + \lambda_t + \varepsilon_{i,t} \qquad \textbf{(2a)}$$

$$\Delta Leverage_{i,t} = \alpha + \beta_1 \cdot \Delta Total\ Assets_{i,t} + \beta_2 \cdot IAS21Effect_{i,t} + \gamma \cdot \Delta RWATA_{i,t} + \lambda_c + \lambda_t + \varepsilon_{i,t} \qquad \textbf{(2b)}$$

### 2.5.3 Interactions between leverage procyclicality, financial dollarisation, exchange rate volatility, and regulatory recapitalisation episodes

This section investigates whether the degree of leverage procyclicality, captured by its responsiveness to changes in bank total assets ($\Delta Total\ Assets_{i,t}$) and domestic output growth ($\Delta GDP_{c,t}$), systematically varies with financial dollarisation, exchange rate volatility, and episodes of regulatory-driven recapitalisation across the five Sub-Saharan African case study countries. The analysis focuses on the interaction terms between $\Delta Total\ Assets_{i,t}$ or $\Delta GDP_{c,t}$ and the following conditioning variables: dollarisation – measured as the share of foreign currency liabilities ($Dollar\_liab_{i,t}$) and the share of foreign currency loans ($Dollar\_loan_{i,t}$), exchange rate appreciation ($FXAppreciation_{c,t}$), exchange rate depreciation ($\mathrm{FXDepreciation}_{c,t}$), and recapitalisation policy episodes ($CAP_{k,c}$). These interaction terms are used to examine whether leverage dynamics respond differently under conditions of elevated dollarisation, exchange rate shocks, or during periods of policy-induced capital increases.

To capture potential asymmetries in leverage procyclicality, we differentiate between periods of expansion and contraction in both total assets and GDP, following the approach of prior research (e.g., Laux and Rauter, 2017). This approach enables us to assess whether the elasticity of leverage adjustments differs according to the nature of exchange-rate movements. In particular, it distinguishes between currency appreciations – typically associated with economic expansions and reductions in the domestic-currency value of foreign-currency-denominated exposures, where embedded leverage may accumulate – and currency depreciations, which are more commonly associated with downturns and increases in the domestic-currency value of foreign-currency exposures, potentially causing leverage to rise even as underlying exposures contract due solely to exchange-rate valuation effects. Particular attention is paid to the estimated coefficients of the interaction terms involving FX movements and $\Delta Total\ Assets_{i,t}$ or $\Delta GDP_{c,t}$. A statistically significant and positive interaction coefficient indicates a reinforcing effect on leverage procyclicality under the relevant condition, suggesting that the associated variable amplifies the cyclical sensitivity of leverage. The empirical analysis is formalised through Equations (3a) and (3b). Equation (3a) specifies the interaction with changes in total assets ($\Delta Total\ Assets_{i,t}$), while Equation (3b) models the interaction with changes in real GDP ($\Delta GDP_{c,t}$), as presented below:

$$\begin{aligned}\Delta Book\ Leverage_{i,t} = {} & \alpha + \beta \cdot \Delta Total\ Assets_{i,t} \\ & + \delta_1 \cdot (\Delta Total\ Assets_{i,t} \times Dollar\_liab_{i,t}) \\ & + \delta_2 \cdot (\Delta Total\ Assets_{i,t} \times Dollar\_loan_{i,t}) \\ & + \delta_3 \cdot (\Delta Total\ Assets_{i,t} > 0 \times FXAppreciation_{c,t}) \\ & + \delta_4 \cdot (\Delta Total\ Assets_{i,t} > 0 \times FXDepreciation_{c,t}) \\ & + \delta_5 \cdot (\Delta Total\ Assets_{i,t} < 0 \times FXAppreciation_{c,t}) \\ & + \delta_6 \cdot (\Delta Total\ Assets_{i,t} < 0 \times FXDepreciation_{c,t}) \\ & + \textstyle\sum_k \theta_k \cdot (\Delta Total\ Assets_{i,t} \times CAP_{k,c}) \\ & + \zeta \cdot \Delta RWATA_{i,t} + \gamma \cdot \Delta GDP_{c,t} + \lambda_c + \lambda_t + \varepsilon_{i,t}\end{aligned} \qquad \textbf{(3a)}$$

$$\begin{aligned}\Delta Book\ Leverage_{i,t} = {} & \alpha + \beta \cdot \Delta GDP_{c,t} \\ & + \delta_1 \cdot (\Delta GDP_{c,t} \times Dollar\_liab_{i,t}) \\ & + \delta_2 \cdot (\Delta GDP_{c,t} \times Dollar\_loan_{i,t}) \\ & + \delta_3 \cdot (\Delta GDP_{c,t} > 0 \times FXAppreciation_{c,t}) \\ & + \delta_4 \cdot (\Delta GDP_{c,t} > 0 \times FXDepreciation_{c,t}) \\ & + \delta_3 \cdot (\Delta GDP_{c,t} < 0 \times FXAppreciation_{c,t}) \\ & + \delta_4 \cdot (\Delta GDP_{c,t} < 0 \times FXDepreciation_{c,t}) \\ & + \textstyle\sum_k \theta_k \cdot (\Delta GDP_{c,t} \times CAP_{k,c}) \\ & + \zeta \cdot \Delta Total\ Assets_{i,t} + \gamma \cdot \Delta RWATA_{i,t} + \lambda_c + \lambda_t + \varepsilon_{i,t}\end{aligned} \qquad \textbf{(3b)}$$

The variables are defined as follows:

- $Dollar\_liab_{i,t}$ and $Dollar\_loan_{i,t}$ measure financial dollarisation, defined as the share of banking sector liabilities and loans, respectively, denominated in foreign currency.
- $FXAppreciation_{c,t}$ measures the extent of a year-on-year appreciation of the domestic currency relative to the U.S. dollar, defined as the negative first difference of the natural logarithm of the annual average exchange rate.
- $FXDepreciation_{c,t}$ captures the magnitude of a depreciation, defined as the first difference of the natural logarithm of the exchange rate (positive values indicate domestic currency weakening).
- $CAP_{k,c}$ represents a set of binary country-specific indicators equal to 1 during years when mandatory equity recapitalisation policies were implemented, and 0 otherwise (see Appendix 6 for details).

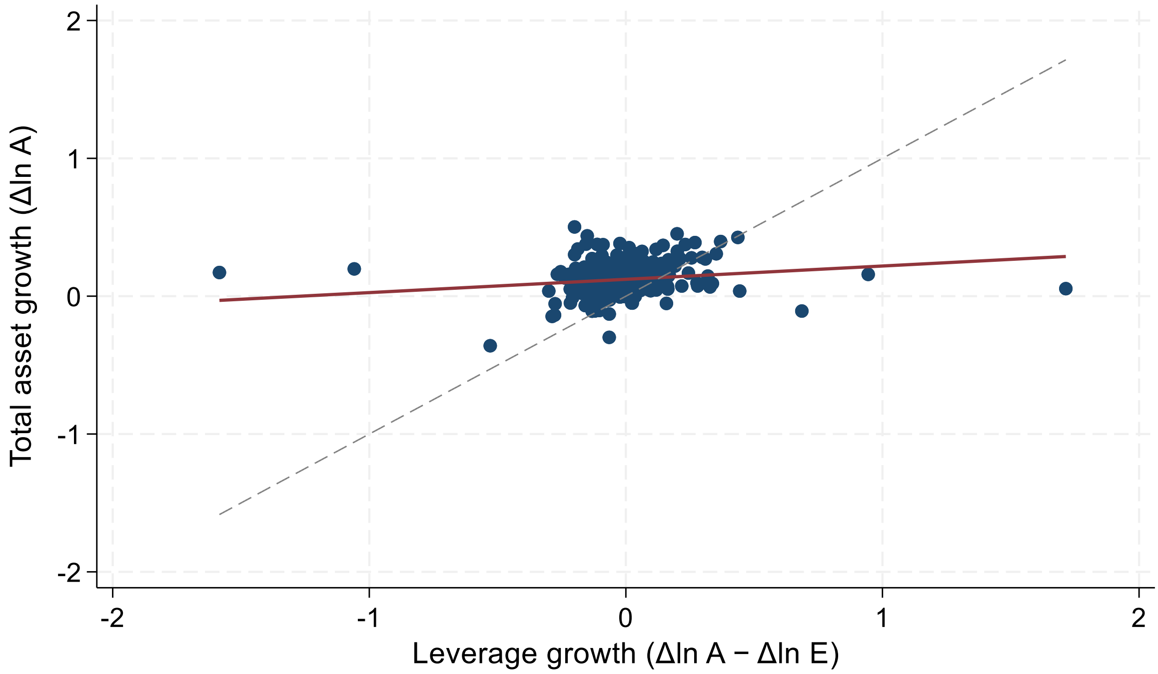
## 2.6 Empirical results and discussions

### 2.6.1 Graphical analysis of leverage procyclicality

Figure 1 plots banking-sector asset growth on the vertical axis, ΔlnA between periods *t* and *t*+1, against leverage growth on the horizontal axis, Δln(A/E) = ΔlnA−ΔlnE, following the framework of Adrian and Shin (2011, p. 294). The fitted regression line (red line) is positive but relatively flat for the SSA sample, indicating a modest degree of leverage procyclicality: leverage tends to increase as bank assets expand (Adrian and Shin, 2010, p. 419; 2011, p. 296). This pattern is consistent with the conventional interpretation that banks expand their balance sheets during economic upswings and contract them during downturns, with debt financing accounting for a substantial share of balance-sheet growth (Acharya and Ryan, 2016, p. 316).

For interpretative purposes, the dotted grey line represents the 45° reference line y = x (Adrian and Shin, 2011, p. 295). Observations lying on this line correspond to zero equity growth (ΔlnE = 0), with the vertical deviation from the line, y = x, capturing the change in equity. Points above the line indicate positive equity growth (ΔlnE>0), while points below the line reflect declining equity (ΔlnE<0). For the SSA sample, most observations cluster near the origin and above the 45° line, suggesting equity typically grows alongside assets (though more slowly). A few outliers, high leverage growth with little asset growth, sit well below the line, consistent with episodes of equity erosion. Overall, leverage increases in our SSA sample are usually driven by asset growth outpacing equity growth, with some cases reflecting equity declines rather than rapid asset expansion. This contrasts with evidence for advanced banking systems (e.g., the U.S.), where leverage adjustment is mainly through movements in total assets and equity grows more steadily alongside (see, for example, Adrian and Shin, 2011, Fig. 9, p. 301).

**Figure 1. Asset growth and leverage growth**




*Source: Author's calculations based on IMF Financial Soundness Indicators dataset.*

### 2.6.2 Measuring leverage procyclicality

Across all equations (1a – 1d), Breusch-Pagan LM tests indicate no detectable country-level random effects in first differences ($\rho \approx 0$; $p=1.00$), so pooled OLS with year fixed effects and country-clustered standard errors is appropriate (e.g., Cameron and Trivedi, 2022, pp. 376, 377-378, 390, 394, 409-414).[35] Accordingly, we adopt pooled OLS with year fixed effects (Wooldridge, 2025)[36] and country-clustered standard errors as our primary estimator. For robustness, we additionally report the results of the classical Hausman tests alongside Mundlak/Correlated Random Effects (CRE) joint tests of unit means. The Hausman test rejects the null hypothesis only for Equation (1a) at the 5% significance level and is marginally significant for Equation (1c) at approximately the 10% level, while Equations (1b) and (1d) do not reject the null. Similarly, the Mundlak/CRE tests do not reject the specifications in Equations (1a), (1b), and (1d), with Equation (1c) again yielding borderline significance. Given $\rho = 0$ throughout, these diagnostics support pooled OLS as the main specification, with FE/CRE reported as sensitivity checks.

To assess the asymptotic properties,[37] we applied Fisher-type panel ADF tests (one lag, cross-section demeaning) to all variables in Eqs. (1a) to (1d), ΔBook Leverage, ΔAssets, ΔGDP, Δln(RWA/TA), and the IAS 21 valuation effects, an approach appropriate for unbalanced panels (e.g., Miles et al., 2012, p. 9). Across all series, the modified inverse chi-squared statistic (*P*m) decisively rejects the null hypothesis that all panels contain a unit root ($p < 0.001$), a conclusion corroborated by the Z and inverse-logit-t statistics. Accordingly, the variables are treated as stationary, implying that they are unlikely to be governed by unit-root

---

[35] That is, when the key regressor, a policy variable, varies at a higher aggregation (e.g., state level), standard errors should be clustered at that level, use vce(cluster clustvar); see Cameron and Trivedi (2022, pp. 377 - 378).

[36] Including time fixed effects removes secular changes in the economic environment that have the same effect on all units (Wooldridge, 2025).

[37] For example, for a detailed discussion of unit-root testing, see Hansen (2022, pp. 578 - 579).

processes and instead exhibit behaviour consistent with stationary dynamics (see, e.g., Hansen, 2022, p. 579). Variable definitions are presented in Table 1, while descriptive statistics are reported in Table 2. To mitigate the influence of extreme observations and enhance the robustness of the regression estimates, all continuous variables – excluding dummy indicators – are Winsorised at the 1st and 99th percentiles (e.g., Dang et al., 2023; Kanga et al., 2020).[38] Regression results are presented in Tables 5 - 12, each corresponding to a different specification.

#### 2.6.2.1 Equation (1a): Baseline model

We begin with the baseline specification in Equation (1a), reported in Table 5, which examines the direct relationship between changes in banks' book leverage and balance-sheet expansion. The results provide strong evidence of leverage procyclicality. The estimated coefficients on ΔTotal Assets are positive and highly statistically significant under both pooled OLS and fixed-effects estimators (OLS: 0.400, t = 3.385; FE: 0.499, t = 3.078). These findings indicate that bank leverage systematically rises as balance sheets expand and declines as they contract. Quantitatively, a 1-percentage-point increase in asset growth is associated with approximately a 0.40–0.50 percentage-point increase in book leverage. In standardised terms, a one-standard-deviation increase in asset growth corresponds to an increase in leverage growth of roughly 0.33 standard deviations, underscoring a materially significant degree of leverage procyclicality.[39]

---

[38] This procedure reduces the distorting effect of outliers without discarding data, thereby preserving the integrity of the sample while aligning the distribution more closely with typical values.

[39] We gauge the economic relevance of the estimated coefficient by translating a one-standard-deviation increase in total asset growth (0.0983) into the implied change in book leverage growth. Using the coefficient on ΔTotal Assets reported in Table 5, the economic effect is calculated as (0.400 x 0.0983)/ 0.119 = 0.33, where 0.400 denotes the estimated asset-growth coefficient (Table 5), 0.0983 is the standard deviation of ΔTotal Assets, and 0.119 is the standard deviation of ΔBook Leverage (see Laux and Rauter, 2017, pp. 252-254).

#### 2.6.2.2 Equation (1b): Adding GDP growth

Extending Equation (1a), Table 6 incorporates real GDP growth (Equation 1b) to assess whether broader macroeconomic conditions influence leverage procyclicality. The results show that bank asset growth remains a strong and statistically significant determinant of leverage procyclicality across specifications (OLS: 0.416, t = 3.256; FE: 0.498, t = 3.074), whereas GDP growth exerts no statistically significant effect once asset growth and year-specific shocks are controlled for. Across all estimation approaches (OLS, FE, and RE), the coefficient on ΔReal GDP remains insignificant (OLS/RE: −0.185, t = −1.165; FE: 0.102, t = 0.631). These findings suggest that leverage procyclicality in the SSA context is not systematically driven by aggregate macroeconomic fluctuations, but rather by banks' balance-sheet management behaviour–particularly asset-liability management decisions–independent of contemporaneous movements in real economic activity.

Auxiliary Equation (1b_1) further clarifies this result. Although ΔReal GDP is positively associated with ΔTotal Assets under pooled OLS and RE specifications (OLS: 0.614, t = 2.760; RE: 0.580, t = 2.580), the relationship disappears once country fixed effects and year dummies are introduced (FE: 0.08, t = 0.313). This indicates that GDP growth provides little additional explanatory power after controlling for within-country variation and common time-specific shocks. The statistical significance of several year dummies–particularly for 2020–suggests that common exogenous events, such as the COVID-19 pandemic, exerted important effects on banking-sector balance-sheet dynamics across countries. This pattern contrasts with evidence from advanced economies, particularly the United States, where real GDP growth is found to significantly predict leverage procyclicality (e.g., Laux and Rauter, 2017). In such settings, leverage cycles are more closely aligned with domestic macroeconomic conditions, with credit booms and busts reinforcing cyclical leverage dynamics.

By contrast, in SSA LMICs, the dominant transmission mechanism operates primarily through bank balance sheets and is strongly influenced by structural exposure to external financial shocks. These include volatile capital flows and commodity price cycles (Kasekende et al., 2012, p. 17), together with high levels of financial dollarisation (Ajide et al., 2019, p. 401) interacting with persistent exchange-rate volatility. Banking systems in the region are also frequently dominated by foreign bank subsidiaries – particularly from Europe, China, India, the United States, and South Africa – which actively manage foreign-currency exposures and domestic securities portfolios through group-level balance-sheet management strategies. Consequently, leverage dynamics in SSA LMICs are shaped more by cross-border balance-sheet adjustments and external financial conditions than by domestic GDP fluctuations alone.

#### 2.6.2.3 Equation (1c): Adding RWATA

Table 7 reports the results from Equation (1c), which extends the baseline specification (Equation 1a) by incorporating changes in the ratio of risk-weighted assets to total assets (ΔRWATA) to examine the regulatory channel of leverage procyclicality. The key test is whether controlling for changes in average portfolio risk weights reduces the magnitude or significance of β, the coefficient on asset growth (ΔTotal Assets). Consistent with the framework developed by Amel-Zadeh et al. (2017), binding regulatory leverage constraints imply that β should weaken, while the coefficient on ΔRWATA (γ) is expected to be negative and statistically significant.

The results support the presence of binding, or at least economically relevant, regulatory leverage constraints. Specifically, changes in book leverage (ΔLeverage) are negatively and significantly associated with changes in average regulatory risk weights (ΔRWATA), with coefficients of −0.171 ($t = -2.402$) under pooled OLS and −0.156 ($t = -2.354$) under fixed effects estimation. At the same time, the coefficient on ΔTotal Assets remains positive and highly significant, confirming that leverage remains procyclical even after controlling for changes in portfolio risk composition. However, the magnitude of the asset-growth coefficient declines relative to the baseline specification – from 0.400 (t = 3.385) to 0.342 (t = 3.044) under pooled OLS, and from 0.499 (t = 3.078) to 0.442 (t = 2.888) under fixed effects estimation. This suggests that part of the observed leverage procyclicality is driven by portfolio reallocations undertaken in response to risk-based capital constraints. More specifically, increases in exposure to higher-risk assets constrain leverage expansion because they require higher capital charges per unit of exposure. Conversely, reallocations toward lower-risk-weight assets – such as sovereign securities and foreign-currency reserves carrying 0% or 20% risk weights – allow banks to expand leverage more rapidly for a given level of asset growth.

This mechanism is particularly relevant in SSA LMICs, where banks typically maintain substantial holdings of government securities and foreign-currency reserves. These portfolio allocations reflect both the preference for liquid, lower-risk assets in environments characterised by weak lending opportunities and elevated default risk, and the structural effects of persistent dollarisation and exchange-rate volatility. During downturns, rising non-performing loans, declining risk appetite, and capital erosion further incentivise banks to shift toward lower-risk-weight assets. Consequently, reductions in average portfolio risk weights are associated with greater leverage expansion, whereas increases in risk weights constrain leverage growth by raising regulatory capital requirements per unit of assets. Formally, the negative coefficient on $\Delta RWATA$ ($\gamma<0$) indicates that leverage expands more easily as portfolio risk weights decline. This highlights how portfolio reallocation under risk-based regulatory frameworks can amplify the procyclical behaviour of leverage.

#### 2.6.2.4 Equation (1d): Integrated model

Table 8 presents the integrated specification (Equation 1d), which jointly incorporates asset growth (ΔTotal Assets), GDP growth (ΔGDP), and changes in the ratio of risk-weighted assets to total assets (ΔRWATA) to provide a comprehensive assessment of leverage procyclicality. The results indicate that leverage procyclicality is driven primarily by balance-sheet expansion and further amplified by portfolio reallocation toward lower-risk-weight assets within the regulatory framework. The balance-sheet channel remains the dominant mechanism: leverage rises mainly because banks expand their assets. At the same time, the regulatory risk-weight channel also plays an important role. Specifically, reductions in average portfolio risk weights (lower ΔRWATA) create additional capacity for leverage expansion, whereas increases in risk weights constrain leverage growth through higher regulatory capital requirements. Consistent with the earlier results reported in Tables 5–7, GDP growth does not exert a statistically significant direct effect on leverage once these bank-level balance-sheet channels are taken into account.

Overall, the evidence from Tables 5 through 8 consistently suggests that leverage procyclicality in SSA LMICs is fundamentally driven by balance-sheet dynamics. The statistically significant negative coefficient on ΔRWATA ($\gamma$), together with the reduction in the magnitude of the asset-growth coefficient ($\beta$) relative to the simpler specifications, indicates that leverage fluctuations arise not only from asset expansion itself, but also from active adjustments in portfolio risk composition. Importantly, these effects appear largely independent of contemporaneous GDP growth. From a policy perspective, the findings imply that leverage dynamics respond both to the pace of balance-sheet expansion and to changes in the underlying risk profile of banks' asset portfolios. In particular, shifts toward lower-risk-weight assets – or broader declines in average portfolio risk weights – facilitate greater leverage expansion even in the absence of stronger real economic activity. Accordingly, the subsequent empirical analysis (i.e., Section 2.6.3) focuses primarily on ΔTotal Assets and ΔRWATA, complemented by accounting-based valuation effects, as integrated measures of leverage procyclicality.

**Table 5. Baseline regression: Leverage procyclicality.**
This table reports estimates from the baseline model (Eq. 1a), where the annual change in book leverage (ΔBook Leverage) is regressed on the change in total assets (ΔTotal Assets). Standard errors are robust to clustering at the country level. Coefficient *t*-statistics are reported in parentheses. Statistical significance is denoted by *, **, and *** at the 10%, 5%, and 1% levels, respectively.

| | OLS | FE | RE |
|---|---|---|---|
| **Dependent Variable:** ΔBook Leverage | | | |
| *ΔTotal Assets* | 0.400*** | 0.499*** | 0.400*** |
| | (3.385) | (3.078) | (3.385) |
| *Constant* | -0.049*** | -0.066* | -0.048* |
| | (-3.101) | (-1.927) | (-1.734) |
| *Country effects* | NO | YES | NO |
| *Year effects* | YES | YES | YES |
| *Observations* | 400 | 400 | 400 |
| *$R^2$ - Overall* | 0.174 | 0.172 | 0.174 |
| *$R^2$ - Between* | | 0.065 | 0.071 |
| *$R^2$ - Within* | | 0.198 | 0.195 |
| *F-test or Wald test (RE)* | 11.46 | 7.14 | 149.51 |
| *Prob>F* | 0.002 | 0.000 | 0.000 |

**Table 6. Balance sheets and GDP growth.**
This table presents results from Eq. 1b, extending the baseline by including real GDP growth (ΔGDP) to examine the relationship between macroeconomic fluctuations and bank leverage. Standard errors are robust to clustering at the country level. Coefficient t-statistics are reported in parentheses. Statistical significance is denoted by *, **, and *** at the 10%, 5%, and 1% levels, respectively.

| | OLS | FE | RE |
|---|---|---|---|
| **Dependent Variable:** ΔBook Leverage | | | |
| *ΔTotal Assets* | 0.416*** | 0.498*** | 0.416*** |
| | (3.256) | (3.074) | (3.256) |
| *ΔReal GDP* | -0.185 | 0.102 | -0.185 |
| | (-1.165) | (0.631) | (-1.165) |
| *Constant* | -0.045*** | -0.072** | -0.040 |
| | (-3.088) | (-2.337) | (-1.526) |
| *Country effects* | NO | YES | NO |
| *Year effects* | YES | YES | YES |
| *Observations* | 400 | 400 | 400 |
| *$R^2$ - Overall* | 0.177 | 0.168 | 0.177 |
| *$R^2$ - Between* | | 0.059 | 0.086 |
| *$R^2$ - Within* | | 0.199 | 0.191 |
| *F-test or Wald test (RE)* | 5.69 | 7.62 | 176.38 |
| *Prob>F* | 0.008 | 0.000 | 0.000 |

**Table 6A. Asset growth and GDP growth.**

This table reports estimates from Eq. (1b_1), an auxiliary specification to Eq. (1b), where ΔTotal Assets is regressed on real GDP growth (ΔGDP) to further assess the relationship between bank asset expansion and a country's macroeconomic conditions. Standard errors are clustered at the country level. t-statistics are reported in parentheses. Statistical significance is indicated by *, **, and *** at the 10%, 5%, and 1% levels, respectively.

| | OLS | FE | RE |
|---|---|---|---|
| **Dependent Variable:** ΔTotal Assets | | | |
| *ΔReal GDP* | 0.614*** | 0.080 | 0.580*** |
| | (2.760) | (0.313) | (2.580) |
| *Constant* | 0.103*** | 0.200*** | 0.167*** |
| | (11.049) | (11.251) | (9.236) |
| *Country effects* | NO | YES | NO |
| *Year effects* | YES | YES | YES |
| *Observations* | 400 | 400 | 400 |
| *$R^2$ - Overall* | 0.197 | 0.159 | 0.197 |
| *$R^2$ - Between* | | 0.091 | 0.494 |
| *$R^2$ - Within* | | 0.179 | 0.156 |
| *F-test or Wald test (RE)* | 7.62 | 23.57 | 898.47 |
| *Prob>F* | 0.010 | 0.000 | 0.000 |

## Table 7. Regulatory dimension of procyclicality.

This table reports results from Eq. (1c), which augments the baseline model with the annual change in risk-weighted assets to total assets (ΔRWATA) to test the role of regulatory risk weights in leverage procyclicality. Standard errors are clustered at the country level. t-statistics are reported in parentheses. Statistical significance is indicated by *, **, and *** at the 10%, 5%, and 1% levels, respectively.

| | OLS | FE | RE |
|---|---|---|---|
| **Dependent Variable:** ΔBook Leverage | | | |
| *ΔTotal Assets* | 0.342*** | 0.442*** | 0.342*** |
| | (3.044) | (2.888) | (3.044) |
| *ΔRWATA* | -0.171** | -0.156** | -0.171** |
| | (-2.402) | (-2.354) | (-2.402) |
| *Constant* | -0.042*** | -0.075** | -0.059** |
| | (-2.818) | (-2.324) | (-2.497) |
| *Country effects* | NO | YES | NO |
| *Year effects* | YES | YES | YES |
| *Observations* | 399 | 399 | 399 |
| *$R^2$ - Overall* | 0.198 | 0.194 | 0.198 |
| *$R^2$ - Between* | | 0.082 | 0.095 |
| *$R^2$ - Within* | | 0.217 | 0.214 |
| *F-test or Wald test (RE)* | 9.31 | 14.80 | 247.16 |
| *Prob>F* | 0.001 | 0.000 | 0.000 |

## Table 8. Integrated model: Assets, GDP, and Risk Weights.

This table presents results from Eq. (1d), combining ΔTotal Assets, ΔGDP, and ΔRWATA to assess their joint impact on the procyclical behaviour of bank leverage. Standard errors are clustered at the country level. t-statistics are reported in parentheses. Statistical significance is indicated by *, **, and *** at the 10%, 5%, and 1% levels, respectively.

| | OLS | FE | RE |
|---|---|---|---|
| **Dependent Variable:** ΔBook Leverage | | | |
| *ΔTotal Assets* | 0.355*** | 0.439*** | 0.355*** |
| | (2.960) | (2.869) | (2.960) |
| *ΔReal GDP* | -0.141 | 0.143 | -0.141 |
| | (-0.978) | (0.934) | (-0.978) |
| *ΔRWATA* | -0.167** | -0.159** | -0.167** |
| | (-2.404) | (-2.403) | (-2.404) |
| *Constant* | -0.039*** | -0.081** | -0.055** |
| | (-2.825) | (-2.753) | (-2.439) |
| *Country effects* | NO | YES | NO |
| *Year effects* | YES | YES | YES |
| *Observations* | 399 | 399 | 399 |
| *$R^2$ - Overall* | 0.199 | 0.190 | 0.199 |
| *$R^2$ - Between* | | 0.072 | 0.109 |
| *$R^2$ - Within* | | 0.219 | 0.211 |
| *F-test or Wald test (RE)* | 6.86 | 40.96 | 679.09 |
| *Prob>F* | 0.001 | 0.000 | 0.000 |

### 2.6.3 Assessing accounting valuation effects on leverage procyclicality

#### 2.6.3.1 Equation (2a): Extending the baseline model with IAS21Effect

Table 9 reports the results for Equation (2a), which extends the baseline specification in Equation (1a) by explicitly incorporating a measure of asset changes attributable to accounting valuation effects under IAS 21 (IAS21Effect). This specification enables a clear distinction between: (i) leverage procyclicality driven purely by accounting-based valuation effects, and (ii) leverage changes arising from the combined influence of accounting revaluations and genuine growth in foreign-currency-denominated assets within overall balance-sheet expansion.

Consistent with the earlier findings, changes in total assets remain strongly and positively associated with changes in book leverage. The estimated coefficients on ΔTotal Assets are both economically and statistically significant across estimators (OLS: 0.522, t = 4.164; FE: 0.615, t = 4.048). Contrary to prior expectations, however, the loans-based IAS21Effect enters with a negative and statistically significant coefficient at the 5% level (OLS: −1.637, t = −2.283; FE: −1.551, t = −2.206). This suggests that IAS 21-related revaluations of foreign-currency loans tend to dampen, rather than amplify, leverage increases associated with balance-sheet expansion.[40] A positive coefficient would have supported the hypothesis that IAS 21 translation effects intensify leverage procyclicality beyond that generated by real balance-sheet growth.

The observed negative relationship may instead reflect two plausible mechanisms. First, valuation gains on foreign-currency-denominated assets during episodes of currency depreciation may exceed corresponding valuation losses on foreign-currency liabilities,

[40] Furthermore, the IAS 21 effect is statistically distinguishable from the ΔAssets effect (Equality F = 8.09, p = 0.008), indicating that the FX-loan channel operates independently rather than merely mirroring asset growth. In addition, untabulated results using alternative normalisations of the IAS variable, FX-loans/Equity, yield the same negative sign, albeit with borderline significance under the FE specification (OLS: -0.158, t = -2.06; FE: -0.130, t = -1.78), thereby reinforcing the main finding

thereby generating a net increase in equity capital and reducing measured leverage. Second, in environments characterised by persistent currency depreciation – where exchange-rate revaluations mechanically inflate both balance-sheet size and leverage – regulatory authorities may respond through mandatory recapitalisation or equity-injection measures. Such interventions can impose a deleveraging effect that offsets the leverage-increasing impact of FX-driven asset growth. Overall, the results suggest that the IAS 21 translation channel, particularly in highly dollarised banking systems, may operate to moderate rather than amplify leverage procyclicality, primarily through valuation gains that strengthen equity buffers and through regulatory interventions triggered during periods of exchange-rate stress.

**2.6.3.2 Equation (2b): Incorporating IAS21Effect and RWATA into the baseline model**

Table 10 reports the results for Equation (2b), which extends the baseline specification (Equation 1a) by jointly incorporating IAS21Effect and changes in risk-weight density (ΔRWATA). This integrated specification enables simultaneous assessment of both the accounting valuation channel operating through IAS 21 remeasurement effects and the regulatory channel operating through portfolio risk-weight adjustments.

The interpretation of the results aligns closely with the framework developed by Amel-Zadeh et al. (2017, p. 1428), which distinguishes between leverage procyclicality arising from regulatory leverage constraints and that associated with accounting valuation practices. In their framework, procyclical leverage for banks facing binding regulatory constraints is driven primarily by regulatory capital requirements rather than fair-value accounting itself. By contrast, where leverage constraints are not binding, accounting valuation effects may play a more important role in shaping leverage dynamics. More broadly, because regulatory leverage depends on the risk weights assigned to assets, banks seeking to maximise return on equity must continuously balance the trade-off between holding lower-risk-weight, lower-return assets and higher-risk-weight, higher-return assets (Amel-Zadeh et al., 2017, p. 1429). In practice, portfolio reallocation toward higher-risk lending occurs only when risk-adjusted and capital-adjusted returns become sufficiently attractive relative to low-risk alternatives such as government securities or foreign-currency reserve holdings (e.g., Fatouh et al., 2024, p. 35).

The empirical results remain consistent with leverage procyclicality. ΔTotal Assets continues to exhibit a positive and highly significant relationship with changes in book leverage at the 1% significance level. At the same time, the coefficient on ΔRWATA is negative and statistically significant, with a somewhat larger magnitude than in Table 7 (OLS: −0.203, t = −2.606; FE: −0.192, t = −2.719). This indicates that increases in average portfolio risk weights constrain leverage growth, whereas shifts toward lower-risk-weight assets facilitate faster leverage expansion. The loans-based IAS21Effect coefficient remains negative and economically meaningful, although its statistical significance weakens slightly after controlling for ΔRWATA (OLS: −1.476, t = −2.039; FE: −1.354, t = −1.855). One plausible explanation is that ΔRWATA captures part of the exchange-rate-induced balance-sheet adjustment previously attributed to IAS 21 valuation effects. For instance, during periods of currency depreciation and market stress, banks frequently rebalance toward lower-risk, highly liquid foreign-currency assets – such as cash holdings and nostro balances – which typically attract risk weights of 0–20%. These portfolio reallocations reduce average risk-weight density while simultaneously strengthening equity positions through FX translation gains, thereby moderating the marginal contribution of IAS 21 valuation effects once changes in portfolio risk composition are explicitly controlled for.

**Table 9. Leverage dynamics: Asset Growth and IAS 21 FX valuation channels.**
This table presents estimates from Eq. (2a), which extends the baseline specification by incorporating asset changes arising solely from IAS 21 valuation effects in order to assess the contribution of accounting remeasurement to leverage procyclicality. Standard errors are clustered at the country level, with t-statistics shown in parentheses. Statistical significance is denoted by *, **, and *** at the 10%, 5%, and 1% levels, respectively.

| | OLS | FE | RE |
|---|---|---|---|
| **Dependent Variable:** ΔBook Leverage | | | |
| *ΔTotal Assets* | 0.522*** | 0.615*** | 0.522*** |
| | (4.164) | (4.048) | (4.164) |
| *ΔIAS21Effect* | -1.637** | -1.551** | -1.637** |
| | (-2.283) | (-2.206) | (-2.283) |
| *Constant* | -0.052*** | -0.107*** | -0.096*** |
| | (-3.625) | (-3.405) | (-3.257) |
| *Country effects* | NO | YES | NO |
| *Year effects* | YES | YES | YES |
| *Observations* | 358 | 358 | 358 |
| *$R^2$ - Overall* | 0.205 | 0.228 | 0.205 |
| *$R^2$ - Between* | | 0.058 | 0.068 |
| *$R^2$ - Within* | | 0.228 | 0.225 |
| *F-test or Wald test (RE)* | 8.74 | 100.31 | 2580.15 |
| *Prob>F* | 0.001 | 0.000 | 0.000 |

**Table 10. Asset Growth, Regulatory, and IAS21 Valuation Channels and Procyclicality.**
This table presents estimates from Eq. (2b), which extends the baseline specification by adding the annual change in the ratio of risk-weighted assets to total assets (ΔRWATA) together with the IAS21Effect, allowing a joint assessment of accounting remeasurement and regulatory channels of procyclicality. Standard errors are clustered at the country level; t-statistics are shown in parentheses. Statistical significance is denoted by *, **, and *** at the 10%, 5%, and 1% levels, respectively.

| | OLS | FE | RE |
|---|---|---|---|
| **Dependent Variable:** ΔBook Leverage | | | |
| *ΔTotal Assets* | 0.447*** | 0.544*** | 0.447*** |
| | (3.685) | (3.789) | (3.685) |
| *ΔRWATA* | -0.203** | -0.192** | -0.203*** |
| | (-2.606) | (-2.719) | (-2.606) |
| *ΔIAS21Effect* | -1.476* | -1.354* | -1.476** |
| | (-2.039) | (-1.855) | (-2.039) |
| *Constant* | -0.045*** | -0.089*** | -0.075*** |
| | (-3.202) | (-3.072) | (-2.809) |
| *Country effects* | NO | YES | NO |
| *Year effects* | YES | YES | YES |
| *Observations* | 358 | 358 | 358 |
| *$R^2$ - Overall* | 0.235 | 0.231 | 0.235 |
| *$R^2$ - Between* | | 0.085 | 0.105 |
| *$R^2$ - Within* | | 0.254 | 0.251 |
| *F-test or Wald test (RE)* | 10.74 | 1560000 | 1363.92 |
| *Prob>F* | 0.000 | 0.000 | 0.000 |

### 2.6.4 Leverage procyclicality, dollarisation, FX volatility and recapitalisations

#### 2.6.4.1 Interactions with ΔTotal Assets

Table 11 presents the estimation results for Equation (3a), which examines how the elasticity of bank leverage with respect to asset growth is shaped by structural characteristics such as financial dollarisation, exchange-rate movements, and episodes of regulatory-driven recapitalisation across the five Sub-Saharan African case-study countries. The baseline coefficient on asset growth (ΔTotal Assets) remains positive and highly statistically significant (OLS: 0.621, $t = 5.935$; FE: 0.676, $t = 5.576$), confirming strong leverage procyclicality: banks tend to increase leverage as their balance sheets expand. Similarly, the coefficient on changes in average risk-weight density (ΔRWATA) is negative and statistically significant (OLS: −0.199, $t = -2.841$; FE: −0.194, $t = -2.714$), reinforcing earlier findings that portfolio shifts toward lower-risk-weight assets facilitate faster leverage expansion. By contrast, GDP growth (ΔReal GDP) remains economically weak and statistically fragile. Although the coefficient is marginally significant at the 10% level under pooled OLS (−0.314, $t = -1.718$), it becomes statistically insignificant under fixed effects estimation (−0.102, $t = -0.529$), consistent with earlier results indicating that leverage dynamics in SSA LMICs are not strongly linked to domestic macroeconomic cycles.

Despite the strong average relationship between leverage and asset growth, the results reveal important heterogeneity across structural conditions. Interaction terms between asset growth and financial dollarisation – measured using loan and liability dollarisation ratios (ΔAssets × Dollar_loan and ΔAssets × Dollar_liab) – are statistically insignificant, suggesting no robust differential effect of dollarisation once other structural factors are controlled for. More substantial effects emerge through exchange-rate dynamics. The interaction between asset growth and currency appreciation is positive and statistically significant during periods of asset contraction (OLS: 7.418, $t = 2.633$; FE: 7.053, $t = 2.178$), whereas the corresponding interaction during depreciation episodes is not statistically significant. Under the pooled OLS specification, the differential FX pass-through between appreciation and depreciation during expansions versus contractions is 6.37 ($p = 0.052$), indicating marginal significance at the 10% level, although this effect does not remain significant under fixed effects estimation.

These findings suggest that leverage procyclicality intensifies during episodes of currency appreciation. As the domestic currency strengthens, the local-currency value of banks' foreign-currency-denominated assets and liabilities declines, mechanically reducing total assets relative to equity and improving reported leverage ratios. This creates additional balance-sheet capacity, enabling banks to expand assets without corresponding increases in equity. At the same time, the underlying accumulation of foreign-currency exposures may remain obscured, as the domestic-currency value of these assets grows more slowly – or may even decline – as a share of total assets. This embedded leverage becomes more visible during subsequent depreciation episodes, when the domestic-currency value of foreign-currency exposures rises sharply relative to equity, thereby intensifying leverage procyclicality.

The recapitalisation interaction terms produce the strongest policy-related effects. In Nigeria, Zambia, and Ghana, recapitalisation episodes significantly reduce the leverage–asset elasticity, consistent with regulatory interventions that constrain balance-sheet expansion through mandatory equity injections. In Kenya, the interaction term is negative and only marginally significant, likely reflecting the gradual implementation of recapitalisation reforms, which allowed asset growth to outpace equity injections and weakened the short-run effect on leverage adjustment. For Uganda, the coefficient is likewise negative and statistically significant under pooled OLS but loses significance under fixed effects estimation, suggesting that the dampening effect of recapitalisation on leverage may be sensitive to model specification and potentially transitory.

#### 2.6.4.2 Interactions with ΔReal GDP

Table 12 reports the results for Equation (3b), which examines whether the responsiveness of bank leverage to GDP growth is conditioned by financial dollarisation, exchange-rate volatility, and episodes of regulatory-driven recapitalisation. The specification controls for changes in total assets (ΔTotal Assets) and average risk-weight density (ΔRWATA), both of which remain consistent with earlier findings: asset growth is positively and significantly associated with leverage, while increases in risk-weight density exert a negative and statistically significant effect on leverage growth. By contrast, the baseline coefficient on GDP growth (ΔReal GDP) remains statistically insignificant.

The results provide little evidence that financial dollarisation systematically alters the relationship between leverage and GDP growth. Interaction terms between ΔReal GDP and the shares of foreign-currency-denominated loans and liabilities are statistically insignificant, suggesting that dollarisation does not materially mediate the effect of macroeconomic growth on leverage dynamics. Similarly, exchange-rate movements do not appear to significantly condition this relationship, as the interaction terms associated with both currency appreciation and depreciation remain statistically imprecise. By comparison, recapitalisation episodes exert a more pronounced moderating effect. The interaction terms between ΔGDP and the recapitalisation indicators ($\Delta GDP \times CAP_k$) are generally negative and statistically significant, suggesting that recapitalisation episodes materially weaken the leverage–asset elasticity. This is consistent with regulatory interventions that restrain balance-sheet expansion through mandatory equity injections and higher capital requirements.

**Table 11. Procyclicality: Asset Growth, GDP, and Risk Weights with Interaction Effects (ΔTotal Assets).** This table reports estimates from Eq. (3a), which jointly incorporates ΔTotal Assets, ΔGDP, and ΔRWATA to examine drivers of bank leverage procyclicality. Interaction terms between ΔTotal Assets and key structural variables, financial dollarisation, exchange rate fluctuations, and recapitalisation episodes, are included to assess conditional effects. Standard errors are clustered at the country level, with t-statistics in parentheses. Significance levels are denoted by *, **, and *** for the 10%, 5%, and 1% thresholds, respectively.

| | OLS | FE | RE |
|---|---|---|---|
| **Dependent Variable:** ΔBook Leverage | | | |
| *ΔTotal Assets (TA)* | 0.621*** | 0.676*** | 0.621*** |
| | (5.935) | (5.576) | (5.935) |
| *ΔRWATA* | -0.199*** | -0.194** | -0.199*** |
| | (-2.841) | (-2.714) | (-2.841) |
| *ΔReal GDP* | -0.314* | -0.102 | -0.314* |
| | (-1.718) | (-0.529) | (-1.718) |
| *ΔTA * Dollar Loans* | -0.020 | 0.277 | -0.020 |
| | (-0.071) | (0.858) | (-0.071) |
| *ΔTA * Dollar Liabilities* | -0.326 | -0.554 | -0.326 |
| | (-1.009) | (-1.229) | (-1.009) |
| *ΔTA > 0 * FX Appreciation* | 1.051 | 1.595 | 1.051 |
| | (0.892) | (1.221) | (0.892) |
| *ΔTA > 0 * FX Depreciation* | -0.660 | -0.804 | -0.660 |
| | (-1.382) | (-1.550) | (-1.382) |
| *ΔTA < 0 * FX Appreciation* | 7.418** | 7.053** | 7.418*** |
| | (2.633) | (2.178) | (2.633) |
| *ΔTA < 0 * FX Depreciation* | -7.382 | -4.087 | -7.382 |
| | (-0.448) | (-0.219) | (-0.448) |
| *ΔTA * CAP Ghana* | -0.299*** | -0.313*** | -0.299*** |
| | (-3.066) | (-3.479) | (-3.066) |
| *ΔTA * CAP Kenya* | -0.240* | -0.285* | -0.240* |
| | (-1.728) | (-1.834) | (-1.728) |
| *ΔTA * CAP Nigeria* | -0.635*** | -0.725*** | -0.635*** |
| | (-7.377) | (-4.413) | (-7.377) |
| *ΔTA * CAP Uganda* | -0.268*** | -0.075 | -0.268*** |
| | (-3.745) | (-0.548) | (-3.745) |
| *ΔTA * CAP Zambia* | -0.531*** | -0.666*** | -0.531*** |
| | (-4.594) | (-5.454) | (-4.594) |
| *Constant* | -0.042*** | -0.091*** | -0.079*** |
| | (-4.579) | (-4.398) | (-5.042) |
| *Country effects* | NO | YES | NO |
| *Year effects* | YES | YES | YES |
| *Observations* | 353 | 353 | 353 |
| *$R^2$ - Overall* | 0.282 | 0.270 | 0.282 |
| *$R^2$ - Between* | | 0.036 | 0.132 |
| *$R^2$ - Within* | | 0.301 | 0.294 |

**Table 12. Procyclicality: Asset Growth, GDP, and Risk Weights with Interaction Effects (ΔGDP).** This table reports estimates from Eq. (3b), which jointly incorporates ΔTotal Assets, ΔGDP, and ΔRWATA to examine drivers of bank leverage procyclicality. Interaction terms between ΔGDP and key structural variables, financial dollarisation, exchange rate fluctuations, and recapitalisation episodes, are included to assess conditional effects. Standard errors are clustered at the country level, with t-statistics in parentheses. Significance levels are denoted by *, **, and *** for the 10%, 5%, and 1% thresholds, respectively.

| | OLS | FE | RE |
|---|---|---|---|
| **Dependent Variable:** ΔBook Leverage | | | |
| *ΔTotal Assets (TA)* | 0.418*** | 0.473** | 0.418*** |
| | (3.293) | (2.703) | (3.293) |
| *ΔRWATA* | -0.199** | -0.206*** | -0.199*** |
| | (-2.758) | (-2.779) | (-2.758) |
| *ΔReal GDP* | 0.145 | 0.297 | 0.145 |
| | (0.436) | (0.822) | (0.436) |
| *ΔGDP * Dollar Loans* | 0.288 | 1.234 | 0.288 |
| | (0.260) | (0.982) | (0.260) |
| *ΔGDP * Dollar Liabilities* | -1.458 | -2.068 | -1.458 |
| | (-1.320) | (-1.586) | (-1.320) |
| *ΔGDP > 0 * FX Appreciation* | -3.906 | -3.759 | -3.906 |
| | (-0.525) | (-0.460) | (-0.525) |
| *ΔGDP > 0 * FX Depreciation* | -1.839 | -1.125 | -1.839 |
| | (-1.116) | (-0.497) | (-1.116) |
| *ΔGDP < 0 * FX Appreciation* | 2.620 | 6.171 | 2.620 |
| | (0.401) | (0.888) | (0.401) |
| *ΔGDP < 0 * FX Depreciation* | 2.647 | 6.565 | 2.647 |
| | (0.538) | (0.849) | (0.538) |
| *ΔGDP * CAP Ghana* | -0.877*** | -0.818*** | -0.877*** |
| | (-3.426) | (-3.562) | (-3.426) |
| *ΔGDP * CAP Kenya* | -1.303*** | -1.677*** | -1.303*** |
| | (-3.008) | (-3.611) | (-3.008) |
| *ΔGDP * CAP Nigeria* | -7.067*** | -7.813*** | -7.067*** |
| | (-7.511) | (-7.442) | (-7.511) |
| *ΔGDP * CAP Uganda* | -0.656*** | -0.243 | -0.656*** |
| | (-3.565) | (-0.882) | (-3.565) |
| *ΔGDP * CAP Zambia* | -2.203*** | -2.617*** | -2.203*** |
| | (-6.069) | (-7.025) | (-6.069) |
| *Constant* | -0.032* | -0.045 | -0.038 |
| | (-1.970) | (-0.801) | (-0.938) |
| *Country effects* | NO | YES | NO |
| *Year effects* | YES | YES | YES |
| *Observations* | 353 | 353 | 353 |
| *$R^2$ - Overall* | 0.260 | 0.246 | 0.259 |
| *$R^2$ - Between* | | 0.024 | 0.103 |
| *$R^2$ - Within* | | 0.280 | 0.272 |

## 2.7 Policy implications and conclusion

### 2.7.1 Policy implications and regulatory recommendations

The findings of this chapter carry important implications for the design of macroprudential policy frameworks in highly dollarised SSA LMICs and other structurally vulnerable emerging market economies. Overall, the evidence suggests that leverage dynamics in these banking systems are driven less by conventional domestic credit cycles and more by balance-sheet adjustments linked to exchange-rate volatility, financial dollarisation, accounting valuation effects, and regulatory portfolio incentives. Consequently, macroprudential frameworks calibrated primarily around credit-to-GDP gaps and risk-weighted capital ratios may fail to adequately capture the build-up of systemic banking sector leverage.

First, the results provide strong support for adopting a binding Basel III-style leverage ratio as an active macroprudential instrument (i.e., a frontstop) rather than merely a passive regulatory backstop. The consistently positive relationship between balance-sheet expansion and book leverage confirms that leverage procyclicality in SSA LMICs is fundamentally balance-sheet driven. At the same time, the negative and significant coefficient on ΔRWATA indicates that banks actively adjust portfolio composition toward lower-risk-weight assets in order to preserve regulatory capital ratios while continuing to expand leverage. In such environments, reliance solely on risk-weighted capital measures may understate the true extent of systemic leverage accumulation, particularly where large holdings of sovereign securities and foreign-currency reserve assets attract low or zero risk weights. A leverage ratio therefore serves as a transparent and non-risk-based capital floor capable of constraining excessive balance-sheet expansion regardless of measured risk weights.

Second, the findings raise important concerns regarding the suitability of conventional countercyclical capital buffer (CCyB) calibration frameworks based primarily on the credit-to-GDP gap. The empirical insignificance of GDP growth across specifications suggests that leverage cycles in SSA LMICs are only weakly linked to domestic business-cycle fluctuations. Instead, leverage dynamics are more strongly shaped by external financial conditions, exchange-rate movements, commodity-price cycles, and cross-border balance-sheet adjustments. This implies that GDP- or credit-gap-based CCyB frameworks may provide weak or delayed signals in highly dollarised economies. Regulators should therefore consider complementing conventional CCyB indicators with measures linked to leverage growth, foreign-currency exposure, exchange-rate volatility, and balance-sheet risk concentration. More generally, the findings support the case for a broader structural macroprudential approach centred on balance-sheet resilience rather than solely on domestic credit-cycle indicators.

Third, the negative coefficient on ΔRWATA has important regulatory implications for the design of risk-weighted capital frameworks. The results suggest that banks facing regulatory constraints may expand leverage by reallocating portfolios toward lower-risk-weight assets rather than by materially reducing overall balance-sheet exposure. In SSA LMICs, this behaviour frequently manifests through increased holdings of government securities and foreign-currency reserve assets. While such reallocations may improve measured regulatory capital ratios, they can simultaneously deepen sovereign-bank linkages, reinforce financial dollarisation, and embed hidden leverage risks within the financial system. Regulators should therefore carefully reassess the calibration of risk weights assigned to sovereign exposures and foreign-currency assets, particularly in economies characterised by high exchange-rate volatility and concentrated sovereign exposures. This may include introducing positive risk weights, concentration limits, or supplementary capital overlays for foreign-currency exposures and sovereign holdings.

Fourth, the findings relating to IAS 21 valuation effects highlight the importance of incorporating exchange-rate-induced accounting dynamics into prudential supervision. Although the estimated IAS21Effect enters negatively, suggesting that FX valuation gains may temporarily strengthen equity buffers and moderate measured leverage, these effects do not necessarily imply a reduction in underlying systemic risk. Currency appreciations can mechanically compress reported leverage ratios and create additional balance-sheet capacity, thereby allowing embedded leverage and foreign-currency exposures to accumulate during boom periods. Conversely, depreciation episodes may rapidly reverse these effects, generating abrupt increases in leverage and balance-sheet fragility. Prudential authorities should therefore distinguish between improvements in capital ratios arising from genuine capital accumulation and those driven primarily by accounting revaluation effects. This may justify the use of prudential filters, stress-adjusted leverage measures, or supplementary FX-related capital buffers designed to neutralise purely valuation-driven improvements in regulatory ratios.

Fifth, the results underscore the importance of timely and forward-looking recapitalisation policies. The evidence indicates that regulatory-driven recapitalisation episodes in countries such as Zambia, Nigeria, and Ghana significantly weakened the leverage–asset elasticity, suggesting that mandatory equity injections can effectively restrain excessive balance-sheet expansion. However, these interventions were typically implemented only after financial vulnerabilities had already intensified. In practice, delayed recapitalisation measures risk reinforcing procyclicality, as banks are often required to raise capital precisely when financial conditions are weakest and external funding is least accessible. Regulators should therefore move toward more pre-emptive and rules-based recapitalisation frameworks, including graduated capital buffers linked to leverage growth, FX exposure concentrations, or systemic importance. Such approaches could reduce reliance on large capricious recapitalisations implemented during periods of crisis.

Finally, the broader conceptual and empirical findings support the argument that macroprudential frameworks in highly dollarised SSA LMICs should explicitly incorporate structural vulnerabilities associated with commodity dependence, exchange-rate volatility, and financial dollarisation. Rather than treating the leverage ratio as a passive safeguard against model risk, regulators could deploy it as a dynamic "frontstop" instrument that actively constrains excessive leverage accumulation across the financial cycle. In this regard, a time-varying or countercyclical leverage ratio – tightened during commodity-driven expansionary phases and relaxed during downturns – may offer a more effective stabilisation mechanism than conventional CCyB frameworks calibrated solely on domestic credit conditions. Such an approach would better align prudential policy with the structural characteristics of highly dollarised financial systems exposed to persistent external shocks.

### 2.7.2 Chapter conclusion

This chapter challenges the Basel III presumption that the leverage ratio should function primarily as a supplementary backstop to risk-weighted capital requirements. In highly dollarised and shock-prone SSA LMIC banking systems, the evidence suggests that the leverage ratio should instead be elevated to a binding macroprudential "frontstop" – a core regulatory instrument capable of constraining excessive leverage accumulation, mitigating exchange-rate-induced accounting valuation effects under IAS 21, and providing a transparent and credible capital anchor. Repositioned in this manner, the leverage ratio offers a pragmatic and technically robust mechanism for strengthening financial stability in structurally fragile emerging market economies.

The empirical analysis, based on a panel of 30 SSA LMICs over the period 2005–2024, demonstrates that leverage in these banking systems is strongly procyclical. However, unlike the conventional Basel III framework – which emphasises domestic credit cycles and credit-to-GDP gaps – the results show that leverage dynamics in SSA LMICs are driven primarily by balance-sheet management behaviour, exchange-rate volatility, and foreign-currency valuation effects. Leverage rises systematically with balance-sheet expansion, intensifies during periods of currency appreciation, and is further reinforced by regulatory-induced portfolio reallocations toward low-risk-weight assets. The findings also suggest that IAS 21 valuation effects and large, discretionary recapitalisation mandates can amplify leverage cycles and potentially constrain the supply of credit to the real economy.

More broadly, the results highlight important limitations of relying exclusively on risk-weighted capital regulation and conventional countercyclical capital buffers in highly dollarised financial systems. The negative relationship between leverage and changes in average portfolio risk weights indicates that banks can expand leverage by shifting toward assets carrying lower regulatory risk weights, even where underlying systemic vulnerabilities continue to build. Similarly, the weak empirical relationship between GDP growth and leverage suggests that macroprudential frameworks calibrated primarily around domestic credit conditions may provide limited traction in economies heavily exposed to external shocks, commodity-price volatility, and exchange-rate fluctuations.

Although traditional critiques of non-risk-based regulation argue that leverage constraints may induce risk-shifting behaviour, the conceptual and empirical evidence presented in this chapter suggests that a well-calibrated leverage ratio can instead exert a stabilising influence in structurally vulnerable banking systems. By anchoring capital requirements to total exposures rather than model-based or static risk weights alone, the leverage ratio helps contain mechanically driven balance-sheet expansion and enhances resilience where risk-weighted measures may be distorted by sovereign exposures, financial dollarisation, and exchange-rate movements.

Accordingly, this chapter argues that elevating the Basel III-style leverage ratio from a passive backstop to a binding and structurally calibrated macroprudential instrument (i.e., a frontstop) would provide SSA LMICs with a more effective and forward-looking framework for safeguarding financial stability. Such a shift would strengthen the transparency, simplicity, and countercyclical effectiveness of prudential regulation, repositioning the leverage ratio as a central pillar of macroprudential policy in highly dollarised and commodity-dependent economies.

# 3 DO LEVERAGE RATIO REQUIREMENTS SUBSTANTIALLY ABOVE BASEL III STANDARDS INCREASE BANK RISK-TAKING? EVIDENCE FROM A QUASI-NATURAL EXPERIMENT IN ZAMBIA

## 3.1 Introduction

The Basel III regulatory framework, introduced by the Basel Committee on Banking Supervision (BCBS) in 2010, emerged in response to the structural weaknesses exposed by the 2007–2009 Global Financial Crisis (GFC). Among the most significant deficiencies were the excessive build-up of leverage and the inadequate quality of regulatory capital within banking systems, particularly in advanced economies, despite banks continuing to report apparently strong risk-weighted capital ratios. Basel III therefore sought to strengthen financial stability by improving both the quantity and quality of regulatory capital, thereby enhancing the resilience of banks to economic and financial shocks (BCBS, 2010c, 2011, 2017). A central innovation of the framework was the introduction of a non-risk-based leverage ratio (LR), calibrated at a minimum of 3 percent of Tier 1 capital relative to total exposures, intended to serve as a credible "backstop" to risk-weighted capital requirements. The leverage ratio was specifically designed to limit regulatory arbitrage, reduce model risk, and constrain the excessive build-up of leverage during financial booms (BCBS, 2022).

Nevertheless, even after the completion of the post-GFC Basel III reform package in 2017 (BCBS, 2017), significant concerns remain regarding the adequacy of the framework, particularly the calibration of the 3 percent Tier 1 leverage ratio. Critics – including Admati et al. (2010), Admati and Hellwig (2013, 2024), and Firestone et al. (2019) – argue that the Basel III leverage ratio remains insufficiently stringent to prevent future systemic crises comparable to the GFC. More recent developments, notably the 2023 regional banking turmoil in the United States and Switzerland, including the collapse of the Basel III-compliant institution Credit Suisse, have reinforced these concerns and intensified calls by policymakers for substantially stronger capital standards (BCBS, 2023; FSI, 2023). Proponents of more robust capitalisation advocate significantly higher equity-to-assets ratios – often ranging between 10 percent and 30 percent – arguing that stronger capital buffers are necessary to improve bank solvency and constrain excessive risk-taking (e.g., Admati et al., 2010; Admati and Hellwig, 2013, 2024; Hanson et al., 2011; Goldstein, 2017; Cline, 2017).

At the same time, materially increasing leverage ratio requirements involves important theoretical and empirical trade-offs. When binding, leverage ratios may incentivise banks to shift toward higher-yielding and riskier assets, potentially increasing overall portfolio risk. Mean-variance portfolio theory, for example, suggests that flat, risk-insensitive capital requirements distort marginal capital costs across asset classes, thereby increasing the relative attractiveness of riskier investments (Kahane, 1977; Koehn and Santomero, 1980; Kim and Santomero, 1988). Recent empirical evidence on Basel III reforms remains mixed. Some studies identify risk-shifting responses following tighter leverage constraints (e.g., Kiema and Jokivuolle, 2014; Choi et al., 2020), whereas others show that binding leverage ratios – although occasionally associated with a modest increase in portfolio risk – remain linked to lower overall insolvency risk (e.g., Barth and Miller, 2018; Acosta-Smith et al., 2024), or alternatively find no increase in portfolio risk alongside reductions in leverage and insolvency risk (e.g., Fatouh et al., 2024). These divergent findings raise an important policy question: can substantially higher binding leverage ratio requirements, satisfied through genuine equity injections, increase bank risk-taking, or can they strengthen bank resilience without creating adverse incentives for excessive risk-taking?

This chapter addresses this question by exploiting Zambia's 2012 New Capital Adequacy Framework (NCF) as a Basel III-style quasi-natural experiment. Implemented in a lower-middle-income Sub-Saharan African economy, the NCF imposed substantial increases in Tier 1 equity capital requirements, particularly for foreign-owned banks, and required compliance through fresh equity recapitalisation rather than through balance-sheet contraction or deleveraging. Consequently, the reform generated a significant increase in banks' implicit leverage ratios. The minimum fixed Tier 1 equity capital requirement increased nearly ninefold for locally owned banks – from K12 million (approximately US$2.3 million) to K104 million (approximately US$20 million) – and more than fortyfold for foreign-owned banks, to K520 million (approximately US$100 million). Put differently, foreign-owned banks were subject to minimum capital requirements five times larger than those imposed on locally owned institutions. This pronounced ownership-based differentiation in regulatory treatment creates an ideal setting for a difference-in-differences (DID) empirical design.

The NCF further required Tier 1 capital to consist exclusively of common equity (CET1), thereby exceeding Basel III standards, which require only that at least 75 percent of Tier 1 capital comprise CET1 instruments. As a result, the implicit leverage ratio (equity-to-assets) of foreign-owned banks increased from 10.6 percent to 15 percent – a statistically significant increase at the 5 percent level – while the corresponding increase among locally owned banks, from 12.9 percent to 13 percent, was small and statistically insignificant. The NCF therefore closely aligned with the core Basel III objective of increasing both the quantity and quality of regulatory capital. Importantly, the implied leverage ratio of 15 percent among foreign-owned banks was effectively five times larger than Basel III's 3 percent minimum requirement. Moreover, unlike Basel III, where Tier 1 capital may include hybrid instruments, the NCF relied exclusively on CET1 capital. These features provide a strong empirical setting for identifying the causal effects of leverage ratio requirements substantially above Basel III standards on bank risk-taking and insolvency risk. In particular, the abrupt implementation of the reform, the ownership-based differentiation in treatment intensity, the sharp break from previously uniform capital standards, and the tightly enforced compliance timeline together generate plausibly exogenous variation suitable for analysing the behavioural effects of binding leverage constraints.

A growing body of literature has examined the effectiveness of Basel III reforms in strengthening bank resilience and safeguarding financial stability. Two broad strands of research have emerged. The first argues that, despite increasing capital standards and emphasising common equity, Basel III requirements remain too low to prevent crises comparable to the GFC (e.g., Admati et al., 2010; Admati and Hellwig, 2013; Goldstein, 2017; Firestone et al., 2019). The second strand shifts attention away from the calibration of capital ratios toward the mechanism of adjustment, arguing that regulators should prioritise requiring banks to raise substantial new equity capital rather than merely comply with higher ratios. From this perspective, equity-based recapitalisation more effectively fulfils Basel III's objective of improving both the quantity and quality of bank capital (Hanson et al., 2011; Greenwood et al., 2017; Goldstein, 2017; Juelsrud, 2018; Gropp et al., 2019). This study contributes directly to both strands by examining the effects of leverage ratio requirements substantially above Basel III standards and enforced through mandatory equity issuance. The analysis is situated within broader academic and policy debates concerning the credibility of Basel III minimum capital standards, particularly following the 2023 banking turmoil that emerged shortly after completion of the post-GFC reform cycle in December 2017 (BCBS, 2017).

Accordingly, the chapter advances three principal objectives: (i) to evaluate the effects of an implicit leverage ratio (equity-to-assets ratio) substantially above Basel III standards on banks' portfolio risk and insolvency risk; (ii) to assess whether flat regulatory recapitalisation mandates implemented through equity issuance generate stabilising or destabilising effects; and (iii) to provide empirical evidence from a Sub-Saharan African context that contributes to global Basel III policy debates regarding whether significantly higher leverage ratios, enforced through mandatory equity recapitalisation, can reduce excessive risk-taking and lower the probability of future banking crises. To address these objectives, the study employs a DID framework in which foreign-owned banks constitute the treatment group and locally owned banks form the control group. This empirical approach follows established quasi-natural experimental methodologies in the capital regulation literature that exploit exogenous regulatory shocks to identify causal effects (e.g., Gropp et al., 2019).

The analysis yields three principal findings. First, the reform generated substantial recapitalisation effects: foreign-owned banks subject to markedly higher capital requirements increased their Tier 1 equity-to-assets ratios by 5.9 percentage points relative to the control group ($t = 2.39$; $p < 0.05$), indicating a strong and statistically significant treatment effect. Second, the analysis finds no evidence of risk-shifting behaviour. Contrary to some theoretical predictions and recent empirical findings, treated banks did not increase their exposure to higher-risk assets, and their risk-weighted asset composition remained broadly stable following the reform. Third, insolvency risk declined significantly. The probability of insolvency fell by 0.536 percentage points – equivalent to a 13.8 percent reduction relative to the sample mean – while a one-standard-deviation increase in the implicit leverage (equity-to-assets) ratio was associated with a 0.138 standard deviation decline in insolvency risk. Collectively, these findings provide robust evidence that well-designed and credibly enforced equity-based recapitalisation can materially strengthen bank stability without deteriorating asset quality or increasing portfolio risk, consistent with the "skin-in-the-game" mechanism emphasised by Acosta-Smith et al. (2024).

This study contributes to the Basel III literature in three important respects. First, it provides rare quasi-experimental evidence on leverage ratio reforms in developing economies, particularly within low- and lower-middle-income Sub-Saharan African countries, where Basel III capital standards remain only partially implemented (World Bank, 2020). More specifically, it contributes to the growing literature questioning the adequacy of Basel III minimum capital standards, particularly critiques arguing that the 3 percent Tier 1 leverage ratio is too low to exert a meaningful disciplinary effect on bank risk-taking behaviour (e.g., Admati et al., 2010;

Admati and Hellwig, 2013, 2024; Firestone et al., 2019). By demonstrating that increases in equity-to-assets ratios from approximately 10 percent to 15 percent significantly reduce insolvency risk, the study provides empirical support for proposals advanced by Admati and Hellwig (2013, 2024) – grounded in Modigliani-Miller-type theoretical reasoning (Gambacorta and Karmakar, 2018) – calling for substantially stronger equity capital standards. Importantly, the study validates these arguments in a low-income, highly dollarised, and macro-financially volatile setting, thereby extending existing evidence beyond advanced economies.

Second, the study strengthens the policy case advanced, for example, by Hanson et al. (2011), Greenwood et al. (2017), and Gropp et al. (2019) in favour of equity-based recapitalisation as a means of preventing banks from meeting higher capital requirements through balance-sheet contraction. By explicitly mandating equity issuance rather than permitting deleveraging through asset reduction, Zambia's NCF provides a particularly clear setting for evaluating the effects of equity-driven recapitalisation. The absence of risk-shifting behaviour among treated banks supports the argument that equity-based adjustments are more stabilising and less procyclical than deleveraging-based adjustment mechanisms, especially in developing economies characterised by shallow financial markets and constrained credit intermediation.

Finally, the study offers important policy insights for regulators in Sub-Saharan Africa. Basel III implementation across the region has been slow and uneven (World Bank, 2020), reflecting data limitations, constrained supervisory capacity, and persistent macroeconomic volatility. Although stricter flat capital requirements are often criticised for potentially encouraging excessive risk-taking, the evidence presented here suggests that equity-based recapitalisation mandates combined with materially higher leverage ratios can strengthen bank resilience without inducing adverse portfolio reallocation. These findings are particularly relevant as SSA banking systems continue to converge toward international prudential standards amid emerging risks, including climate-related financial vulnerabilities and heightened geopolitical uncertainty.

The remainder of the chapter is structured as follows. Section 3.2 outlines the institutional and regulatory background to Zambia's NCF reforms. Section 3.3 reviews the relevant literature and develops the study's hypotheses. Section 3.4 describes the data, sample, and empirical methodology, while Section 3.5 presents and discusses the empirical results. Section 3.6 reports additional robustness checks, and Section 3.7 provides policy recommendations and conclusion.

## 3.2 Institutional and regulatory background to Zambia's capital adequacy reforms

This section presents stylised facts on the institutional and regulatory foundations of Zambia's capital adequacy reforms, with particular emphasis on the introduction of the 2012 New Capital Adequacy Framework (NCF) in Section 3.2.1. Section 3.2.2 subsequently evaluates the extent to which the NCF constitutes a plausibly exogenous regulatory capital shock, thereby providing a suitable quasi-experimental setting for analysing the effects of large policy-induced increases in bank capital on key banking-sector outcomes, including risk-taking behaviour and liquidity creation.

### 3.2.1 Zambia's capital adequacy regulatory reforms

The Bank of Zambia (BoZ), as the country's prudential supervisory authority, is responsible for establishing and enforcing minimum capital standards for banks and other regulated financial institutions. Zambia formally adopted risk-based capital adequacy regulations broadly aligned with the 1988 Basel Capital Accord in November 1995.[41] Under this framework, banks were required to maintain a minimum Primary (Tier 1) capital ratio of 5 percent – above the Basel benchmark of 4 percent – and a total capital ratio of 10 percent relative to risk-weighted assets (RWAs), compared with the Basel minimum requirement of 8 percent. In addition to these risk-based requirements, banks were also required to maintain a fixed minimum Primary paid-up capital of two thousand million (2 billion) kwacha. The regulatory framework therefore established a dual capital requirement structure, under which banks were required to comply with whichever threshold was more binding: (i) the fixed minimum Primary paid-up capital requirement, or (ii) the risk-based Primary (Tier 1) capital requirement calculated as 5 percent of RWAs.

Earlier banking legislation, particularly the 1971 Banking Act, relied primarily on fixed amount paid-up equity thresholds, which were set at 500,000 kwacha for state-owned banks

[41] https://www.boz.zm/StatutoryInstrumentNo.184_CapitalAdequacy.pdf.

and 2 million kwacha for private foreign-owned banks. However, persistent exchange-rate depreciation within a volatile macroeconomic environment – characterised by high inflation, macroeconomic instability, and rising financial dollarisation – substantially eroded the real value of these local-currency (i.e., kwacha) capital requirements over time. As noted by Brownbridge (1996, p. 18), the 2 million kwacha threshold introduced in 1971 declined in real terms from approximately US$3 million equivalent (i.e., in 1971) to nearly US$150,000 by 1989, necessitating an upward revision to 20 million kwacha. Despite subsequent adjustments, the real value of minimum capital requirements – particularly when measured in U.S. dollar terms – remained significantly weakened by the mid-1990s.

Meanwhile, the risk-based capital ratios introduced in 1995 remained largely unchanged until the partial adoption of Basel III standards under the Banking and Financial Services Act of 2017 (amended in 2020)[42] and the implementation of the 2025 Capital Adequacy Framework.[43] By contrast, the fixed amount minimum paid-up capital requirement was revised twice during the study sample period. First, in 2007, the BoZ increased the minimum Primary paid-up capital threshold from two thousand million (2 billion) kwacha set in 1995 to twelve thousand million (12 billion) kwacha, citing sustained exchange-rate depreciation that had reduced the real value of the earlier requirement to approximately US$0.46 million by end-2006.[44] Second, under the 2012 New Capital Adequacy Framework (NCF), the minimum capital regime was fundamentally restructured into a differentiated framework, with foreign-owned banks required to maintain minimum Primary (Tier 1) capital

[42] For further details, refer to Part VI, "Prudential Regulation and Supervision" (Sections 52–56) of the Banking and Financial Services Act of 2017, as amended in 2020. The full text of the Act and its amendment can be accessed at: [The Banking and Financial Services Act No. 7 of 2017 (https://www.boz.zm/TheBankingandFinanceActNo7of2017.pdf)] and [The Banking and Financial Services Amendment Act No. 7 of 2020 (https://www.boz.zm/TheBankingandFinancialServicesAmendActNo.7of2020.pdf)].
[43] Banking and Financial Services (Capital Adequacy) Regulations, 2025. [online] Available at: https://www.boz.zm/S.I_Number_62_of_2025_The_Banking_and_Financial_Services_Act_Capital_Adequacy_Rules.pdf [Accessed 24 December 2025].
[44]See Bank of Zambia Annual Report, 2007, p.43 on https://www.boz.zm/BOZAnnualReport2007.pdf.

of 520 billion kwacha (approximately US$100 million), while locally owned banks were required to maintain 104 billion kwacha (approximately US$20 million). This represented a substantial increase from the previous uniform minimum Primary paid-up capital requirement of 12 billion kwacha (approximately US$2.3 million) set in 2007 and applied equally across all banks. [45,46]

The NCF also introduced significantly stricter eligibility criteria for Primary (Tier 1) capital instruments. A key structural reform was the shift away from the earlier emphasis on minimum Primary paid-up capital introduced under the 1995 capital adequacy regulations toward a broader Primary (Tier 1) capital-based threshold. However, unlike the more expansive definition of primary capital under the previous framework, the NCF adopted a more restrictive and higher-quality capital definition. Specifically, all Primary (Tier 1) capital was required to consist entirely of common equity instruments, with at least 80 percent comprising paid-up common shares (nominal paid-up equity capital). The remaining 20 percent could consist of share premium, retained earnings, and other appropriated retained earnings, including general and statutory reserves. Banks were initially required to comply with the revised Primary (Tier 1) capital requirements by 31 December 2012, although the compliance deadline was subsequently extended to 31 December 2013.[47] The BoZ justified the reforms as necessary to strengthen banking-sector resilience, expand lending capacity, and enhance overall financial stability. Given the scale, asymmetry, and timing of the reform, the 2012 NCF constitutes a

[45] CB Circular No. 02/2012 (New Capital Adequacy Framework) on https://www.boz.zm/02-2012.pdf.

[46] In August 2012, the Zambian Kwacha was rebased by dividing the currency unit by 1,000, as outlined in CB Circular No. 17-2012 (accessible at: https://www.boz.zm/17-2012.pdf ), with the rebase taking effect on January 1, 2013. Therefore, from this point, all amounts mentioned in Zambian Kwacha throughout the rest of the document are presented in their rebased form, both before and after January 1, 2013.

[47] Bank of Zambia, Annual Report 2012. Page 50 [online] Available at: https://www.boz.zm/BOZANNUALREPORT2012.pdf [Accessed 20 February 2025].

plausibly exogenous regulatory shock to bank capital, risk-taking behaviour, and lending activity within Zambia's banking system.

### 3.2.2 Zambia's 2012 NCF as an exogenous regulatory capital shock

Empirically identifying the causal effects of bank capital regulation on risk-taking and bank output[48] is inherently difficult because bank capital, portfolio risk, and output decisions are jointly determined. In practice, banks simultaneously adjust capital structures, asset composition, and lending strategies in response to both regulatory incentives and prevailing macroeconomic conditions, generating significant concerns of simultaneity and reverse causality (Evans and Haq, 2022, p. 5; Acosta-Smith et al., 2024, p. 2). A central challenge in the empirical literature on bank capital regulation is therefore the identification of plausibly exogenous variation in capital requirements that allows credible causal inference regarding the behavioural effects of higher equity buffers on banks' activities (Gropp et al., 2019).

This chapter addresses this identification problem by exploiting Zambia's 2012 New Capital Adequacy Framework (NCF), which introduced a discrete shift from a uniform minimum capital regime – where all banks were subject to the same fixed monetary capital threshold – to a differentiated framework in which foreign-owned banks were subjected to substantially higher capital requirements than locally owned banks. This institutional change enhances the ability to identify the effects of new regulatory capital requirements while substantially reducing concerns relating to reverse causality. Accordingly, the chapter exploits the NCF as a plausibly exogenous regulatory intervention to evaluate the causal effects of large and abrupt policy-induced increases in bank capital on risk-taking behaviour. The institutional design and implementation of the NCF possess several characteristics that strongly support its interpretation as an exogenous capital shock and a credible quasi-natural experiment.

[48] Bank output refers to activities such as lending or liquidity creation. For further details, see page 30 of Bouwman, C.H. (2018). Creation and Regulation of Bank Liquidity.

First, the reform was introduced during a period of relative macro-financial stability rather than in response to an ongoing banking crisis or widespread financial distress. According to the Bank of Zambia's 2011 Annual Report,[49] 18 out of 19 banks in the sector already complied with the prevailing fixed minimum paid-up capital requirement of K12 million, while 17 institutions met both the risk-weighted Tier 1 and total regulatory capital ratio thresholds. At the macroeconomic level, real GDP growth stood at approximately 6.5 percent, broadly consistent with the authorities' growth objectives, and there were no clear indications of systemic banking-sector instability requiring emergency recapitalisation measures. This timing is particularly important because it distinguishes the NCF from crisis-driven regulatory interventions, such as the Basel III reforms introduced in the aftermath of the 2007-2009 Global Financial Crisis, or the 2011/2012 European Banking Authority (EBA) capital exercise, which formed part of a coordinated set of policy measures aimed at restoring confidence in the European banking sector amid the escalating sovereign debt crisis and rising concerns over banks' sovereign exposure. Consequently, the NCF reform is less likely to reflect endogenous policy responses to deteriorating bank conditions, thereby strengthening causal identification.

Second, the magnitude and asymmetric structure of the reform further reinforce its plausibly exogenous nature. The NCF increased minimum paid-up capital requirements fortyfold for foreign-owned banks – from K12 million to K520 million – while locally owned banks faced a comparatively smaller, though still substantial, increase to K104 million. These increases represented an abrupt and unprecedented escalation in regulatory capital requirements that was not directly linked to contemporaneous measures of bank risk, asset quality, profitability, or capital adequacy. Importantly, foreign-owned banks were, on average, already better capitalised and more profitable than their domestic counterparts prior to the

[49] See Bank of Zambia Annual Report, 2011, pages 1 and 40 [accessible on https://www.boz.zm/BOZANNUALREPORT2011.pdf.]

reform.[50] The disproportionate regulatory burden imposed on these institutions therefore cannot easily be explained by bank-specific fundamentals or by differential supervisory assessments of risk exposure. Instead, the policy change constituted an externally imposed regulatory shock that altered banks' capital structures independently of their prior balance-sheet conditions.

Third, the reintroduction of differentiated capital thresholds represented a major institutional and regulatory discontinuity. Under the 1994 Banking and Financial Services Act,[51] Zambia had operated a largely uniform capital regime for nearly two decades, with all banks subject to the same minimum capital standards irrespective of ownership structure. The 2012 NCF therefore marked a significant structural break by reintroducing differentiated requirements based on ownership classification. Although Zambia's earlier 1971 Banking Act[52] had imposed higher thresholds on foreign banks, these distinctions were primarily motivated by political and economic considerations rather than prudential regulatory concerns (Harvey, 1973; Beveridge, 1974). The unexpected revival of differentiated capital treatment in 2012 represented a sharp departure from the prevailing regulatory framework and was not anticipated by market participants, thereby enhancing the plausibility of treating the reform as an exogenous policy discontinuity.

Fourth, the implementation process itself further supports the identification strategy. The reform imposed a uniform compliance timeline across all institutions regardless of size, ownership structure, profitability, or underlying risk profile. Banks were therefore required to adjust capital positions within a common regulatory horizon that was externally determined by

[50] Please see page 47, Bank of Zambia's 2011 Annual Report [accessible on https://www.boz.zm/BOZANNUALREPORT2011.pdf ].

[51] Banking and Financial Services Act, 1994, Chapter 387 of the Laws of Zambia. The Banking Act (1970,1971) were repealed under Section 131 of the Banking and Financial Services Act, 1994.

[52] The Banking Act, 1971 (No. 43 of 1971). Section 18 (Minimum Capital) established the paid-up equity requirement at K500,000 for banks where the Government holds all or part of the shares, and at K2,000,000 for all other banks.

the supervisory authority rather than by market conditions. The behavioural responses observed following the reform provide additional evidence of the regulatory shock's exogeneity. In particular, several smaller foreign-owned banks attempted to seek reclassification as locally owned institutions in order to avoid the substantially higher capital requirements applicable to foreign banks, despite failing to meet the stipulated 51 percent domestic ownership threshold.[53] Such responses indicate that banks' strategic adjustments were driven primarily by the regulatory design of the NCF rather than by underlying shifts in economic fundamentals or competitive market pressures.

Taken together, the timing, magnitude, asymmetry, institutional discontinuity, and uniform enforcement of the 2012 NCF strongly support its interpretation as an exogenous regulatory capital shock. These features substantially reduce concerns relating to reverse causality and endogenous policy intervention, thereby providing a credible quasi-experimental setting for analysing the effects of large, regulatory-driven increases in bank capital on risk-taking behaviour, balance-sheet adjustment, and real-sector financial intermediation within Zambia's banking system, a lower-middle-income Sub-Saharan African economy.

[53] Refer to Bank of Zambia CB Circular No. 23/2013, dated December 30, 2013. Available at: https://www.boz.zm/232013CAPITAL.pdf.

### 3.3 Literature review and hypothesis development

#### 3.3.1 Introduction

Bank regulators aim to reduce the probability of bank failure by constraining leverage, primarily through minimum capital requirements and restrictions on the composition of banks' balance sheets (Kahane, 1977). Since the late 1980s, capital regulation has constituted the central pillar of prudential banking supervision (Shrieves and Dahl, 1992; Wall and Peterson, 1996).[54] A major turning point was the introduction of the 1988 Basel Capital Accord ("Basel I"), implemented in 1992 across G-10 countries, which established internationally harmonised minimum capital standards based on credit risk exposures (BCBS, 1987, 1988).[55] Basel I was subsequently revised in 1996 to incorporate explicit capital charges for market risk (BCBS, 1996). The underlying rationale for risk-based capital regulation is that, when risk weights are appropriately calibrated, capital requirements can more effectively limit excessive risk-taking and reduce the probability of bank insolvency (Kim and Santomero, 1988). Fundamentally, capital adequacy regulation seeks to ensure that banks maintain sufficient capital buffers to absorb unexpected losses and preserve solvency.

Basel I was later replaced by Basel II in 2004, with a comprehensive revision issued in 2006. Basel II sought to enhance the risk sensitivity of capital regulation through more refined risk-weighting methodologies and by permitting banks to use internal models to assess credit and operational risk exposures (BCBS, 2004, 2006).[56] The most recent framework, Basel III – formally titled *A Global Regulatory Framework for More Resilient Banks and Banking Systems* – was introduced in December 2010 in direct response to the 2007–2009 Global Financial

[54] On the rationale for bank regulation and capital requirements, see Dewatripont and Tirole (1994); Bhattacharya et al. (1998); and Berger, Herring, and Szegö (1995).

[55] See Goodhart, C. (2011), The Basel Committee on Banking Supervision: A History of the Early Years, 1974-1997, pp. 146-285, for an in-depth account of capital requirements from 1974 to 1997, with particular emphasis on the 1988 Basel Capital Accord and the 1996 Market Risk Amendment.

[56] See Tarullo, D.K. (2008), Banking on Basel: The Future of International Financial Regulation, pp. 87 - 223, for a comprehensive review of the Basel II framework, beginning with the release of the first consultative paper in June 1999 that initiated its development.

Crisis.[57] The crisis, which originated in the United States, revealed how excessive on- and off-balance-sheet leverage, combined with deteriorating capital quality and insufficient loss-absorbing buffers, significantly amplified systemic vulnerabilities and intensified the severity of the financial collapse (BCBS, 2010, 2011).[58]

### 3.3.2 Basel III and contemporary debates in capital regulation

The Basel III framework was introduced in response to the structural weaknesses exposed by the 2007–2009 Global Financial Crisis (GFC), particularly excessive bank leverage, inadequate loss-absorbing capital, and overreliance on internally modelled risk weights (BCBS, 2010c, 2011). A central objective of the reforms was to strengthen both the quantity and quality of regulatory capital. Accordingly, Basel III increased the minimum Common Equity Tier 1 (CET1) requirement to 4.5 percent of risk-weighted assets (RWAs), while the minimum Tier 1 capital ratio was raised from 4 percent to 6 percent, thereby enhancing banks' capacity to absorb losses under stress conditions. A major innovation of the framework was the introduction of the leverage ratio – a non-risk-based requirement mandating banks to maintain Tier 1 capital equivalent to at least 3 percent of total exposures (i.e., unweighted). Conceived as a supplementary "backstop" to risk-weighted capital regulation, the leverage ratio was intended to constrain hidden leverage accumulation, reduce excessive dependence on internal risk models, and mitigate destabilising deleveraging during periods of financial stress (BCBS, 2022).

Despite these reforms, an expanding literature questions whether Basel III capital standards are sufficiently stringent to ensure long-term financial stability. Bostandzic et al.

[57] See Olsson, C. (2022), Basel III: The Three Pillars, Capital Adequacy, Liquidity and Leverage Ratios Explained – "How Updates to the Basel Framework Since the Financial Crisis Have Strengthened the Banking System". The book provides a comprehensive overview of the evolution of the Basel regulatory framework from Basel I through to Basel III.

[58] The Basel III reforms were finalised in December 2017 and January 2019, with full implementation initially scheduled for January 1, 2023. However, the timeline for certain requirements was extended to January 1, 2028.

(2022), for example, highlight continuing uncertainty regarding the extent to which Basel III capital requirements materially reduce bank insolvency risk. Critics of the framework – including Admati et al. (2010), Admati and Hellwig (2013, 2024), Firestone et al. (2019), and Goldstein (2017) – argue that the Basel III leverage ratio remains too low to meaningfully constrain excessive leverage and risk-taking. Admati and Hellwig (2013) contend that even if Basel III had been fully implemented prior to 2007, it would likely have been insufficient to prevent the GFC. They therefore advocate substantially higher leverage requirements, proposing equity-to-assets ratios in the range of 20–30 percent. Cline (2017) estimates that such levels would correspond to approximately 36–53 percent of RWAs in the United States and euro area banking systems. Similar conclusions emerge from other simulation-based studies: Hanson et al. (2011) propose leverage requirements equivalent to roughly 15 percent of total assets; Goldstein (2017) suggests a range of 18–32 percent; while Firestone et al. (2019) estimate optimal capital levels between 13–26 percent. Survey evidence reported by Ambrocio et al. (2020) further indicates that approximately one-quarter of academics support equity-to-assets ratios within this higher range (i.e., 20–30 percent).

At the same time, other scholars caution that excessively high equity requirements may generate unintended economic costs. Calomiris and Herring (2013), Baker and Wurgler (2015), and Cline (2017), for example, argue that very high equity-to-assets ratios could increase banks' cost of capital, constrain credit growth, and weaken support for the real economy. Jones (2020) similarly emphasises the need to balance financial stability objectives (e.g., leverage requirements) with banks' intermediation role. Empirical evidence broadly supports these concerns, with several studies associating higher capital requirements with lower credit supply and increased lending costs (e.g., Fang et al., 2022; De Jonghe et al., 2020; De Nicolò, 2019; Rahman et al., 2018; Naceur et al., 2018; Bridges et al., 2014; Berrospide and Edge, 2011; Cosimano and Hakura, 2011).

These debates among both academics and policymakers have intensified following the 2023 regional banking turmoil in the United States and Europe, including the failure of the Basel III-compliant institution Credit Suisse.[59] For critics such as Admati and Hellwig (2013, 2024), these events reinforce concerns regarding the inadequacy of existing capital standards, particularly the reliance on Additional Tier 1 (AT1) instruments as part of regulatory capital buffers. They argue that significantly stronger common equity buffers remain necessary to enhance resilience and reduce systemic fragility. More broadly, they advocate phased and mandatory equity-raising programmes, maintaining that well-capitalised banks are less vulnerable to crises, allocate credit more prudently, and can continue performing maturity transformation without destabilising the financial system. Importantly, Basel III represented a major departure from Basel II by placing greater emphasis on the quality – not merely the quantity – of regulatory capital (Jones and Zeitz, 2017).

Nevertheless, the manner in which banks adjust to higher capital requirements remains an important policy concern. In practice, regulators typically tighten minimum capital ratios with the objective of promoting deleveraging and strengthening banking-sector resilience. Implicit in this approach is the expectation that banks will comply by raising additional equity capital. Put differently, the preferred adjustment mechanism is what Blundell-Wignall and Atkinson (2012) describe as "good deleveraging," whereby banks strengthen capital positions through retained earnings, reduced dividend distributions, lower bonus payments, or new equity issuance, rather than through balance-sheet contraction – particularly reductions in lending activity, or "bad deleveraging."

[59] For instance, see: François Villeroy de Galhau, "Banking Turmoil - Three Blessings and a Funeral", Speech at the Eurofi High-level Seminar 2023, Stockholm, 28 April 2023, [Accessed at: https://www.bis.org/review/r230502b.htm]; Report on the 2023 banking turmoil. The Basel Committee on Banking Supervision, [Accessed at: https://www.bis.org/bcbs/publ/d555.htm]; Rodrigo Coelho, Jatin Taneja, and Rastko Vrbaski, "When AT1 Instruments Absorb Losses Before Equity", Financial Stability Institute, September 2023 [Accessed at: https://www.bis.org/fsi/fsibriefs21.htm].

In theory, however, banks are often reluctant to issue new equity because of its relatively high cost and the adverse signals it may transmit to financial markets (e.g., Myers and Majluf, 1984). Under conditions of asymmetric information, equity issuance may be interpreted as a "lemons problem," whereby outside investors undervalue newly issued shares, leading to dilution of existing shareholders' claims. Anticipating these effects, bank managers and shareholders generally resist equity issuance unless compelled to do so by regulation or market pressure (e.g., Admati et al., 2018; Adrian and Shin, 2011; Dahl and Shrieves, 1990; Wall and Peterson, 1996). Consistent with this reasoning, empirical evidence indicates that banks frequently respond to tighter capital requirements by reducing risky assets – particularly credit exposures – rather than by issuing new equity, especially during economic downturns (Aiyar et al., 2015). Such adjustment behaviour can reinforce procyclicality and amplify economic contractions. Aiyar et al. (2015) therefore argue that requiring banks to raise fixed amounts of equity capital, rather than merely comply with ratio-based targets, could help mitigate these adverse adjustment dynamics, although they acknowledge that such an approach may amount to micromanaging banks and therefore extend beyond the conventional scope of prudential capital regulation.

These concerns have contributed to a growing body of literature advocating equity-focused recapitalisation strategies centred on mandatory equity injections rather than purely ratio-based capital targets (e.g., Hanson et al., 2011; Greenwood et al., 2017; Goldstein, 2017; Juelsrud, 2018; Gropp et al., 2019). Proponents argue that ratio-based capital frameworks may encourage banks to satisfy regulatory thresholds through balance-sheet contraction rather than through genuine capital strengthening. In such circumstances, a bank may achieve the required capital ratio by reducing total assets without materially lowering the underlying riskiness of its portfolio.[60] In some cases, this adjustment process may even prove counterproductive by increasing the bank's overall risk exposure. A classic example is a bank improving its regulatory capital ratio by shrinking its balance sheet while simultaneously reallocating toward riskier, higher-yielding assets (Ediz et al., 1998). The European Banking Authority (EBA)'s 2011/2012 capital exercise provides a prominent illustration of these limitations. Implemented during the European sovereign debt crisis, the exercise sought to raise Core Tier 1 capital ratios from 5 percent to 9 percent. Although policymakers intended banks to achieve compliance primarily through equity raising (Barth et al., 2012; Lane, 2012), many institutions instead adjusted by reducing risk-weighted assets (RWAs). Exploiting the EBA capital exercise as a quasi-natural experiment, Gropp et al. (2019) show that banks relied predominantly on asset-side adjustments – particularly reductions in RWAs – rather than new capital issuance, thereby weakening the effectiveness of the reform. Similarly, Juelsrud (2018), also using the EBA exercise as a quasi-experimental setting, documents an increase in systemic risk following the intervention. Bostandzic et al. (2022) further report a divergence between regulatory and market-based indicators of bank stability: while regulatory solvency ratios improved, market-based measures of financial soundness deteriorated.

[60] This is the essence of a risk-based approach to the design and implementation of regulation and can help to ensure that regulatory approaches are efficient, effective and account for risk/risk trade-offs across policy objectives (OECD 2010. Risk and Regulatory Policy.)

### 3.3.3 Theoretical framework

#### 3.3.3.1 Introduction

The theoretical foundation for discussions of capital regulation originates from Modigliani and Miller's (1958) Proposition I, which posits that under perfect capital market conditions – characterised by complete information, the absence of taxes, and no transaction or bankruptcy costs – a firm's capital structure is irrelevant to its overall value (Berger et al., 1995, pp. 393–394). In such an environment, firm value depends solely on the cash flows generated by underlying assets rather than on the specific mix of debt and equity financing. Put differently, decisions regarding balance-sheet size and investment allocation can be separated from financing decisions concerning whether projects are funded through debt or equity (Adrian and Shin, 2011, p. 290).

Applied to banking, the Modigliani–Miller irrelevance proposition implies that capital requirements – which directly influence bank leverage – would be neutral and costless in the absence of market frictions (Admati et al., 2013, p. 5 and footnote 9). Under these assumptions, and abstracting from bankruptcy costs, banks would be indifferent to both their capital structures and portfolio composition (Rochet, 1992, pp. 1142–1143). Consequently, leverage choices would have no meaningful implications for profitability, lending behaviour, operating decisions, social welfare, or the pricing and quantity of credit supplied to the economy (e.g., Dagher et al., 2020; De Jonghe et al., 2020; Martynova, 2015). In a frictionless world, there would therefore be little economic justification for imposing minimum capital requirements (Rochet, 1992, p. 1138).

However, once real-world frictions are introduced – including taxes, bankruptcy costs, transaction costs, and asymmetric information – capital structure becomes economically relevant (Dagher et al., 2020; De Jonghe et al., 2020; Martynova, 2015; Francis and Osborne, 2012; Milne, 2002; Santos, 2001). In the banking sector, additional distortions arise from deposit insurance arrangements and the fact that bank liabilities are largely held by small, relatively uninformed depositors (Santos, 2001). Rochet's (1992, pp. 1142–1143) theoretical model demonstrates that if depositors were fully informed about banks' activities and underlying risk exposures, deposit insurance would be unnecessary and capital regulation largely redundant. Similarly, Bhattacharya et al. (1998, p. 757) justify capital requirements as a mechanism for mitigating the moral hazard associated with deposit insurance, which itself arises because information asymmetries make banking systems vulnerable to destabilising bank runs. In practice, however, depositors are imperfectly informed, making prudential regulation economically relevant. Importantly, Rochet (1992) further argues that under Modigliani–Miller conditions, capital requirements alone may still be inefficient because banks may respond by shifting toward riskier asset portfolios. He therefore suggests that actuarially fair deposit insurance could, in principle, restore neutrality and eliminate the need for capital regulation. In reality, however, the presence of information asymmetries and other financial frictions invalidates the neutrality proposition of Modigliani and Miller and provides the fundamental economic rationale for bank capital regulation (Berger et al., 1995, pp. 397–400).

**3.3.3.2 Theories on bank regulation**

Bank regulation represents a form of government intervention designed to address market failures arising primarily from two sources: asymmetric information and externalities (Berger et al., 1995). Akerlof (1978) highlights how asymmetric information – where buyers and sellers possess unequal access to information, particularly in markets characterised by varying product quality – can generate inefficient outcomes and, in extreme cases, market collapse. In financial markets, these informational frictions are especially pronounced because financial institutions often face difficulties in accurately assessing borrowers' creditworthiness and effectively monitoring their actions over time (Dell'Ariccia, 2001).

Asymmetric information gives rise to two related problems: moral hazard and adverse selection (Guesnerie et al., 1989). Moral hazard arises when an agent undertakes actions that are unobservable to the principal and that benefit the agent at the principal's expense, whereas adverse selection occurs when one party possesses superior information that impairs the ability of the other party to make fully informed decisions (Darrough and Stoughton, 1986). Theories of bank regulation grounded in asymmetric information largely focus on mitigating moral hazard problems (Stolz, 2002; VanHoose, 2007). Diamond and Rajan (2000, 2001), for example, analyse moral hazard on the liability side of banks' balance sheets, particularly in relation to bank runs, while Diamond (1984, 1991) focuses on the asset side, emphasising the role of delegated loan monitoring in controlling borrower moral hazard. Similarly, Campbell et al. (1992) develop a representative-bank framework highlighting banks' central role in monitoring and controlling moral hazard, arguing that depositors – or their agents, such as deposit insurers – either directly monitor banks or impose capital requirements as a disciplining mechanism. Santos (1999) further identifies two simultaneous sources of moral hazard: one arising from the relationship between banks and deposit insurers, and another embedded in the borrower–bank relationship. Although much of the literature concentrates on moral hazard, adverse selection also occupies an important place in theories of bank regulation. Morrison and White (2005) and Thakor (1996), for instance, examine how regulators and deposit insurers mitigate adverse selection through the screening of banking licence applicants and the design of optimal capital requirements.

Externalities constitute a second major rationale for bank regulation because of their contribution to systemic risk within financial systems (Berger et al., 1995). Externalities arise when the actions of one economic agent affect the welfare of others beyond the immediate parties involved in the transaction (Randall, 1983). In banking systems, the failure of one or more systemically important institutions – or even a large number of smaller banks – can generate widespread financial instability and contagion effects. As Berger et al. (1995) observe, incomplete public information regarding banks' financial conditions further amplifies these risks by making it difficult for market participants to distinguish isolated institutional failures from broader systemic distress, thereby threatening confidence and stability across the financial system as a whole.

#### 3.3.3.3 Theories linking minimum capital requirements to bank capital structure

Minimum capital requirements influence how banks finance their balance sheets by constraining the relative mix of debt and equity within their capital structures (Admati et al., 2013). Their primary objective is to reduce insolvency risk by ensuring that banks maintain sufficient equity buffers to absorb losses, while also mitigating incentive distortions arising from market imperfections and financial frictions (Gambacorta and Karmakar, 2018, p. 156). In practice, however, banks are often reluctant to issue new equity because of its relatively high cost and the adverse market signals associated with equity issuance, as highlighted in the asymmetric information framework of Myers and Majluf (1984). Nevertheless, failure to comply with regulatory capital requirements can impose substantial costs on banks, effectively forcing institutions to choose between costly recapitalisation and potentially value-destructive liquidation of a bank (Milne and Whalley, 2001).

When regulators require banks to increase equity capital without imposing immediate compliance deadlines, banks' adjustment behaviour is generally consistent with the pecking order theory of corporate finance (Myers, 1984; Myers and Majluf, 1984). Under this framework, banks preferentially rely on internally generated funds, followed by debt financing, while treating external equity issuance as a last resort. Consequently, retained earnings typically constitute the preferred mechanism through which banks satisfy higher capital requirements (Admati et al., 2013; Mehran and Thakor, 2011). More profitable banks are generally able to accumulate equity internally through earnings retention, whereas less profitable institutions may resort to rights issues or external capital raising when retained earnings prove insufficient.

Retained earnings therefore play a central role in bank recapitalisation dynamics. Modigliani and Miller (1958) treat retained earnings as economically equivalent to a fully subscribed common equity issuance, provided management acts in shareholders' best interests.

Similarly, Dahl and Shrieves (1990) emphasise the gradual and continuous contribution of retained earnings to bank capital accumulation, in contrast to the infrequent and larger adjustments associated with external equity injections. However, reliance on retained earnings also has important risk implications. Wall and Peterson (1996) argue that efficiently managed banks – already operating at profit-maximising risk levels – may only be able to increase retained earnings by reducing dividend payouts or by assuming additional risk. For this reason, Kashyap et al. (2010) emphasise the importance of gradually phasing in higher capital requirements, thereby allowing banks sufficient time to build equity buffers internally and avoid destabilising balance-sheet adjustments.

#### 3.3.3.4 Theories linking capital regulation to banks' risk-taking behaviour

A broad range of theoretical frameworks has been developed to explain the relationship between capital regulation and banks' risk-taking behaviour, with much of the literature centring on the moral hazard problem (see Stolz, 2002; VanHoose, 2007). The moral hazard perspective argues that higher equity capital reduces banks' incentives to engage in excessive risk-taking because shareholders directly bear losses when core capital buffers are depleted (World Bank, 2020). By requiring banks to place a larger share of their own funds at risk – commonly referred to as increasing "skin in the game"– capital regulation compels shareholders and managers to internalise the costs associated with excessive risk-taking (Hellmann et al., 2000).The franchise value, or charter value, theory extends this argument by emphasising that excessive risk-taking threatens not only shareholders' existing equity but also the future stream of profits derived from continued banking operations. Since bank failure destroys this franchise value, shareholders in profitable institutions with substantial equity stakes have stronger incentives to avoid excessive risk exposure (Honohan and Stiglitz, 2001; Jokipii and Milne, 2011).

Both perspectives underscore the central role of regulatory authorities in shaping banks' incentives and behaviour. Regulators may require undercapitalised banks to raise additional equity or, alternatively, exit the market, with exit implying the loss of franchise value even where creditors are ultimately repaid from the remaining asset portfolio (Gorton and Winton, 2017). More generally, supervisory authorities may intervene by compelling banks to issue new equity, restricting dividend distributions and executive compensation, or, in extreme cases, closing institutions considered financially unsound (Buser et al., 1981). Consequently, minimum capital requirements impose binding regulatory constraints and potential penalties that materially influence banks' capital management decisions and risk-taking incentives.

**3.3.3.4.1 Moral hazard**

Within the conventional banking framework, capital regulation is primarily justified as a mechanism for mitigating the moral hazard problem arising from limited shareholder liability and the existence of explicit or implicit depositor guarantees (e.g., Bhattacharya et al., 1998). This institutional arrangement creates an asymmetry whereby shareholders capture the upside gains from risky activities while being partially insulated from downside losses (Milne and Whalley, 2001). Consequently, banks may have incentives to increase the variance of portfolio returns beyond levels that would prevail in an uninsured banking environment. The underlying rationale for capital requirements is that when banks are required to finance a larger share of their balance sheets with their own equity, the "capital-at-risk" effect strengthens market discipline. In this setting, equity serves as a buffer that absorbs part of the downside losses associated with risky investments (Hellmann et al., 2000). Adequate equity capital therefore increases banks' incentives to select more prudent asset portfolios in equilibrium.

From this perspective, regulatory capital requirements constrain excessive risk-taking and reduce the probability of bank failure, provided that such requirements are binding – that is, set above the level of capital banks would voluntarily choose to hold in the absence of regulation (Milne and Whalley, 2001). Milne and Whalley (2001) further identify two distinct channels through which moral hazard may emerge in a dynamic setting with endogenous capital adjustment. First, a solvent but financially stressed bank may experience significant cash-flow deterioration yet avoid recapitalisation because of the high costs associated with issuing new equity (Myers and Majluf, 1984), unless compelled to recapitalise through regulatory intervention. In such circumstances, the bank may instead adopt riskier investment strategies to avoid immediate shareholder dilution. Second, an insolvent bank with little remaining franchise value and minimal residual equity at stake may seek to maximise the value of the regulatory safety net by aggressively shifting into high-risk asset portfolios.

**3.3.3.4.2 Franchise value**

Franchise value refers to the present discounted value of a bank's expected future profit stream, which is preserved only while the institution remains a going concern (Demsetz et al., 1996; Hellmann et al., 2000). Because this value is destroyed in the event of liquidation, it acts as a disciplining mechanism that moderates incentives for excessive risk-taking (Milne and Whalley, 2001). Within the banking literature, franchise value is often used interchangeably with charter value (Marcus, 1984; Stolz, 2002; Jokipii and Milne, 2011). The concept reflects not only the regulatory licence required to operate a bank (e.g., Buser et al., 1981), but also structural features such as barriers to entry, market power, operational efficiency, and the value of established lending relationships (e.g., Demsetz et al., 1996). When franchise value is high, banks have stronger incentives to preserve solvency and maintain adequate capital buffers in order to protect this stream of future earnings; conversely, when franchise value is low, these incentives weaken substantially (Milne and Whalley, 2001).

Marcus (1984) demonstrates that charter value – arising from entry restrictions and preferential access to funding or lending opportunities – can influence banks toward either relatively conservative or highly risky strategies, with intermediate strategies proving less optimal. In this framework, additional capital initially increases bank value by protecting the franchise against insolvency risk. However, beyond a certain point, further increases in capital contribute only marginally to reducing default risk. Importantly, declines in franchise value make riskier strategies relatively more attractive, thereby reinforcing the importance of franchise value as a mechanism for limiting moral hazard. Empirical evidence supports this view. Demsetz et al. (1996), for example, find that banks with higher franchise values tend to hold larger capital buffers, assume lower portfolio risk, and exhibit greater overall stability. Since such banks have more to lose in the event of insolvency, franchise value helps align shareholder incentives with prudential regulatory objectives. Banks capable of generating sustained profits therefore have stronger incentives to protect their franchise value by restraining excessive risk-taking behaviour.

Building on these insights, Milne and Whalley (2001) and Milne (2002) model bank capital as an endogenous response to regulatory incentives. Their framework predicts that banks with positive franchise value maintain higher levels of capitalisation because expected future earnings provide an important first line of defence against adverse shocks. By contrast, banks with very low franchise value have weaker incentives to hold capital and are consequently more vulnerable to distress and failure. Interestingly, the model suggests that even moderate levels of franchise value may be sufficient to induce banks to maintain substantial capital buffers, whereas extremely high franchise values may reduce the marginal incentive for further capital accumulation. Only when franchise value becomes exceptionally low does the incentive to preserve it collapse, encouraging banks to exploit moral hazard opportunities despite the presence of prudential regulation.

**3.3.3.4.3 Regulatory costs**

Capital regulation is fundamentally motivated by the concern that banks may choose to operate with lower levels of capital than are socially optimal relative to their underlying risk exposures, because the broader systemic costs associated with bank distress and failure are not fully internalised in private capital decisions (Rime, 2001). In the absence of regulation, banks may therefore have incentives to operate with excessively high leverage and engage in greater risk-taking, particularly where deposit insurance arrangements, limited liability, or expectations of government support weaken market discipline (e.g., Shrieves and Dahl, 1992; Rochet, 1992; Bhattacharya et al., 1998). As banks operate closer to, or below, regulatory minimum capital thresholds, they become subject to increasingly stringent supervisory scrutiny and intervention, which in turn generates higher regulatory and market-related costs (Jeitschko and Jeung, 2007). These costs extend beyond direct financial penalties and encompass a broader set of operational and reputational consequences. For example, financially constrained banks may be forced to divert substantial management time and organisational resources toward negotiations with regulators and the implementation of corrective supervisory measures.

In addition, emergency recapitalisation efforts may dilute existing shareholders' claims, while weakening capital positions can undermine market confidence and reduce creditworthiness, thereby increasing funding costs as banks approach minimum regulatory thresholds (Milne and Whalley, 2001). Importantly, the prospect of these regulatory, financial, and reputational costs creates incentives for banks to maintain capital buffers above the minimum required levels. Milne and Whalley (2001) and Milne (2002) therefore argue that banks optimally hold precautionary capital buffers in order to reduce the probability of breaching regulatory requirements and to avoid the substantial costs associated with supervisory intervention, constrained market access, and potential financial distress. In this sense, capital buffers serve not only as loss-absorbing cushions but also as strategic safeguards against the escalating regulatory and market pressures that emerge when banks become undercapitalised.

### 3.3.4 Empirical studies

Empirical evidence on the effects of Basel III capital reforms on bank risk-taking and financial stability remains mixed, reflecting differences in regulatory design, implementation frameworks, institutional environments, and the channels through which banks adjust to tighter capital requirements. Given the central objective of this chapter – to assess whether leverage ratio requirements substantially above Basel III standards increase bank risk using Zambia's 2012 recapitalisation reforms as a quasi-natural experiment – this literature is particularly important in clarifying whether stronger capital requirements stabilise banks or instead generate unintended incentives for risk-taking and balance-sheet adjustment.

A substantial strand of the Basel III literature suggests that tighter risk-weighted capital requirements do not necessarily reduce bank risk unambiguously. Dias (2021), for example, finds that stricter capital regulation may induce greater risk-taking irrespective of banks' initial capital positions. Similarly, Beccalli et al. (2018) find that higher capital requirements may contribute to greater systemic risk, while Nguyen et al. (2019) report evidence consistent with rising default probabilities following the tightening of regulatory capital standards. Nguyen et al. (2019) further provide more nuanced evidence, documenting reductions in bank capital without significant corresponding changes in measured risk, thereby suggesting that the relationship between capital regulation and bank risk-taking may be non-linear and contingent on institutional and macro-financial conditions. Other studies, however, document stabilising effects. Ashraf et al. (2016) and Adesina and Mwamba (2016) find that stronger capital requirements reduce portfolio risk, while Chalermchatvichien et al. (2014) report declines in bank risk-taking behaviour.

By contrast, empirical studies examining the Basel III leverage ratio – a non-risk-weighted capital constraint – tend to provide more consistent evidence regarding its stabilising role. A growing body of literature suggests that leverage ratio requirements enhance bank resilience and reduce systemic vulnerabilities without materially encouraging excessive risk-taking (Barth and Miller, 2018; Choi et al., 2020; Acosta-Smith et al., 2024; Fatouh et al., 2024). Barth and Miller (2018), for instance, evaluate the macroprudential effects of leverage ratio requirements ranging from 4 percent to 15 percent and find that the marginal benefits of higher leverage thresholds, in terms of reducing the probability of financial crises, consistently exceed the associated marginal costs, including potential reductions in credit supply arising from higher funding costs. Their findings support the view that stronger leverage requirements constitute an effective macroprudential instrument for constraining systemic risk.

The literature nevertheless recognises potential concerns regarding risk-shifting under binding non-risk-based capital constraints. Choi et al. (2020), exploiting the Supplementary Leverage Ratio (SLR) imposed on U.S. global systemically important banks as a natural experiment, investigate whether leverage-constrained banks rebalanced portfolios toward riskier assets in order to preserve returns. Their results provide mixed evidence. While certain risk indicators, such as default probabilities, increased modestly among SLR-constrained banks, other measures remained unchanged or declined. Overall, the evidence points to limited portfolio reallocation toward higher-yield assets, suggesting only modest incentives for risk-shifting under binding leverage constraints. Acosta-Smith et al. (2024) provide a broader assessment using a panel of 655 European Union banks over the period 2005–2014. Their analysis tests two central hypotheses: first, whether a binding leverage ratio induces increases in portfolio risk among initially constrained banks; and second, whether leverage ratio requirements reduce the probability of bank distress. Their findings support both propositions. Although banks subject to binding leverage constraints modestly increased average portfolio risk weights following the 2009 regulatory announcement, the stabilising effects associated with higher capital buffers dominated the increase in risk-taking. Simulation results indicate that stronger leverage-based capital requirements substantially reduce the likelihood of financial distress, reinforcing the leverage ratio's role as an effective complement to risk-weighted capital regulation.

Fatouh et al. (2024) reach similar conclusions in the United Kingdom context using a difference-in-differences framework comparing leverage-ratio-constrained banks with a matched control group over 2016–2020. Contrary to concerns that binding leverage requirements encourage riskier portfolio allocation, the study finds that leverage-constrained banks marginally reduced average portfolio risk weights and increased leverage ratios by approximately 6.2 basis points, implying lower effective leverage and reduced insolvency risk. Market-based indicators corroborate these improvements: credit default swap (CDS) spreads on five-year subordinated debt declined significantly among leverage-ratio-constrained banks, indicating stronger market confidence in bank solvency. Their findings challenge the argument that binding leverage constraints necessarily induce destabilising risk-taking behaviour, instead suggesting that well-designed leverage regulation can moderate excessive balance-sheet expansion while strengthening financial stability.

Overall, the empirical literature suggests that the effects of Basel III risk-weighted capital reforms on bank risk-taking remain contested and highly context-dependent, reflecting differences in regulatory implementation, institutional structures, and banks' adjustment strategies. In contrast, evidence relating to the leverage ratio appears comparatively more consistent across jurisdictions and empirical settings. Although some studies identify limited risk-shifting incentives under binding leverage constraints, the broader evidence indicates that leverage ratio requirements are generally associated with improved solvency, enhanced resilience, and lower systemic risk. Collectively, these findings lend important support to the argument advanced in this chapter that stronger leverage-based capital requirements can function as effective micro- and macroprudential tools for enhancing banks' safety and soundness and strengthening financial stability, particularly in structurally vulnerable and highly dollarised banking systems.

### 3.3.5 Research question and hypothesis development

Since its introduction in December 2010, the Basel III framework has generated extensive debate among policymakers and academics regarding the effectiveness of its post-GFC reforms. Two broad strands of literature on minimum capital regulation have emerged. The first argues that, despite Basel III's emphasis on higher-quality common equity capital, the prescribed capital thresholds remain insufficient to prevent crises comparable to the GFC (e.g., Admati et al., 2010; Admati and Hellwig, 2013; Goldstein, 2017; Firestone et al., 2019). The second strand focuses on the implementation of capital regulation, arguing that regulators should place greater emphasis on requiring banks to raise actual amounts of new equity, rather than relying predominantly on ratio-based targets. Proponents contend that this approach more effectively advances Basel III's objective of strengthening both the quantity and quality of bank capital (Hanson et al., 2011; Greenwood et al., 2017; Goldstein, 2017; Juelsrud, 2018; Gropp et al., 2019).

In Sub-Saharan Africa (SSA), where Basel III adoption remains relatively limited (World Bank, 2020), regulatory authorities may have greater scope to implement more stringent equity-based capital frameworks tailored to structurally fragile and shock-prone financial systems. This chapter contributes to the literature by integrating these two strands of post-Basel III debate within the SSA context. Specifically, it examines the implications of imposing leverage ratio requirements substantially above Basel III standards, combined with mandatory equity injections, against the backdrop of the 2023 banking turmoil in the United States and Switzerland, which occurred shortly after the completion of the major post-GFC Basel III reforms (i.e., 2017/2019).

#### 3.3.5.1 Hypotheses

Accordingly, the chapter addresses the following central question: What are the effects of stringent leverage ratio requirements with compulsory equity raising on banks' portfolio risk and insolvency risk in SSA banking systems? More specifically, do such regulatory measures strengthen financial stability by reducing bank risk, or do they instead create incentives for greater risk-taking and heightened financial fragility? To address these questions, we formulate four testable hypotheses grounded in the theoretical relationship between bank capital, portfolio risk, and the probability of insolvency (e.g., Koehn and Santomero, 1980).

##### 3.3.5.1.1 Higher equity capital and portfolio risk: Competing hypotheses

The 2012 New Capital Adequacy Framework (NCF), which imposed substantially higher minimum equity capital requirements differentiated by ownership structure but uniformly applied across banks irrespective of size, may generate ambiguous effects on banks' risk-taking behaviour. In particular, a regulatory-driven increase in equity relative to total assets (i.e., an implicit leverage ratio) may either intensify or restrain portfolio risk-taking, depending on how banks respond to tighter leverage constraints (Wall and Peterson, 1996, p. 7). This theoretical ambiguity provides a compelling motivation for empirical analysis. Under the NCF, minimum Tier 1 capital thresholds increased sharply from a uniform K12 million (approximately US$2.5 million) applicable to all banks to K520 million (approximately US$100 million) for foreign-owned banks and K104 million (approximately US$20 million) for locally owned banks. The behavioural response of foreign-owned banks to these substantially higher capital requirements, set at levels approximately five times greater than those imposed on locally owned banks, is likely to differ across institutions depending on bank size, market positioning, and strategic incentives (e.g., De Haan, 2012).

For larger banks, higher equity requirements may create incentives to shift toward riskier and higher-yielding portfolios in order to preserve target returns on equity. Rather than indiscriminately expanding lending volumes, such banks may concentrate exposures within established blue-chip clientele and larger corporate borrowers, leveraging informational advantages and long-standing lending relationships. Provided that regulatory constraints remain within acceptable thresholds (e.g., large exposure limits), these banks may continue expanding their loan portfolios. By contrast, smaller or newly established foreign-owned banks, given the substantial increase in minimum capital requirements, may face stronger pressures to expand their balance sheets aggressively in order to justify the significantly higher equity levels. In attempting to achieve target profitability, these institutions may increase exposure to riskier borrowers, including SMEs and relatively unseasoned clients, potentially weakening asset quality. Such incentives may be further amplified by newly established foreign banks' limited familiarity with local credit markets (Kanga et al., 2021), weaker franchise value, and less developed credit-risk assessment capabilities, particularly in environments characterised by limited historical default data.

Building on the mean–variance framework, Shrieves and Dahl (1992) argue that higher capital requirements may unintentionally encourage risk-taking by making leverage and asset risk partial substitutes. In this setting, banks facing involuntary reductions in leverage due to regulatory-induced increases in equity may compensate by increasing portfolio risk in order to maintain target overall returns and risk profiles. This reasoning aligns with the regulatory hypothesis advanced by Shrieves and Dahl (1992), who argue that regulation alters the implicit costs of capital and risk, thereby generating a positive relationship between changes in bank capital and portfolio risk. Kashyap et al. (2010) therefore advocate gradual implementation of capital reforms, allowing banks sufficient time to accumulate equity through retained earnings and thereby reducing incentives for destabilising balance-sheet adjustments. These arguments give rise to the following risk-shifting hypothesis (e.g., Acosta-Smith et al., 2024; Choi et al., 2020; Barth and Miller, 2018; Kiema and Jokivuolle, 2014):

***H1a:*** *Imposing significantly higher equity requirements relative to banks' total assets (i.e., an implicit leverage ratio) that substantially exceed Basel III standards, both in terms of capital quality and quantity, induces risk-shifting toward higher-credit-risk assets.*

A competing hypothesis, however, suggests that substantially higher equity capital requirements may instead reduce banks' incentives to take excessive risk. As equity buffers increase, shareholders internalise a larger share of potential downside losses, thereby strengthening incentives for more prudent risk management. This view is supported by two related theoretical perspectives. The first is the moral hazard hypothesis, which argues that stronger capital requirements mitigate excessive risk-taking by aligning shareholders' incentives with financial stability objectives (Hellmann et al., 2000; Milne and Whalley, 2001). The second is the franchise value hypothesis, which posits that well-capitalised banks behave more conservatively in order to preserve valuable future profit streams and charter value (Honohan and Stiglitz, 2001; Jokipii and Milne, 2011).

In practice, banks responding to abrupt regulatory-induced equity increases may initially allocate resources toward safer and more liquid assets, such as government securities and foreign currency reserves, rather than expanding risky loan portfolios. Such behaviour may reflect both a desire to avoid mispricing unfamiliar credit risk and incentives to minimise the probability of regulatory sanctions that could threaten franchise value (Buser et al., 1981; Marcus, 1984). In Zambia, income from government securities and foreign exchange activities constitutes an important share of bank earnings,[61] reducing the relative attractiveness of higher-

[61] For instance, during 2024, interest income from government securities represented the second-largest source of operating income, with interest income from loans and advances ranking first, though only marginally higher. Additionally, foreign exchange income accounted for the third-largest share of total operating income (see Bank of Zambia Annual Report, 2024, p. 48, available at https://www.boz.zm/Bank_of_Zambia_2024_Annual_Report.pdf).

risk lending activities. Consistent with Fatouh et al. (2024), if risk-adjusted returns on sovereign or low-risk assets equal or exceed those on private lending, banks may rationally prefer safer portfolio allocations, thereby limiting incentives for risk-shifting. Moreover, tighter capital requirements may induce credit rationing behaviour, with banks rejecting even positive net present value lending opportunities in order to preserve capital buffers (Wall and Peterson, 1996, p. 10). Similarly, Thakor's (1996) equilibrium model demonstrates that stricter capital requirements can increase funding costs and raise the likelihood of loan denials and overall credit contraction. These considerations motivate an alternative hypothesis (**H1b**), namely that substantially higher equity capital requirements do not induce banks to shift toward riskier assets and may instead encourage more conservative portfolio allocation strategies (e.g., Adesina and Mwamba, 2016; Fatouh et al., 2024). Formally, the hypothesis can be stated as follows:

> ***H1b****: Imposing significantly higher equity requirements relative to banks' total assets (i.e., an implicit leverage ratio) that substantially exceed Basel III standards, both in terms of capital quality and quantity, does not induce risk-shifting toward higher-credit-risk assets and may instead contribute to lower portfolio risk.*

#### 3.3.5.1.2 Higher equity capital and insolvency risk: Contrasting hypotheses

Recent theoretical contributions by Acosta-Smith et al. (2024) and Fatouh et al. (2024) examine bank behaviour under the dual regulatory structure embedded in Basel III, where banks are simultaneously subject to leverage ratio (LR) and risk-weighted ratio (RWR) capital requirements. Within this framework, the binding regulatory constraint may shift between the LR and the RWR depending on a bank's balance-sheet composition, leverage position, and portfolio risk profile. Acosta-Smith et al. (2024) argue that when equity capital is costly, a binding LR may incentivise banks to increase portfolio risk by substituting asset risk for constrained leverage. In this setting, the risk-shifting hypothesis (**H1a**) holds, as a binding LR encourages banks to reallocate toward higher-credit-risk assets. By contrast, when the LR is non-binding, it exerts little or no behavioural influence.

Under a purely risk-based capital regime, however, higher capital costs tend to discourage risk-taking because riskier assets attract higher regulatory capital charges. Importantly, although a binding LR may induce some degree of risk-shifting, their framework demonstrates that stronger loss-absorbing capital buffers ultimately reduce the probability of bank insolvency. This occurs because the LR directly constrains leverage expansion, while any increase in portfolio risk remains bounded either by the re-emergence of the risk-based capital constraint or by the "skin-in-the-game" effect, which limits excessive risk-taking incentives.

Similarly, Fatouh et al. (2024) identify two countervailing effects arising when a LR is introduced into a regulatory framework previously governed solely by risk-weighted capital requirements. Because the LR imposes an effective minimum capital charge on all assets irrespective of risk weights, it constrains banks' ability to accumulate large volumes of low-risk assets such as government securities. When the LR becomes binding, banks may respond by reallocating portfolios away from low-risk assets toward higher-yielding and riskier loans. However, this increase in portfolio risk is accompanied by a reduction in total assets for a given level of capital, implying lower effective leverage and, consequently, lower insolvency risk. The overall effect on financial stability therefore depends on whether the increase in asset risk outweighs the stabilising effect associated with lower leverage.

Taken together, these theoretical frameworks suggest that binding leverage ratio requirements may increase portfolio risk, particularly when banks adjust through portfolio reallocation. However, the net effect on insolvency risk remains theoretically ambiguous. The stabilising benefits associated with stronger capital buffers may be weakened, or potentially offset, if banks comply with higher capital requirements primarily through balance-sheet contraction and increased portfolio risk rather than through genuine equity increase (e.g., Wall and Peterson, 1996; Gropp et al., 2019). This distinction is particularly important because capital reforms intended to strengthen resilience may prove less effective where compliance occurs mainly through asset reduction instead of increases in equity capital. Importantly, although Acosta-Smith et al. (2024) and Fatouh et al. (2024) emphasise different adjustment mechanisms, both ultimately support the central proposition that a binding leverage ratio may induce risk-shifting behaviour while producing theoretically ambiguous effects on overall insolvency risk. In both models, the introduction of a binding LR alters banks' portfolio incentives and may encourage movement toward higher-risk assets. However, whether financial stability ultimately improves or deteriorates depends critically on the mechanism through which banks satisfy the tighter capital constraint – particularly whether adjustment occurs through deleveraging and balance-sheet contraction or through genuine equity expansion. Thus, although the two frameworks differ in emphasis, both reinforce the broader hypothesis that the stabilising effects of higher capital buffers may be undermined if banks respond to binding leverage requirements primarily through asset reduction combined with greater portfolio risk-taking. Against this backdrop, we propose the following hypothesis:

> ***H2a***: *A leverage ratio set substantially above Basel III standards, once binding, may increase portfolio risk. If the resulting increase in portfolio risk outweighs the stabilising benefits of stronger capital buffers, overall insolvency risk may rise – particularly where compliance is achieved primarily through asset contraction to satisfy the higher ratio rather than through genuine equity expansion.*

An alternative outcome may emerge, however, when hypothesis (**H1b**) holds – namely, that substantially higher equity capital requirements do not induce banks to shift toward riskier assets and may instead encourage more conservative portfolio allocation strategies (e.g., Adesina and Mwamba, 2016; Fatouh et al., 2024). This view is consistent with the moral hazard hypothesis, which posits that stronger capital requirements mitigate excessive risk-taking by aligning shareholders' incentives more closely with financial stability objectives (e.g., Hellmann et al., 2000; Milne and Whalley, 2001). It is also consistent with the franchise value hypothesis, which argues that well-capitalised banks behave more conservatively in order to preserve valuable future earnings streams and charter value (e.g., Honohan and Stiglitz, 2001; Jokipii and Milne, 2011). Moreover, where compliance with higher leverage ratio requirements occurs through regulatory-driven equity recapitalisation, the strengthening of banks' loss-absorbing capacity becomes more certain, thereby reinforcing the stabilising mechanism emphasised by Acosta-Smith et al. (2024). This is also consistent with the conventional ceteris paribus assumption in capital regulation models that an increase in bank capital, holding other factors constant, reduces overall insolvency risk (Koehn and Santomero, 1980, p. 1235).

Importantly, this adjustment process differs fundamentally from the framework in Fatouh et al. (2024), which assumes a constant level of capital. Under a recapitalisation framework, even if banks modestly increase portfolio risk, the larger equity buffer strengthens loss-absorbing capacity and improves overall solvency. Zambia's New Capital Adequacy Framework (NCF), for example, required that at least 80 percent of Tier 1 capital consist of paid-up common equity in fixed monetary amounts, with the remainder comprising retained earnings. Under such a framework, compliance necessarily involves a clear and measurable increase in banks' equity capital base. Against this backdrop, we propose the following competing hypothesis:

> ***H2b***: *A binding leverage ratio set substantially above Basel III standards reduces insolvency risk when compliance is achieved through genuine equity injections, as stronger capital buffers enhance loss-absorbing capacity and the "skin-in-the-game" effect dominates, thereby constraining excessive risk-taking incentives.*

### 3.4 Data Sample and methodology

This section presents the empirical strategy and research design, including the sample selection process, data sources, and variable definitions, together with the summary statistics. It also examines correlation patterns and multicollinearity diagnostics to assess the robustness of the empirical framework, before outlining the estimation methodology and model specifications.

#### 3.4.1 Empirical strategy

Our empirical strategy exploits the exogenous policy shock to banks' financial positions generated by Zambia's implementation of the New Capital Adequacy Framework (NCF) in 2012. The NCF is treated as a proxy for a Basel III-style leverage ratio framework because of its emphasis on flat, non-risk-sensitive Tier 1 capital requirements. Although Basel III standards were only formally introduced in Zambia in 2018 under the Banking and Financial Services Act of 2017, this study hypothetically applies the implicit Basel III leverage ratio concept – defined as equity relative to total assets – across the full sample period from January 2006 to February 2019. The NCF therefore provides a quasi-natural experiment for analysing the effects of leverage ratio requirements set substantially above Basel III norms, allowing us to evaluate how stricter capital requirements influence banks' risk outcomes using observational data before and after the reform's implementation in January 2012.

#### 3.4.2 Research design

In the research design subsection, we highlight the empirical advantages of treating the NCF as a quasi-natural experiment and employing a difference-in-differences estimation strategy. We further demonstrate how the NCF, used as a proxy for a Basel III-style leverage ratio framework, provides a credible setting for analysing the effects of leverage requirements set substantially above Basel III standards, thereby supporting the broader objectives of the study.

#### 3.4.2.1 Introduction

Causal inference in empirical research frequently involves questions that cannot be examined through randomised experiments (REs), either because such experiments are infeasible or because they may lack external validity (de Chaisemartin and D'Haultfœuille, 2023, p. 10). In these settings, researchers commonly rely on natural experiments, where treatment and control groups arise exogenously – typically through policy interventions rather than deliberate assignment by the researcher. Within the social sciences, such settings are often referred to as quasi-experiments, reflecting their ability to replicate certain features of REs without constituting fully controlled experiments (Meyer, 1995, p. 152).

Quasi-experimental, or quasi-natural experimental, approaches therefore provide a valuable framework for identifying causal effects under real-world conditions where controlled experiments are impractical (Harris et al., 2006; Meyer, 1995). As emphasised by Meyer (1995), well-designed quasi-experiments strengthen causal inference by exploiting exogenous variation generated through legislative reforms, regulatory interventions, or similar institutional changes.[62] Consequently, robust quasi-experimental analysis relies heavily on observational data, given that randomised field experiments are often infeasible when evaluating the effects of large-scale policies or regulatory programmes (Buckley and Shang, 2002).

Panel data methods have become particularly important in analysing the effects of policy interventions and exogenous shocks in such contexts (Kennedy-Shaffer, 2024). As a

[62] Meyer (1995, p. 151) argues that "natural experiments," which examine outcome measures for observations in treatment and comparison groups that are not randomly assigned, can be enhanced through the use of more complex research designs. Specifically, incorporating multiple treatment and comparison groups enables additional hypothesis testing, refining of hypotheses, and ruling out alternative explanations. Similarly, using multiple observations before or after an intervention can help assess the comparability of comparison groups and account for the effects of omitted factors.

result, much applied policy research in economics depends on observational data – that is, data generated without random assignment mechanisms (Athey and Imbens, 2017). However, deriving credible causal inference from observational settings remains challenging because confounding factors may simultaneously influence both treatment assignment and observed outcomes (Wang and Guo, 2024). To address these challenges, economists employ econometric techniques that explicitly account for the underlying data-generating process and potential sources of bias (Athey and Imbens, 2017; Van Zeebroeck and Pircalabelu, 2024). Among these approaches, the difference-in-differences (DID) estimator has emerged as one of the most widely used methods for evaluating the causal effects of policy interventions in real-world settings using observational data (Feng et al., 2024; Buckley and Shang, 2002).

#### 3.4.2.2 Exploiting the NCF as a quasi-natural experiment

Zambia's 2012 New Capital Adequacy Framework (NCF) provides a rare and analytically compelling quasi-natural experiment for examining the causal effects of substantially higher equity-based capital requirements on key bank-level outcomes, particularly risk-taking and liquidity creation. The institutional design of the reform introduced sharply differentiated minimum Tier 1 capital thresholds based on ownership structure, requiring foreign-owned banks to maintain K520 million in minimum capital compared with K104 million for locally owned banks. This pronounced, policy-induced variation in treatment intensity creates a strong foundation for implementing a difference-in-differences (DID) estimation strategy (Meyer, 1995, p. 154).

A central challenge in policy evaluations based on natural experiments is the non-random assignment of treatment. Because regulatory exposure is determined by policymakers rather than researchers, treated and control institutions may differ systematically in ways that threaten causal identification (de Chaisemartin and D'Haultfœuille, 2023, p. 10). However, a distinctive institutional feature of the NCF strengthens the plausibility of the common-trends assumption underpinning DID analysis. Specifically, six foreign-owned banks voluntarily converted to local ownership status in order to qualify for the lower capital threshold,[63] with four ultimately joining the control group. This regulatory reclassification suggests that pre-treatment differences between treated and control institutions were likely less pronounced and that group composition was influenced partly by regulatory arbitrage rather than solely by underlying capital or risk characteristics. Consequently, this institutional reshuffling improves group comparability and strengthens the internal validity of the quasi-experimental design.

Moreover, although a fully randomised controlled experiment would allocate capital requirements independently of institutional characteristics, the ownership-based implementation of the NCF reproduces several important features of an experimental setting. The reform was introduced abruptly, applied consistently across institutions, and allowed limited scope for anticipatory behavioural adjustments, thereby creating conditions conducive to credible causal identification. As such, the NCF constitutes a policy-relevant and empirically credible natural experiment for analysing the implications of materially higher leverage-based capital requirements in highly dollarised and structurally fragile banking systems, such as Zambia. Importantly, the structure of the NCF is well suited to an "unequal treatment intensity" framework analogous to multi-valued treatment settings. In such settings, treatment is assigned at varying intensities – for example, substantially higher versus lower capital thresholds – and standard binary DID approaches can be adapted by defining the more intensely regulated group as the treatment group and the less affected institutions as the comparison group (Meyer, 1995, p. 158; Callaway et al., 2024, p. 2; Haxhiu and Helgerman, 2024, p. 4). This stratified

[63] See CB Circular No. 23/2013 (New Capital Adequacy Framework) dated 30 December 2013 and page 48 of the Bank of Zambia Annual Report, 2013.

framework enables direct examination of whether changes in bank outcomes, including risk-taking and liquidity creation, vary systematically with the intensity of the regulatory intervention.

The NCF satisfies three core conditions required for credible DID estimation. First, the timing and scope of the treatment were clearly defined and plausibly exogenous to individual bank characteristics. Announced in early January 2012 and enforced by end-2013, the reform applied uniformly according to ownership structure, thereby limiting the scope for reverse causality and strategic regulatory manipulation. Second, both treatment and control groups are observed before and after the intervention, facilitating a panel DID design consistent with Meyer (1995) and later applications in the capital regulation literature (e.g., Juelsrud, 2018; Gropp et al., 2019; Bostandzic et al., 2022). Third, the fivefold difference in capital thresholds between foreign-owned and locally owned banks generates substantial treatment heterogeneity, a feature often absent in capital regulation reforms. As Juelsrud (2018) notes, regulatory reforms are typically imposed simultaneously across all banks with limited cross-sectional variation. By contrast, Zambia's NCF combines both credible exogeneity and substantial variation in treatment intensity.

Equally important is the nature of compliance imposed under the NCF. Banks were required to satisfy the higher capital thresholds exclusively through equity-based recapitalisation, either via retained earnings or fresh equity injections. This design addresses a common empirical limitation in evaluating capital regulation, namely the difficulty of disentangling whether observed adjustments arise from genuine capital raising or from balance-sheet contraction and portfolio reallocation. As Wall and Peterson (1996) argue, banks may respond to tighter capital requirements by reducing assets or shifting toward riskier portfolios, potentially weakening or even reversing the intended stabilising effects of regulation. By mandating equity-based recapitalisation, the NCF therefore provides a cleaner empirical setting for evaluating whether tighter capital standards strengthen bank resilience through genuine increases in loss-absorbing capital buffers rather than through potentially destabilising deleveraging responses. This institutional feature makes the NCF particularly suitable for testing hypotheses emerging from both regulatory theory and macroprudential policy debates. Proponents such as Admati and Hellwig (2013, 2024) and Firestone et al. (2019) advocate substantially higher leverage ratios – well above Basel III's 3 percent minimum – to strengthen solvency and reduce crisis-induced deleveraging pressures. Others, including Hanson et al. (2011) and Greenwood et al. (2017), argue in favour of equity-based recapitalisation rather than balance-sheet contraction, warning that deleveraging may suppress credit supply and intensify economic downturns. The NCF's binding and explicitly equity-focused structure therefore provides a unique opportunity to evaluate these competing propositions within a highly volatile, low-income, and financially dollarised environment.

In summary, Zambia's 2012 capital reform constitutes a rare and analytically robust policy shock for evaluating the effects of stringent leverage-based capital requirements. The reform addresses longstanding empirical challenges associated with endogenous regulatory responses and uniform treatment assignment by generating exogenous and differential capital shocks across broadly comparable institutions. It also aligns closely with the broader objectives of post-crisis capital reforms, particularly the Basel III emphasis on higher-quality equity capital and stronger loss-absorbing capacity. Consequently, the NCF provides a highly credible setting for difference-in-differences estimation and rigorous analysis of how materially higher leverage ratio requirements affect banks' risk-taking behaviour, insolvency risk, and liquidity creation capacity.

#### 3.4.2.3 Using the NCF as a proxy for a Basel III-type leverage ratio

Beyond its empirical usefulness, the principal analytical significance of Zambia's New Capital Adequacy Framework (NCF) lies in its role as a quasi-experimental setting for evaluating the effects of leverage ratio requirements substantially above Basel III standards. Although Zambia only formally adopted Basel III in 2018, the NCF introduced in 2012 effectively operated as an implicit and binding equity-to-assets (leverage) requirement. This study therefore exploits the NCF to simulate a Basel III-style leverage regime over the 2006–2019 period and employs a difference-in-differences (DID) framework to estimate the causal effects of materially higher equity requirements on bank risk-taking and liquidity creation. In doing so, the analysis aligns with longstanding proposals advocating substantially tougher leverage standards (e.g., Admati et al., 2010, 2013; Admati and Hellwig, 2013, 2024; Goldstein, 2017; Firestone et al., 2019).

Importantly, the institutional design of the NCF closely mirrors the underlying logic of Basel III's leverage ratio. Specifically, the NCF imposed flat, non-risk-sensitive Tier 1 capital requirements expressed in fixed monetary amounts, thereby functioning as a de facto leverage-based capital regime. This creates a rare empirical opportunity to examine the behavioural effects of elevated leverage requirements within a relatively controlled regulatory setting prior to the formal implementation of Basel III. Such evidence is particularly valuable in the Sub-Saharan African (SSA) context, where banking systems differ structurally from those in advanced economies through shallower financial markets, limited securitisation activity, and relatively low reliance on complex off-balance-sheet leverage. These institutional differences strengthen the case for region-specific calibration of prudential regulation. Given the slow and uneven implementation of Basel III across SSA (Anginer et al., 2024), quasi-experimental evidence of this nature is both timely and highly policy relevant.

The original objective of Basel III, introduced in response to the GFC, was to strengthen banking sector resilience by improving both the quantity and quality of regulatory capital (BCBS, 2010c). A central feature of the framework is the distinction between Tier 1 (going-concern) and Tier 2 (gone-concern) capital.[64] Basel III requires that Tier 1 capital consist predominantly of Common Equity Tier 1 (CET1), with at least 75 percent of Tier 1 capital composed of CET1 instruments. The remainder may include Additional Tier 1 (AT1) instruments, such as contingent convertible bonds (CoCos), intended to absorb losses prior to taxpayer intervention. However, the 2023 regional banking crises in the United States and Switzerland renewed concerns regarding the effectiveness, transparency, and market understanding of AT1 instruments despite existing disclosure requirements under Pillar 3 (BCBS, 2023; FSI, 2023).[65,66] These developments have prompted renewed international debate regarding the appropriate structure and role of AT1 capital within modern prudential frameworks.

By contrast, Zambia's NCF exceeded Basel III standards in terms of both capital quality and quantity. On the quality dimension, the NCF required Tier 1 capital to consist entirely of common equity, specifically 80 percent paid-up share capital and 20 percent retained earnings, while excluding hybrid instruments such as AT1 capital altogether. This structure closely aligns with the core Basel III principle that regulatory capital should possess clear and unquestionable loss-absorbing capacity. In this respect, the NCF effectively pre-empted several of the weaknesses in AT1 design exposed during the Credit Suisse[67] collapse and is broadly consistent

[64] Bank for International Settlements, "Definition of capital in Basel III – Executive Summary" FSI Connect, Financial Stability Institute (https://www.bis.org/fsi/fsisummaries/defcap_b3.pdf ).
[65] Basel Committee on Banking Supervision, Report on the 2023 banking turmoil, October 2023, see pages 26 - 27.
[66] Financial Stability Institute, Upside down: when AT1 instruments absorb losses before equity, September 2023, see Pages 2, 8 - 9.
[67] Bank for International Settlement (2023). "Some lessons for crisis management from recent bank failures". Speech by Mr Agustín Carstens, General Manager of the BIS, at the High-level meeting on banking supervision of the Association of Supervisors of Banks of the Americas (ASBA), the Basel

with proposals by Hanson et al. (2011) and Durand and Le Quang (2022) advocating simpler and more transparent equity-based capital frameworks.

On the quantity dimension, the NCF imposed a dramatic increase in minimum Tier 1 capital thresholds, raising the requirement from K12 million (approximately US$2.5 million) for all banks to K520 million (approximately US$100 million) for foreign-owned banks and K104 million (approximately US$20 million) for locally owned banks. For foreign-owned banks, this translated into an increase in the implicit leverage ratio from approximately 10.6 percent to 15.0 percent, representing a statistically significant increase of 4.4 percentage points.[68] This increase substantially exceeds the average global rise in leverage ratios observed under Basel III, which increased from 3.5 percent in 2011 to 6.5 percent in 2021 (BCBS, 2022, p. 13).[69] Even locally owned banks reached implicit leverage ratios of approximately 13 percent, roughly double the global average. Consequently, although Basel III prescribes a minimum leverage ratio of 3 percent, the NCF effectively imposed leverage-equivalent requirements of up to five times that benchmark, thereby creating a highly conservative capital buffer against insolvency risk.

It is important to note, however, that the NCF did not explicitly prescribe a formal leverage ratio. Rather, compliance was assessed against fixed capital thresholds or the equivalent amount calculated as 5 percent of risk-weighted assets, whichever was higher. Accordingly, the leverage ratio applied in this study is estimated ex post using bank-level balance-sheet data. Despite this limitation, the NCF remains analytically robust as a proxy for

---

Committee on Banking Supervision (BCBS) and the BIS Financial Stability Institute (FSI), 19 October 2023, Panama City.

[68] Please see Chapter 3, Table 5 (Means (standard deviations) of regression variables, by treatment).

[69] Note that large global banks, referred to as Group 1 banks, are those with Tier 1 capital exceeding EUR 3 billion and that are internationally active. All other banks fall into the Group 2 category (see page 10). Additionally, the leverage ratio for Group 2 banks showed a proportional improvement from approximately 3 percent to about 5.5 percent (see page 13).

a stringent leverage-based capital regime. The framework removes ambiguity regarding capital quality, limits opportunities for regulatory arbitrage through asset reduction, and facilitates credible causal identification through the DID approach. Thus, while the estimated treatment effects capture the impact of materially higher equity requirements rather than a formally legislated leverage ratio, the underlying policy equivalence remains conceptually and economically clear.

In summary, the NCF represents a rare and contextually appropriate natural experiment for evaluating leverage-based capital regulation in a structurally fragile and highly dollarised financial system. It provides a valuable empirical setting for assessing the macroprudential implications of substantially higher equity requirements and offers important policy insights for the calibration and implementation of Basel III-type reforms in SSA banking systems.

### 3.4.3 Data sample and variable measurements

#### 3.4.3.1 Variable definitions

Table 1 summarises the definitions of the key variables employed in the empirical analysis. **Panel A** presents the dependent variables. **Panel B** reports the main explanatory variables, represented by proxies for the CAMELS framework. **Panel C** outlines the control variables capturing bank fundamentals, while **Panel D** details the treatment variables.

##### 3.4.3.1.1 Dependent variables

For the dependent variables, we focus on two key measures: portfolio risk and insolvency risk. Portfolio risk is defined as the proportion of risky assets in a bank's portfolio (Jeitschko and Jeung, 2007). When analysing the effect of capital on asset risk, Jeitschko and Jeung (2007) argue that portfolio risk is a more appropriate measure than default-based indicators such as the Z-score, since it is not mechanically influenced by the capital adequacy ratio. In particular, portfolio risk is well suited for examining the asset-substitution effect of capital regulation (Jeitschko and Jeung, 2007; Ediz et al., 1998) - that is, the tendency of banks to reallocate within asset categories toward more or less risky exposures, or to shift across asset classes with different levels of credit risk. To capture insolvency risk, we employ the Z-score, which is widely used in the banking and financial stability literature as a proxy for the probability of insolvency (Mare et al., 2017; Bhagat et al., 2015; Lepetit and Strobel, 2015; Lepetit and Strobel, 2013). Importantly, measures of portfolio risk and insolvency risk are closely related, as deteriorating portfolio quality often precedes bank distress or failure (Jiang et al., 2020).

**A. Portfolio risk**

In this study, we focus specifically on credit risk when assessing portfolio risk, given its central role in determining a bank's probability of insolvency. Empirical evidence underscores this linkage: Imbierowicz and Rauch (2014) show that elevated credit risk significantly increases default probability, while Apergis and Payne (2013) find credit risk to be a key determinant of bank failures. We measure credit risk using the ratio of risk-weighted assets (RWA) to gross total assets, in line with the 1988 Basel I framework (Berger and Bouwman, 2013; BCBS, 1988). Commonly referred to as RWA density or the density ratio, this metric reflects the average risk weight - or risk intensity - per unit of exposure or gross assets within a bank or banking system (Masera, 2019; Gambacorta and Karmakar, 2018). The average risk weight is widely applied in empirical studies of bank capital regulation as a key proxy for portfolio risk (e.g., Acosta-Smith et al., 2024; Choi et al., 2020; Bitar et al., 2018; Ashraf et al., 2016; Berger and Bouwman, 2013; Jeitschko and Jeung, 2007; Berger, 1995).

An advantage of the Basel I framework is its uniform definition of RWA across banks, enabling credible cross-bank comparisons of average risk weights. Concerns have generally been raised about inconsistencies in the detailed application of Basel standards (e.g., RWAs computed under advanced approaches), which may undermine the credibility and effectiveness of the capital adequacy framework (Avramova and Le Leslé, 2012). However, while the average risk weight based on Basel I is a comprehensive measure of portfolio risk, it has limitations. Two banks with identical RWA ratios may still face very different credit risk exposures, since Basel I assigns only four risk-weight categories (0%, 20%, 50%, and 100%), each of which may pool together assets with varying degrees of underlying risk (Jeitschko and Jeung, 2007).

To deepen the analysis of banks' asset substitution behaviour across exposures with different credit risk profiles, we supplement the average risk weight with proxies for two main components of RWA, which serve as additional dependent variables in the regressions.[70] This approach allows us to examine the extent of risk-shifting between low-risk assets and high-risk assets (Lundtofte and Nielsen, 2019). According to Lundtofte and Nielsen (2019), binding

[70] All of the control variables from the full specification are included in these regressions.

capital requirements may bias banks either toward or away from high-risk exposures. Under the Zambian capital adequacy framework,[71] low-risk assets include Treasury bills (0% risk weight), government bonds and foreign currency balances held with foreign financial institutions (20% risk weight), all of which are considered low-risk and highly liquid. By contrast, high-risk assets include mortgage loans (50% risk weight), all other loans (100% risk weight), and off-balance sheet exposures. Categorising assets in this way enables us to assess more precisely how banks reallocate portfolios in response to capital constraints and regulatory requirements.

Finally, we introduce two additional measures of credit risk in banks' asset portfolios: the non-performing loans (NPL) ratio and the loan-loss reserves-to-loans (LLRL) ratio. Both serve as key indicators of the credit risk inherent in banks' lending activities. In developing economies, where financial markets are less developed, bank lending is the dominant source of financing for firms and households and the principal driver of bank profitability (Kanga et al., 2020). However, weak regulatory, institutional, and legal frameworks in many emerging markets often result in high levels of non-performing loans (Godlewski, 2005). The challenge is particularly acute in Sub-Saharan Africa, where the banking sector exhibits both the highest and the most volatile NPL ratios globally (Eyraud et al., 2021). The NPL ratio is calculated as the share of non-performing loans in total loans (e.g., Bitar et al., 2018; Ashraf et al., 2016; Jeitschko and Jeung, 2007; Godlewski, 2005; Berger, 1995; Gorton and Rosen, 1995). Non-performing loans, defined as loans overdue by 90 days or more or no longer accruing interest, provide an *ex post* measure of the actual risk embedded in banks' loan portfolios (Gorton and Rosen, 1995). By this measure, SSA banking systems carry substantial loan-related risks.

[71] Bank of Zambia's Capital Adequacy Regulations on: https://www.boz.zm/StatutoryInstrumentNo.184_CapitalAdequacy.pdf

The LLRL ratio, defined as loan-loss reserves divided by total loans (Kanga et al., 2020; Bitar et al., 2018; Ashraf et al., 2016; Dietrich and Wanzenried, 2014), captures banks' forward-looking provisioning for potential loan losses. All else equal, higher reserves indicate greater exposure to credit risk, whereas lower reserves suggest limited expected losses (Kanga et al., 2020). Taken together, the average risk weight and the LLRL ratio function as *ex ante* indicators of credit risk, reflecting potential future losses, while the NPL ratio provides an *ex post* indicator, signalling realised deterioration in loan quality (e.g., Bitar et al., 2018; Ashraf et al., 2016; Jeitschko and Jeung, 2007). *Ex ante* measures are particularly useful for capturing banks' risk-taking preferences, whereas *ex post* measures reveal the realised outcomes of those preferences (Klomp and De Haan, 2012).

### B. Insolvency risk

Insolvency risk refers to the probability that a bank's financial losses, whether expected or unexpected, exceed its equity capital in a given period (Mare et al., 2017; Yeyati and Micco, 2007). In this study, we employ the Z-score as our measure of insolvency risk (e.g., Bostandzic et al., 2022; Mare et al., 2017; Giordana and Schumacher, 2017; Lepetit and Strobel, 2015; Bhagat et al., 2015; Yeyati and Micco, 2007). The Z-score measures a bank's distance-to-default and, under the assumption of normally distributed returns, the square of its inverse can be interpreted as the probability that losses exceed equity (Giordana and Schumacher, 2017). A key advantage of this measure is that it can be constructed directly from accounting data - balance sheets and income statements, without relying on market valuations. This makes it particularly suitable for the SSA region, where the majority of banks are unlisted and market-based default indicators are unavailable. Formally, the Z-score is defined by Equation (1) as:

$$Z = \frac{ROA+(E/TA)}{\sigma\,(ROA)} \tag{1}$$

where ROA is return on assets, E/TA is the equity-to-assets ratio, and σ(ROA) is the standard deviation of ROA, calculated over a 36-month rolling window. As a composite indicator, the Z-score captures three dimensions of bank risk (Yeyati and Micco, 2007): (i) lower returns, reflecting weak performance or inefficiency; (ii) higher volatility of returns, reflecting riskier investments; and (iii) higher leverage, reflecting lower capitalisation. Thus, a smaller Z-score signals higher risk exposure and a greater probability of insolvency. According to Mare et al. (2017), a bank is considered closer to insolvency if it exhibits weaker profitability (lower ROA), thinner capital buffers (lower equity-to-assets), or more volatile earnings (higher standard deviation of ROA). For empirical implementation, we invert the Z-score so that higher values correspond to higher default risk, and we take its logarithm to account for non-linear effects and reduce the influence of outliers (e.g., Pour et al., 2023; Bostandzic et al., 2022; Kanga et al., 2020).

**3.4.3.1.2 Main explanatory variables**

The main explanatory variables in our analysis are the CAMELS indicators, a widely used system of financial soundness measures for evaluating banks' performance and stability (Berger et al., 2020; Lundtofte and Nielsen, 2019; Duchin and Sosyura, 2014; Betz et al., 2014; Li, 2013; Klomp and De Haan, 2012). The CAMELS framework encompasses six dimensions of bank condition: capital adequacy, asset quality, management soundness, earnings, liquidity, and sensitivity to market risk (IMF, 2000). Empirical studies provide robust evidence that proxies for CAMELS indicators are significant predictors of bank distress and failure - for instance, in the context of the 2009 financial crisis (Cole and White, 2012). Betz et al. (2014) further emphasise that accounting-based models incorporating capital adequacy, asset quality, and liquidity variables are especially effective in predicting bank failures. Accordingly, the CAMELS indicators serve as appropriate controls for banks' risk profiles and risk management strategies. We operationalise the six dimensions of CAMELS as follows:

- Capital adequacy (C): proxied by Tier 1 capital scaled either by gross total assets (CAR) or by risk-weighted assets (TIER1). Tier 1 capital - the highest-quality, loss-absorbing form of capital, consisting of common equity, retained earnings, and noncumulative preference shares - provides a buffer against financial losses and thus reduces the probability of insolvency (Betz et al., 2014).
- Asset quality (A): proxied by the ratio of loan loss reserves to total loans or the ratio of non-performing loans to total loans. A higher ratio signals weaker loan portfolio quality and is associated with a greater likelihood of bank failure (Berger and DeYoung, 1997; Betz et al., 2014).
- Management soundness (M): proxied by the ratio of non-interest expenses to gross total assets. A high ratio may reflect inefficiencies and management weaknesses (Klomp and De Haan, 2012), and is positively associated with bank distress (Betz et al., 2014).
- Earnings (E): proxied by return on assets (ROA) or return on equity (ROE). Stronger earnings performance lowers the probability of distress, while weaker profitability raises it (Betz et al., 2014).
- Liquidity (L): proxied by the ratio of liquid assets to deposits and short-term liabilities. Higher liquidity reduces the risk of failure, especially under conditions of maturity mismatch, while lower liquidity heightens vulnerability (Klomp and De Haan, 2012; Betz et al., 2014).
- Sensitivity to market risk (S): proxied by the share of trading income, particularly foreign exchange income. The effect of this variable on bank distress is theoretically ambiguous and may depend on market conditions (Betz et al., 2014).

#### 3.4.3.1.3 Controls

To mitigate concerns of omitted variable bias, we include a set of bank fundamentals commonly employed in the literature (Dias, 2021; Berger et al., 2020; Berger and Bouwman, 2013). These controls proxy for bank size, income structure, and funding stability. Including such variables enables us to account for systematic differences between foreign-owned and locally owned banks that may influence risk outcomes independently of the implementation of the NCF itself (Duchin and Sosyura, 2014). Bank size is an important determinant of portfolio composition and risk exposure (Jeitschko and Jeung, 2007). Size may influence target capital levels through differences in portfolio mix, economies of scale in raising equity, or access to capital markets (Dahl and Shrieves, 1990). Larger banks typically benefit from economies of scale in operations, as well as economies of scope through broader product offerings and loan diversification (Dietrich and Wanzenried, 2014). They also enjoy scale advantages in monitoring and screening borrowers and in diversifying both assets and revenues (Evans and Haq, 2022). These factors suggest that larger banks may be inherently less risky (Kanga et al., 2020; Nguyen et al., 2019). However, large banks are also more likely to engage in riskier activities, including commercial and industrial lending, trading account exposures, and derivative transactions (Jeitschko and Jeung, 2007). Thus, the net effect of size on risk is theoretically ambiguous.

To capture the effect of income structure on bank risk, we use two measures: the ratio of non-interest income to total interest income, as a proxy for income diversification, and the net interest margin (NIM), as a proxy for traditional intermediation income. Banks with greater reliance on non-interest income are often considered riskier (Maudos, 2017), and empirical evidence shows that higher shares of non-interest income increase the probability of insolvency as measured by the Z-score (Maudos, 2017). Conversely, banks focused on traditional activities tend to exhibit greater stability (Köhler, 2014). However, the interpretation of NIM is context-dependent. A higher spread may indicate elevated asset risk, as banks charge higher loan rates to riskier borrowers (Jeitschko and Jeung, 2007). Alternatively, higher spreads may reflect stronger capitalisation, lower funding costs, or greater market power, all of which reduce risk

(Dietrich and Wanzenried, 2014). Notably, foreign-owned banks in low-income countries often exhibit higher interest margins, a finding with particular relevance for Zambia, where subsidiaries of foreign banks held 66.8% of deposits and 60.1% of loans at end-2022. In terms of industry income composition, interest income from government securities and loans accounted for 38.9% and 30.1% of total income, respectively, in 2022.[72] Finally, we account for funding stability, motivated by lessons from the 2007-2009 global financial crisis, which underscored the systemic risks of maturity transformation risk (BCBS, 2010c). Since banks fund long-term assets with short-term liabilities, they remain vulnerable to funding liquidity risk (Casu et al., 2019). If investors doubt a bank's solvency, they may refuse to roll over maturing debt, potentially triggering a wholesale funding freeze (Lipschitz and Schadler, 2019). This so-called stable funding problem is proxied in our analysis by the ratio of wholesale funding to gross total assets.

[72] Bank of Zambia Annual Report, 2022 on: https://www.boz.zm/Bank_of_Zambia_2022_Annual_Report.pdf

**Table 1. Variable description.**

This table reports the key variables employed in the empirical analysis, including their mnemonics, names, definitions, and references. All underlying data used to construct these variables were obtained from the Bank of Zambia's Prudential Returns.

| | | | |
|---|---|---|---|
| **Panel A: Dependent Variables (Risk measures)** | | | |
| **Mnemonic** | **Variable name** | **Definition** | **References** |
| l_INVZSC | Insolvency risk | The log of the inverse Z-score | Dias (2021); Kanga et al. (2020); Nguyen et al. (2019); Rahman et al. (2018) |
| RWATA | Portfolio risk | The ratio of a bank's risk-weighted assets scaled by gross total assets (average risk-weight) | Acosta-Smith et al. 2020; Choi et al. 2020; Berger and Bouwman (2013) |
| LLRL | Portfolio risk | The ratio of loan loss reserves to total loans | Petropoulos et. al (2020); Kanga et al. (2020); Bitar et al. (2018); Fu et al. (2016) |
| RWA_LRA | Portfolio risk | Percentage of total assets invested in treasury bills, government bonds and balances with banks abroad (Low risk assets) | Klomp and De Haan (2012) |
| RWA_HRA | Portfolio risk | Percentage of total assets invested in loans and off-balance sheet exposures (High risk assets) | Kanga et al. (2020); Nguyen et al. (2019) |
| **Panel B: Explanatory Variables (CAMELS proxies)** | | | |
| TIER1/CAR | Capital adequacy | The ratio of tier 1 capital scaled by risk-weighted assets (TIER1) or by gross total assets (CAR) | Petropoulos et. al (2020), Berger et al., 2020; Duchin & Sosyura (2014); Dias (2021), Nguyen et al. (2019), Bitar et al. (2018) |
| NPL | Asset quality | The ratio of non-performing loans scaled by total loans | Dias (2021); Aboyadana (2021); Ashraf et al. (2016) |
| NONIE | Management | The ratio of total non-interest expenses to gross total assets | Petropoulos et. al (2020) |
| ROA/ROE | Earnings | The ratio of profit before taxes to total gross assets (ROA), and profit after taxes to total equity (ROE). | Dias (2021); Kanga et al. (2020); Berger et al., 2020; Bitar et al. (2018); Duchin & Sosyura (2014); Altunbas et al. (2007) |
| NIM | Earnings | The ratio of net-interest income to earning assets | Dias (2021); Kanga et al. (2020); Bitar et al. (2018) |
| LIQR | Liquidity | The ratio of total liquid assets to deposits and short-term liabilities | Nistor and Ongena, 2023; Fang et al. (2020); Dias (2021); Ashraf et al. (2016) |
| FXINC | Sensitivity to market risk | The share of foreign exchange income | Betz et al., 2014 |
| **Panel C: Controls (Bank fundamentals)** | | | |
| INCDF | Income diversification | The ratio of non-interest income to total interest income | Choi et al. 2020 |
| STBFN | Wholesale funding dependence | The ratio of total wholesale funding to gross total assets | Drechsler et al. (2021) |
| SIZE | Bank size | Natural log of gross total assets | Kanga et al. (2020); Bitar et al. (2018); Altunbas et al. (2007) |
| **Panel D: Treatment Variables** | | | |
| NCFBank | A dummy variable set to 1 if a bank was foreign-owned and met the higher minimum capital requirement, and 0 otherwise | | |
| Post | A binary variable set to 1 for the period from February 2012 to February 2019 after the NCF enforcement on January 30, 2012, and set to 0 for all other periods | | |
| NCFBank x Post | The interaction term of NCFBank and Post that captures the estimated policy effect under the assumptions of DID, and 0 otherwise | | |

### 3.4.4 Summary statistics, correlation analysis and collinearity diagnostics

#### 3.4.4.1 Summary statistics

Table 2 presents summary statistics for all principal variables used in the analysis, with variable definitions reported in Table 1. To mitigate the influence of outliers and enhance the robustness of the regression estimates, all continuous variables, excluding dummy indicators, are Winsorised at the 1st and 99th percentiles (e.g., Dang et al., 2023; Kanga et al., 2020).[73] **Panel A** reports the risk indicators. For insolvency risk, measured as the logarithm of the inverse Z-score, the mean (median) value is -3.878 (-3.909). The two primary measures of portfolio risk – the average risk weight (RWATA) and the ratio of loan-loss reserves to total loans (LLRL) – record mean (median) values of 54.1% (55.2%) and 6.1% (4.5%), respectively.

**Panel B** presents the CAMELS indicators. The average leverage ratio, measured as Tier 1 capital relative to total assets (CAR), is 15.2% (median: 11.5%), while the risk-based capital ratio, defined as Tier 1 capital relative to risk-weighted assets (TIER1), averages 29.8% (20.1%). Asset quality, proxied by the non-performing loan ratio, averages 9.1% (6.3%). Management quality, measured by non-interest expenses relative to total assets (NONIE), averages 0.9% (0.7%). Profitability indicators – return on equity (ROE) and net interest margin (NIM) – average 0.6% (1.7%) and 0.8% (0.8%), respectively. Liquidity conditions appear relatively strong, with liquid assets to customer deposits and short-term liabilities averaging 68.7% (63.5%). Sensitivity to market risk, proxied by the share of foreign exchange income in total income, averages 11.2% (10.7%). Overall, the CAMELS indicators suggest that, on average, banks in the sample were well capitalised, highly liquid, and moderately profitable.

**Panel C** indicates that banks maintained relatively diversified income structures, with non-interest income accounting for 43.9% (42.9%) of total interest income. Median bank size,

[73] This procedure reduces the distorting effect of outliers without discarding data, thereby preserving the integrity of the sample while aligning the distribution more closely with typical values.

measured as the logarithm of gross total assets (GTA), is 13.915, corresponding to approximately US$300 million in assets. Finally, Panel D reports the treatment indicators. The NCF Bank dummy indicates that 52.3% of banks in the sample are treated institutions, namely foreign-owned banks subject to the more stringent capital requirements under the NCF. Approximately 60% of observations fall within the post-NCF period, while around 30% relate to banks that are both treated and observed after implementation of the NCF.

**Table 2. Summary statistics.**

Table 2 presents descriptive statistics for the key variables employed in the empirical models, including both dependent variables and covariates. Variable definitions and references are provided in Table 1. All underlying data were obtained from the Bank of Zambia's Prudential Returns.

| Variable | Mean | SD | Min | p25 | p50 | p75 | Max | N |
|---|---|---|---|---|---|---|---|---|
| ***Panel A. Risk measures*** | | | | | | | | |
| Log of inverse Z-Score | -3.878 | 0.943 | -5.516 | -4.646 | -3.909 | -3.230 | -1.509 | 1888 |
| Average risk-weight | 0.541 | 0.170 | 0.165 | 0.444 | 0.552 | 0.644 | 0.964 | 2528 |
| Loan loss allowance | 0.061 | 0.057 | 0.000 | 0.020 | 0.045 | 0.083 | 0.265 | 2526 |
| Low-risk assets | 0.323 | 0.183 | 0.008 | 0.197 | 0.287 | 0.408 | 0.834 | 1924 |
| High-risk assets | 0.512 | 0.189 | 0.070 | 0.392 | 0.511 | 0.610 | 1.125 | 2529 |
| ***Panel B. Explanatory variables*** | | | | | | | | |
| Capital adequacy (Tier 1) | 0.298 | 0.242 | 0.025 | 0.147 | 0.201 | 0.388 | 1.406 | 2528 |
| Capital adequacy (CAR) | 0.152 | 0.103 | 0.028 | 0.083 | 0.115 | 0.195 | 0.652 | 2529 |
| Asset quality (NPL) | 0.091 | 0.096 | 0.000 | 0.018 | 0.063 | 0.135 | 0.535 | 2525 |
| Management quality (NONIE) | 0.009 | 0.007 | 0.001 | 0.005 | 0.007 | 0.010 | 0.043 | 2528 |
| Earnings (ROA) | -0.000 | 0.006 | -0.036 | -0.001 | 0.001 | 0.003 | 0.010 | 2529 |
| Earnings (ROE) | 0.006 | 0.052 | -0.218 | -0.005 | 0.017 | 0.032 | 0.119 | 2528 |
| Earnings (NIM) | 0.008 | 0.004 | -0.003 | 0.006 | 0.008 | 0.010 | 0.030 | 2529 |
| Liquidity (LIQR) | 0.687 | 0.276 | 0.194 | 0.494 | 0.635 | 0.838 | 1.642 | 2529 |
| Sensitivity to market risk (FXINC) | 0.112 | 0.117 | -0.325 | 0.048 | 0.107 | 0.172 | 0.498 | 2528 |
| ***Panel C. Controls*** | | | | | | | | |
| Income diversification (INCDF) | 0.439 | 0.214 | -0.428 | 0.323 | 0.429 | 0.537 | 1.176 | 2528 |
| Stable funding problem (STBFN) | 0.101 | 0.117 | 0.000 | 0.020 | 0.066 | 0.125 | 0.520 | 2529 |
| Bank size | 13.843 | 1.380 | 10.577 | 12.770 | 13.915 | 14.923 | 16.230 | 2529 |
| ***Panel D. Treatment variables*** | | | | | | | | |
| NCFBank | 0.523 | 0.500 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 | 2560 |
| Post | 0.599 | 0.490 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 | 2560 |
| NCFBank x Post | 0.299 | 0.458 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 2560 |

#### 3.4.4.2 Correlation analysis and collinearity diagnostics

Table 3 reports the Pearson correlation coefficients among the principal variables. All three risk measures are negatively and significantly correlated with the treatment indicator (NCFBank × Post), namely insolvency risk (r = -0.36), portfolio risk measured by RWATA (r = -0.06), and the loan-loss reserves-to-loans ratio (LLRL) (r = -0.14). As expected, the leverage ratio (CAR) is negatively associated with insolvency risk (r = -0.48), while exhibiting a positive correlation with the average risk weight (r = 0.08). Strong positive relationships are also observed between the non-performing loan (NPL) ratio and LLRL (r = 0.79), as well as between net interest margin (NIM) and return on equity (ROE) (r = 0.23). Bank size is negatively correlated with both insolvency risk (r = -0.36) and average portfolio risk (r = -0.20), but shows only a weak positive association with LLRL (r = 0.04). These zero-order correlations are purely descriptive; the multivariate regressions presented subsequently provide a more rigorous assessment of these relationships while controlling for confounding influences and common time effects.

To evaluate potential multicollinearity among the explanatory variables, variance inflation factors (VIFs) were computed and are reported in Table 4. All VIF values remain well below the conventional threshold of 10, with a mean VIF of 2.913 and a range of 1.378 to 5.257. Correspondingly, all tolerance values exceed the standard minimum threshold of 0.10. Consistent with established econometric guidelines (Wooldridge, 2016, pp. 84–86; Gujarati and Dawn, 2009, p. 340), these diagnostics indicate that multicollinearity is unlikely to pose a substantive concern. The estimated coefficients are therefore expected to be well identified, with no material inflation in their associated standard errors.

**Table 3. Pairwise Correlations.**
This table reports pairwise Pearson correlation coefficients for the main variables in the sample. Variables are Winsorized at the 1st and 99th percentiles (definitions in Table 1; summary statistics in Table 2). Correlations significance is denoted by *, **, and ***, indicating 10%, 5%, and 1% levels, respectively.

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Log (inv. Z-Score) | 1.000 | | | | | | | | | | |
| | | | | | | | | | | | |
| (2) Average risk-weight | 0.348*** | 1.000 | | | | | | | | | |
| | (0.000) | | | | | | | | | | |
| (3) Loan loss reserves | 0.424*** | 0.130*** | 1.000 | | | | | | | | |
| | (0.000) | (0.000) | | | | | | | | | |
| (4) Leverage ratio | -0.479*** | 0.080*** | -0.306*** | 1.000 | | | | | | | |
| | (0.000) | (0.000) | (0.000) | | | | | | | | |
| (5) NPL ratio | 0.370*** | 0.144*** | 0.791*** | -0.277*** | 1.000 | | | | | | |
| | (0.000) | (0.000) | (0.000) | (0.000) | | | | | | | |
| (6) Return on equity | -0.360*** | -0.236*** | -0.127*** | -0.088*** | -0.198*** | 1.000 | | | | | |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | | | | | | |
| (7) Liquidity ratio | -0.573*** | -0.593*** | -0.329*** | 0.530*** | -0.318*** | 0.161*** | 1.000 | | | | |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | | | | | |
| (8) FX trading income | -0.108*** | -0.085*** | -0.117*** | 0.065*** | -0.086*** | 0.166*** | 0.140*** | 1.000 | | | |
| | (0.000) | (0.000) | (0.000) | (0.001) | (0.000) | (0.000) | (0.000) | | | | |
| (9) Net interest margin | -0.005 | 0.022 | -0.096*** | 0.221*** | -0.169*** | 0.234*** | 0.039** | -0.112*** | 1.000 | | |
| | (0.824) | (0.279) | (0.000) | (0.000) | (0.000) | (0.000) | (0.047) | (0.000) | | | |
| (10) Bank size | -0.364*** | -0.196*** | 0.036* | -0.386*** | -0.014 | 0.357*** | -0.034* | 0.036* | -0.052*** | 1.000 | |
| | (0.000) | (0.000) | (0.072) | (0.000) | (0.469) | (0.000) | (0.091) | (0.068) | (0.010) | | |
| (11) NCFBank x Post | -0.359*** | -0.059*** | -0.137*** | -0.011 | -0.187*** | 0.160*** | 0.130*** | 0.033* | -0.101*** | 0.592*** | 1.000 |
| | (0.000) | (0.003) | (0.000) | (0.583) | (0.000) | (0.000) | (0.000) | (0.093) | (0.000) | (0.000) | |

**** p<0.01, ** p<0.05, * p<0.1*

**Table 4. Collinearity diagnostics.**
The table reports variance inflation factors (VIF) and tolerance (1/VIF) for all regressors. VIF quantifies how much a coefficient's variance is inflated by linear dependence among covariates; tolerance is its reciprocal. As a rule of thumb, VIF values above 10 - or equivalently tolerance below 0.10 - signal potentially problematic multicollinearity. Values comfortably within these bounds suggest that collinearity is unlikely to distort coefficient estimates or standard errors.

| Variable | VIF | Tolerance |
|---|---|---|
| Tier 1 capital | 5.257 | 0.190 |
| CAR | 3.967 | 0.252 |
| NPL ratio | 1.401 | 0.714 |
| Non-interest expenses | 3.803 | 0.263 |
| ROA | 3.972 | 0.252 |
| ROE | 2.545 | 0.393 |
| Liquidity ratio | 3.223 | 0.310 |
| FX trading income | 1.415 | 0.707 |
| NIM | 1.855 | 0.539 |
| Income diversification | 1.828 | 0.547 |
| Stable funding | 1.378 | 0.726 |
| Bank size | 2.895 | 0.345 |
| NCF Bank | 3.434 | 0.291 |
| Post | 2.842 | 0.352 |
| NCFBank x Post | 3.884 | 0.257 |
| **Mean VIF** | **2.913** | |

### 3.4.5 Methodology and model specification

#### 3.4.5.1 Empirical strategy

This chapter examines the causal effects of substantially higher equity capital requirements, exceeding Basel III standards in both capital quantity and quality, on bank risk-taking behaviour. In particular, the analysis focuses on the implications of requiring banks to raise additional equity capital in order to comply with these more stringent requirements, especially through the imposition of a binding leverage ratio. To address this objective, the study adopts an empirical strategy similar to that of Gropp et al. (2019), combining a quasi-natural experimental framework with a difference-in-differences (DID) estimation approach. The DID methodology identifies a policy intervention (the treatment) that affects one group of institutions (the treated group) while leaving another group (the control group) relatively unaffected.

By comparing changes in the outcome variable across the treated and control groups before and after the intervention, the approach isolates the average causal effect of the treatment (Li et al., 2024). In this context, Zambia's implementation of the New Capital Adequacy Framework (NCF) in January 2012 provides a valuable quasi-natural experiment for evaluating the effects of new regulatory capital policies – particularly leverage requirements set substantially above Basel III standards – on bank risk-taking behaviour. A central identifying assumption is that the NCF, as a regulatory-driven recapitalisation programme, constituted a significant and plausibly exogenous policy shock, especially for foreign-owned banks.

#### 3.4.5.2 Difference-in-differences approach

The NCF mandated a substantial increase in minimum equity capital requirements, raising the threshold from K12 million to K520 million for foreign-owned banks and to K104 million for locally owned banks. This sharp differentiation in regulatory capital requirements between foreign-owned and locally owned banks provides a strong empirical setting for implementing a DID framework. Within this design, foreign-owned banks – subject to capital requirements five times higher than those imposed on locally owned banks – constitute the treated group, while locally owned banks serve as the control group. Using observational data spanning periods before and after the implementation of the NCF, the study seeks to identify the causal effects of substantially higher equity capital requirements through a range of identification strategies and assumptions designed to strengthen the credibility and robustness of the results.

An important advantage of the DID framework is its ability to mitigate the influence of confounding factors (Li et al., 2024). As noted by Gropp et al. (2019), regulatory discretion in setting bank-specific capital requirements may generate a correlation between regulatory capital standards and unobserved bank characteristics, rendering capital requirements endogenous to banks' balance-sheet conditions. The ownership-based differentiation embedded in the NCF therefore provides a valuable opportunity to examine how ownership structure shapes banks' responses to higher capital requirements and influences risk-taking behaviour. Existing literature identifies two competing perspectives regarding foreign bank ownership and risk (e.g., Kanga et al., 2021). The market-risk view suggests that foreign banks may face higher risks because of limited familiarity with local market conditions. Conversely, an alternative perspective argues that foreign-owned banks benefit from superior diversification opportunities, stronger technological capabilities, and more advanced risk-management systems, resulting in lower risk exposure. Empirical evidence from Sub-Saharan Africa generally supports the latter view, indicating that foreign-owned banks tend to exhibit lower risk profiles than domestically owned banks (Kanga et al., 2020, 2021; Saidane et al., 2021).

Accounting for these structural differences is therefore critical, as failure to do so could confound the estimated treatment effects. Hettinger et al. (2024) further emphasise that DID estimators are widely used in observational studies because they implicitly control for both observed and unobserved confounding factors that remain constant over time but differ across treated and untreated groups. By comparing changes in outcomes over time between institutions exposed to the policy intervention and those that are not, the DID framework strengthens causal inference while reducing the likelihood of omitted variable bias (Wang et al., 2024).

To further strengthen identification, this study employs a two-way fixed effects (TWFE) DID estimator. The TWFE specification controls simultaneously for unit-specific and time-specific effects (Wooldridge, 2025; Jin, 2024).[74] By incorporating both bank-fixed effects and time-fixed effects, the framework accounts for persistent differences across banks as well as common shocks affecting all institutions over time, while relying on the standard parallel trends assumption (Feng et al., 2024). Bank-fixed effects absorb observed and unobserved time-invariant heterogeneity across institutions, whereas time-fixed effects capture economy-wide factors common to all banks within each period (Wang et al., 2024). Within this framework, the DID estimator identifies the average treatment effect on the treated (ATT) by comparing changes in outcomes before and after the intervention relative to the counterfactual scenario in which the treatment had not occurred (Angrist and Pischke, 2009). The TWFE estimator therefore yields unbiased treatment effect estimates provided that the parallel trends assumption holds and treatment effects do not vary systematically across units or over time (Roth et al., 2023; De Chaisemartin and d'Haultfoeuille, 2020).

[74] Including unit fixed effects in a linear regression is identical to removing unit-specific time averages and applying pooled ordinary least squares (OLS) to the transformed data. Including time fixed effects then removes secular changes in the economic environment that have the same effect on all units (Wooldridge, 2025).

#### 3.4.5.2.1 DID assumptions

A central identifying assumption underlying the difference-in-differences framework is the "parallel trends" assumption (Roth et al., 2023; Callaway and Sant'Anna, 2021). This assumption requires that, in the absence of treatment, the average outcomes of the treated and control groups would have evolved along similar trajectories over time. Put differently, the observed trend in the control group is assumed to represent the counterfactual trend that the treated group would have experienced had the policy intervention not occurred (Zhao and Cui, 2023). Under this condition, any post-treatment divergence in outcomes between the treated and control groups can be attributed to the causal effect of the policy intervention itself (Wang et al., 2024). Accordingly, the validity of the DID estimator rests fundamentally on the "parallel trends" assumption, as this condition underlies the causal interpretation of the estimated treatment effects (Roth et al., 2023; Callaway and Sant'Anna, 2021).

A second key identifying condition is the "no-anticipation" assumption, which requires that the treatment exerts no causal effect prior to its formal implementation (Roth et al., 2023). This assumption rules out behavioural adjustments in advance of the policy change and implies that exposure to the reform does not influence outcomes before implementation (Zimmert and Zimmert, 2024). In the present context, this assumption could potentially be violated if banks had anticipated future increases in capital requirements and adjusted their capital positions in advance. Such concerns arise because previous revisions to Zambia's minimum capital requirements were partly motivated by preserving the real U.S. dollar value of regulatory capital thresholds amid sustained exchange-rate depreciation. As discussed in Section 3.2.1, the Bank of Zambia increased the minimum Tier 1 paid-up capital requirement in January 2007 from K2 million – unchanged since 1995 – to K12 million, primarily because persistent currency depreciation had reduced the real value of the requirement to approximately US$0.46 million by end-2006. Given this rationale, banks may have anticipated the possibility of future capital adjustments intended to maintain minimum capital thresholds in U.S. dollar terms. However, such expectations would likely have implied only moderate future revisions, since the 2007 adjustment already restored the minimum requirement to approximately US$2.3 million, exceeding the original 1995 benchmark of roughly US$2 million. Similarly, the 1995 revision itself had been motivated largely by the erosion in the real value of the capital thresholds originally established under the 1971 Banking Act.

Importantly, although differentiated capital requirements had previously existed in Zambia during the 1970s, the institutional logic underlying those reforms differed fundamentally from that of the 2012 NCF. As outlined in Section 3.2.2, the 1971 framework reflected post-independence financial sector reforms associated with the nationalisation of the economy, under which banks with full or partial government ownership were subject to lower capital requirements than privately owned institutions, which at the time were predominantly foreign owned (Harvey, 1973; Beveridge, 1974). By contrast, the 2012 NCF differentiated banks according to local versus foreign ownership, including classifying banks with majority government ownership (partially foreign owned) as locally owned while categorising at least one institution with a minority government stake as foreign-owned. Given these institutional differences, banks were unlikely to have anticipated such a substantial ownership-based restructuring of capital requirements prior to the formal announcement of the NCF on 30 January 2012.

According to Roth et al. (2023), when the parallel trends assumption and the no-anticipation assumption hold, together with independent sampling, the ordinary least squares (OLS) DID estimator identifies the average treatment effect on the treated (ATT). Although these assumptions cannot be tested directly because they involve counterfactual outcomes, the literature commonly assesses their plausibility through graphical inspection of pre-treatment trends. In particular, the absence of systematic differences in pre-treatment outcome trajectories ("pre-trends") between treated and control groups provides preliminary support for the parallel trends assumption. Nevertheless, visual analysis alone is insufficient for establishing causal validity. To more rigorously evaluate the evolution of outcomes between treated and untreated banks while accounting for confounding influences, the study therefore implements a full multivariate DID regression framework following Berger et al. (2020).

### 3.4.5.3 Model specification

The TWFE specification is implemented by regressing the outcome variable on group fixed effects, time fixed effects, and the interaction between a post-treatment indicator and a treatment-status variable capturing exposure to the policy intervention (Callaway et al., 2024; Roth et al., 2023; De Chaisemartin and d'Haultfoeuille, 2020). Because the treatment-group indicator and the post-treatment dummy ($NCFBank_i$ and $Post_t$) are perfectly collinear with the respective fixed effects, their main effects are not separately identified and are therefore omitted from the estimation (Corral and Yang, 2024; Choi et al., 2020).[75] Consequently, identification relies on the time-varying interaction term ($NCFBank_i$ x $Post_t$), which constitutes the principal variable of interest. This relationship is formally expressed in Equation (1):

$$Y_{i,t} = \alpha + \beta \cdot (NCFBank_i \text{ x } Post_t) + \gamma . \Sigma X_{i,t-1} + \lambda_i + \lambda_t + \varepsilon_{i,t} \qquad \textbf{(1)}$$

where $Y_{i,t}$ represents one of the bank risk measure variables (see Table 1), for bank $i$ at year-month $t$, with $i$ = 1,…, N, and $t$ = 1,…,T. The variable $NCFBank_i$ is a dummy equal to 1 for banks classified as foreign-owned and subject to the higher minimum equity capital requirement during the sample period, and 0 otherwise. The variable $Post_t$ is a binary indicator

[75] The variable Treatment only varies across units (i) and remains constant over time (t), while the PostPeriod dummy is absorbed by the period fixed effects since it does not vary across units (i). As a result, both variables are redundant in the model due to collinearity with the fixed effects. Reference: Jeff Wooldridge (June 21, 2021, 15:22), [Statalist discussion](https://www.statalist.org/forums/forum/general-stata-discussion/general/1429277-omitted-because-of-collinearity-with-fixed-effects).

taking the value 1 for the period following the implementation of the NCF (February 2012 to February 2019) and 0 for all months prior to its enforcement on January 30, 2012. Bank fixed effects $\lambda_i$ are included to control for time-invariant heterogeneity across banks, capturing unobserved characteristics that may influence risk outcomes but are not explained by the model's covariates (Choi et al., 2020; Cornett et al., 2011; Berger and Bouwman, 2009). Year-month fixed effects $\lambda_t$ account for common temporal shocks and systematic changes in risk outcomes over time, thereby mitigating potential serial correlation and omitted variable bias linked to macroeconomic or regulatory trends (Berger and Bouwman, 2009; Choi et al., 2020; Cornett et al., 2011).

All regressions use robust standard errors clustered by bank to control for heteroskedasticity and possible correlations among observations of the same bank in different years-months (Cornett et al., 2011; Berger and Bouwman, 2009). The variables $\Sigma X_{i,t-1}$ are bank-specific controls lagged by one period, and $\gamma$ is the vector of the corresponding coefficients. $\varepsilon_{i,t}$ represents the error term. The interaction term $NCFBank_i$ x $Post_t$ serves as the difference-in-differences (DID) estimator, capturing the causal effect of the policy under the DID framework. It specifically measures the impact of the significantly higher capital requirements imposed on foreign-owned banks (treated group) relative to locally-owned banks (comparison group) after the introduction of the NCF. A positive coefficient suggests that the heightened minimum capital requirements led to an increase in bank risk, whereas a negative coefficient indicates that the policy contributed to a reduction in bank risk.

### 3.5 Empirical results and discussions

#### 3.5.1 Preliminary assessment

##### 3.5.1.1 Descriptive review of treatment and control groups

Table 5 (**Panel A**) presents descriptive mean comparisons for total risk-weighted assets (RWATA) and two asset-class proxies for credit risk exposure – low-risk assets (RWA_LRA) and high-risk assets (RWA_HRA) – expressed as shares of gross total assets. **Panel B** reports selected bank condition and performance indicators before and after the Bank of Zambia's 2012 recapitalisation reform. For RWATA, RWA_LRA, and RWA_HRA, both treated banks (NCF banks) and control banks exhibit some post-reform adjustment following the introduction of higher capital requirements. However, the magnitude of these changes remains modest and statistically insignificant across both groups, providing limited evidence of substantial portfolio rebalancing, de-risking, or shifts toward higher-risk-weighted assets after the reform.

By contrast, **Panel B** indicates a more pronounced adjustment in the capital positions of treated banks. Post-reform averages for the capital adequacy ratio (CAR) show that treated banks significantly strengthened their regulatory capital relative to pre-reform levels, whereas no comparable adjustment is observed among control banks. In particular, the leverage ratio (equity-to-assets or CAR) of NCF banks increased by approximately 3 percentage points, with the change statistically significant at the 5 percent level. Across most other indicators, there is limited evidence of simultaneous changes in asset quality, liquidity buffers, funding structure, interest margins, or profitability for either group. Among treated banks, however, non-interest expenses declined significantly at the 5 percent level, while control banks experienced a statistically significant reduction in foreign exchange trading income at the 1 percent level. Overall, the descriptive evidence suggests that the 2012 recapitalisation reform primarily generated a targeted strengthening of capital positions among treated banks without inducing broad contemporaneous adjustments in risk profiles, liquidity conditions, or earnings performance.

**Table 5. Means (standard deviations) of regression variables, by treatment.**
This table reports the means and standard deviations (in parentheses) of the dependent and explanatory variables employed in the empirical analysis. Variable definitions and references are provided in Table 1. Differences between the post- and pre-treatment periods for treated (NCF Banks) and control banks are estimated using regressions with clustered standard errors. Statistical significance is denoted by * and ** at the 5% and 1% levels, respectively. All underlying data used to construct the variables are sourced from the Bank of Zambia's Prudential Returns.

| | **NCF Banks** | | | **Control Banks** | | |
|---|---|---|---|---|---|---|
| | Post | Pre | Diff. | Post | Pre | Diff. |
| **Panel A. Percent of total assets** | | | | | | |
| Risk-weighted assets | 0.50 (0.17) | 0.49 (0.20) | 0.01 | 0.58 (0.10) | 0.48 (0.13) | 0.10 |
| Low-risk assets | 0.42 (0.20) | 0.42 (0.20) | 0.00 | 0.21 (0.09) | 0.26 (0.08) | -0.06 |
| High-risk assets | 0.51 (0.16) | 0.49 (0.21) | 0.02 | 0.54 (0.07) | 0.41 (0.15) | 0.13 |
| **Panel B. Condition data** | | | | | | |
| Tier 1 capital | 0.33 (0.24) | 0.26 (0.19) | 0.07 | 0.18 (0.10) | 0.29 (0.25) | -0.10 |
| CAR | 0.15 (0.07) | 0.11 (0.07) | 0.03* | 0.12 (0.08) | 0.14 (0.09) | -0.01 |
| NPL ratio | 0.05 (0.06) | 0.06 (0.07) | -0.01 | 0.17 (0.13) | 0.11 (0.06) | 0.07 |
| LLRL | 0.04 (0.05) | 0.05 (0.05) | -0.01 | 0.10 (0.06) | 0.08 (0.05) | 0.02 |
| Non-interest expenses | 0.01 (0.00) | 0.01 (0.00) | -0.00* | 0.01 (0.00) | 0.01 (0.00) | 0.00 |
| ROA | 0.00 (0.00) | 0.00 (0.00) | 0.00 | -0.00 (0.00) | 0.01 (0.05) | 0.00 |
| ROE | 0.03 (0.02) | 0.03 (0.05) | 0.00 | -0.01 (0.06) | 0.01 (0.05) | -0.02 |
| Liquidity ratio | 0.77 (0.26) | 0.74 (0.25) | 0.03 | 0.50 (0.14) | 0.67 (0.26) | -0.18 |
| FX income | 0.11 (0.09) | 0.14 (0.12) | -0.03 | 0.07 (0.10) | 0.12 (0.10) | -0.05** |
| NIM | 0.01 (0.00) | 0.01 (0.00) | 0 | 0.01 (0.00) | 0.01 (0.00) | 0.00 |
| Income diversification | 0.39 (0.18) | 0.39 (0.16) | 0 | 0.42 (0.26) | 0.47 (0.16) | -0.05 |
| Funding | 0.10 (0.12) | 0.14 (0.15) | -0.04 | 0.07 (0.04) | 0.05 (0.04) | 0.02 |
| *Observations* | 595 | 511 | | 397 | 365 | |

#### 3.5.1.2 Parallel trends in risk evolution: Treated vs. Control Banks

To provide an initial assessment of risk dynamics surrounding the implementation of the Bank of Zambia's New Capital Adequacy Framework (NCF) on 30 January 2012, Figures 1 and 2 plot the evolution of risk outcomes for treated and control banks over a 36-month window around the reform. Two complementary indicators are examined: a regulatory risk measure, proxied by the Tier 1 capital ratio, and a non-regulatory insolvency risk measure, proxied by the natural logarithm of the inverse Z-score (e.g., Bostandzic et al., 2022). Figure 1 illustrates the average Tier 1 capital ratio for treated and control banks, while Figure 2 traces the evolution of the log inverse Z-score.

Figure 1 provides partial support for the parallel trends assumption. During the earlier pre-treatment period (-36 to approximately -15 months), the trajectories of treated and control banks are broadly similar. Some divergence emerges between approximately -15 and -6 months prior to the reform, as the control group exhibits a moderate decline in capital ratios relative to treated banks. However, from roughly six months before implementation to approximately 12 months after the reform, the trends again appear broadly parallel. A pronounced divergence then emerges thereafter. Treated banks recapitalise substantially, while control banks display no comparable adjustment. From month +12 onward – corresponding to the Bank of Zambia's original recapitalisation deadline of 31 December 2012 (later extended to 31 December 2013) – Tier 1 capital ratios among treated banks increase sharply relative to the control group. The spike observed, particularly after month +18, is driven mainly by one treated bank whose Tier 1 ratio rose from 31 percent to 159 percent following a substantial capital injection undertaken to meet the regulatory requirement prior to the compliance deadline at month +24 (i.e., 31 December 2013). Specifically, the bank's capital increased by K443 million (449 percent), compared with only a K22.6 million (7.1 percent) increase in risk-weighted assets. This pattern is consistent with the type of post-reform divergence expected under a treatment effect. Overall, the graphical evidence suggests that the 2012 recapitalisation reform generated a substantial strengthening of Tier 1 capital ratios among treated banks.

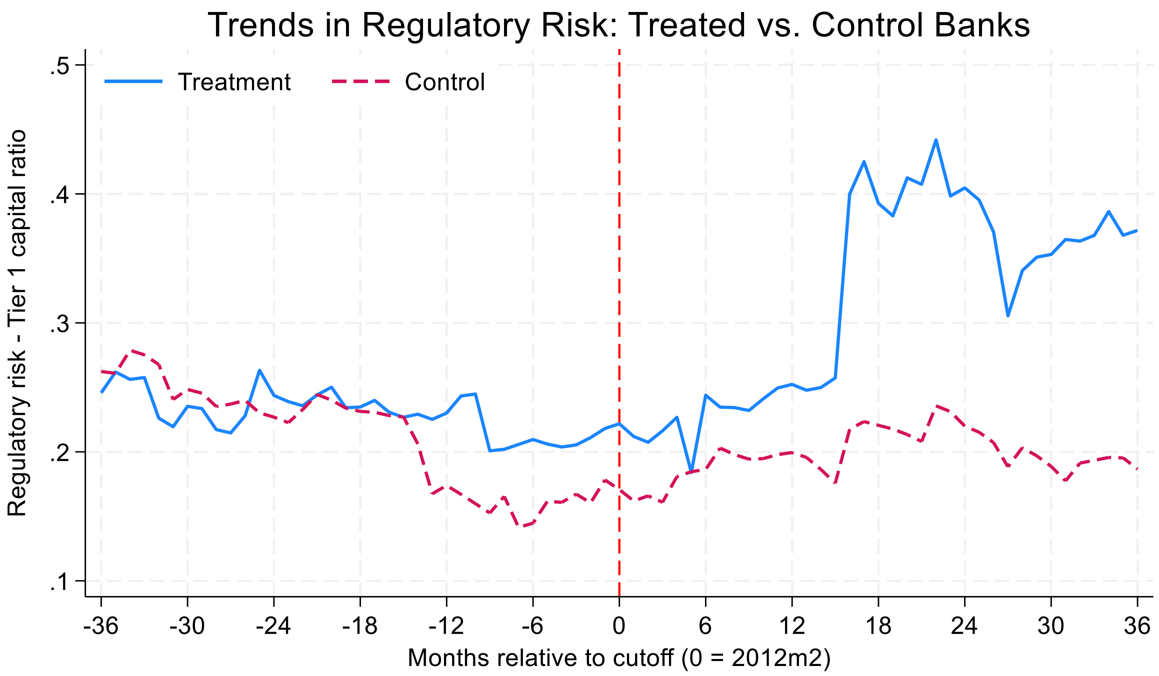



**Figure 1.** The visual plot to test the parallel trends assumption (Tier 1 capital)

Figure 2 provides complementary evidence on the evolution of insolvency risk. Between approximately -36 and -24 months prior to the reform, both treated and control banks exhibit rising insolvency risk trends, while during the -24 to -12 month period both groups display declining trends. No clear divergence is observed between the two groups during the immediate pre-reform window of approximately -12 to -6 months. Similarly, from around four months to twelve months after the reform, both treated and control banks continue to follow comparable downward trends in insolvency risk. A pronounced divergence emerges only after approximately 12 months following implementation. Treated banks experience a sustained decline in insolvency risk, largely reflecting the substantial recapitalisation undertaken by these institutions relative to the control group. This post-reform divergence is consistent with the emergence of a treatment effect rather than the continuation of pre-existing dynamics. Overall, the graphical evidence supports the plausibility of the parallel trends assumption during the immediate pre-treatment period (-24 to -1 months). Nevertheless, formal statistical assessment of the parallel trends assumption – particularly through placebo tests – is necessary to further reinforce this interpretation[76].

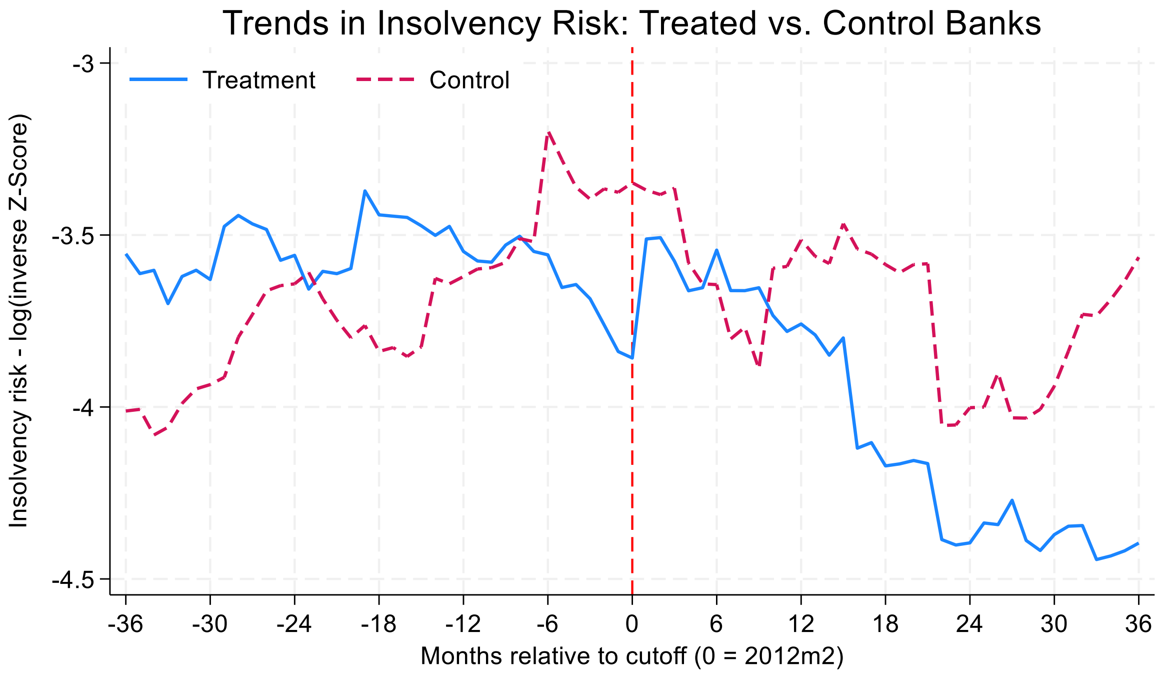



**Figure 2.** The visual plot to test the parallel trends assumption (log inverse Z-score)

[76] Placebo tests conducted in Section 3.6.1 further support the absence of differential pre-trends between the treated and control groups.

### 3.5.2 Baseline results

This section presents the main DID regression results based on the estimation of Equation (1), testing hypotheses **H1a** versus **H1b** (Section 3.3.5.1.1) and **H2a** versus **H2b** (Section 3.3.5.1.2). Across all tables, four alternative model specifications are reported, with Column (4) representing the main specification. Given the established role of CAMELS indicators as measures of bank default risk (e.g., Cole and White, 2012) and broader bank risk characteristics (e.g., Berger et al., 2020; Duchin and Sosyura, 2014), the analysis supplements the baseline regressions with alternative specifications that exclude these variables.

This approach addresses concerns raised in the literature – particularly by Berger et al. (2020) – that including CAMELS variables as controls may generate a "bad controls" problem if some of these variables are themselves affected by the treatment, thereby biasing the estimated treatment effects. Accordingly, Column (2) excludes CAMELS proxies when estimating the effects of the NCF on bank risk. Column (3) retains only CAMELS indicators while excluding the remaining control variables. Column (1) includes only bank and time fixed effects, without additional controls. Column (4), the main specification, incorporates the full set of controls, including both CAMELS indicators and broader bank-specific fundamentals, together with bank and time fixed effects.

#### 3.5.2.1 Portfolio risk analysis

This section evaluates whether the imposition of an implicit leverage ratio (equity-to-assets ratio or CAR) substantially above Basel III standards induced risk-shifting toward higher-credit-risk assets (**H1a**) or, alternatively, encouraged more conservative portfolio allocation behaviour (**H1b**). Put differently, the analysis examines whether the stricter equity requirements introduced under the NCF prompted treated banks to migrate toward higher risk-weighted assets or instead reinforced a safer portfolio structure. To address this question, Equation (1) is estimated using: (i) the average risk weight of assets (RWATA), and (ii) two asset-category proxies for credit risk exposure – low-risk assets (RWA_LRA) and high-risk assets (RWA_HRA). The DID framework compares foreign-owned "NCF banks," which were subject to substantially higher capital requirements, with locally owned control banks in order to assess whether the reform induced movement toward higher-risk exposures (**H1a**) or toward lower-risk portfolios (**H1b**). The results are reported in Tables 6–8.

For aggregate portfolio risk intensity (Table 6, RWATA), the DID coefficient is consistently negative across specifications, indicating lower average risk weights among treated banks following the implementation of the NCF. Although statistical significance varies across models – the coefficient is significant in the specification containing only CAMELS controls but becomes statistically imprecise in the fully controlled model that additionally includes income diversification and bank size (**Model 4** coefficient: -0.042; t-statistic: -1.45) – the uniformly negative coefficients suggest an economically meaningful reduction in portfolio risk intensity of approximately 4 to 8 percentage points.

The results for the bucketed asset measures reported in Tables 7 and 8 further reinforce this interpretation. For low-risk assets (RWA_LRA; Table 7), there is no evidence that NCF banks reduced safer asset exposures. If anything, the estimated coefficients point toward a modest increase in the share of low-risk assets – approximately 1.5 to 3.0 percentage points – although the estimates are not statistically distinguishable from zero. For high-risk assets (RWA_HRA; Table 8), the DID coefficients are consistently negative and statistically insignificant across specifications, indicating no evidence of migration toward higher-risk asset categories and instead suggesting mild portfolio de-risking of approximately 4 to 7 percentage points.

To complement the risk-weight evidence, Equation (1) is also estimated using two additional credit-risk indicators: (i) the ratio of loan-loss reserves to total loans (LLRL, Table

9), which captures expected credit losses ex ante; and (ii) the ratio of non-performing loans to total loans (NPL, Table 10), which measures realised ex post asset-quality deterioration. In Table 9, the DID coefficient for LLRL is negative across all four specifications, ranging from approximately -0.03 to -0.04. In the fully specified model (**Model 4**), the coefficient is -0.043 (t-statistic = -1.99), marginally significant at the 10 percent level. Economically, this suggests a meaningful decline in expected credit losses among treated banks relative to the control group. Because LLRL is an ex ante measure of risk, the negative DID estimate is inconsistent with increased post-reform risk-taking and instead points toward improved expected asset quality, consistent with the RWATA, RWA_LRA, and RWA_HRA findings. The ex post credit-risk results convey a similar message. In Table 10, where risk is measured using the NPL ratio, the DID coefficient remains negative across all specifications, ranging from approximately -0.079 to -0.089. In the main specification (**Model 4**), the coefficient equals -0.089 (t-statistic = -2.15), significant at the 5 percent level, indicating a post-reform decline in realised loan defaults among treated banks relative to controls. When considered together with the evidence from Tables 6–9, these results provide no support for the risk-shifting hypothesis. Instead, they consistently point toward portfolio de-risking, reflected in lower average risk weights, reduced provisioning requirements, and lower realised credit losses.

Taken together, the results reported in Tables 6–10 strongly reject the risk-shifting hypothesis (**H1a**) and instead support **H1b**. The NCF, implemented as a large regulatory-driven equity capital shock, did not induce treated banks to shift toward higher-risk-weighted assets. On the contrary, the evidence consistently indicates a reduction in overall portfolio risk intensity, characterised by lower average risk weights, stable or increasing low-risk asset exposures, declining loan-loss provisions, and lower non-performing loan ratios. Importantly, the reform required compliance through genuine equity recapitalisation rather than through the achievement of higher capital ratios via balance-sheet contraction, which appears to have reinforced more conservative portfolio behaviour rather than incentivising risk-shifting. These findings suggest that materially higher equity capital requirements, when explicitly linked to new equity injections, can strengthen bank resilience without generating adverse incentives for excessive portfolio risk-taking or destabilising balance-sheet reallocation.

**Table 6. Impact of the NCF on bank portfolio risk-shifting.**

This table presents results from the DID regressions assessing the effect of Zambia's New Capital Adequacy Framework (NCF) on banks' portfolio risk-shifting behaviour. The primary risk indicator is the average risk-weight (RWATA). NCFBank is a dummy equal to 1 for foreign-owned banks subject to the significantly higher minimum capital requirement under the NCF, and 0 otherwise. Post is a time dummy set to 1 for periods after 2012:M1 and 0 otherwise. The interaction term (NCFBank × Post) is the DID estimator, capturing the post-NCF treatment effect. A positive and significant coefficient on the DID term would indicate that the higher equity capital requirements under the NCF induced banks to shift toward riskier asset portfolios, while a negative coefficient would imply reduced portfolio risk following the reform. All continuous variables are Winsorised at the 1st and 99th percentiles. Variable definitions are provided in Table 1. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

| | **Excluding All Bank Controls** | **Excluding CAMELS Only** | **Including CAMELS Only** | **Main Specification with All Controls** |
|---|---|---|---|---|
| Dependent Variable: | RWATA | RWATA | RWATA | RWATA |
| | (1) | (2) | (3) | (4) |
| *NCFBank x Post* | -0.084* | -0.070 | -0.054** | -0.042 |
| | (-2.01) | (-1.69) | (-2.17) | (-1.45) |
| **CAMELS:** | | | | |
| *Capital adequacy (CAR)* | | | 0.154 | 0.096 |
| | | | (1.32) | (0.87) |
| *Asset quality (NPL)* | | | 0.055 | 0.061 |
| | | | (0.51) | (0.56) |
| *Management soundness (NONIE)* | | | 1.870 | -0.287 |
| | | | (1.18) | (-0.13) |
| *Earnings (NIM)* | | | 0.919 | 0.270 |
| | | | (0.79) | (0.25) |
| *Liquidity (LDR)* | | | 0.242*** | 0.234*** |
| | | | (4.52) | (4.10) |
| *Sensitivity to market risk (FXINC)* | | | -0.104** | -0.080 |
| | | | (-2.69) | (-1.69) |
| **OTHER CONTROLS:** | | | | |
| *Income diversification (INCDF)* | | -0.092** | | -0.022 |
| | | (-2.30) | | (-0.76) |
| *Bank size (ln(GTA))* | | -0.039 | | -0.042 |
| | | (-1.20) | | (-1.67) |
| *Constant* | 0.555*** | 1.135** | 0.375*** | 0.996** |
| | (40.45) | (2.48) | (8.75) | (2.64) |
| *Bank fixed effects* | YES | YES | YES | YES |
| *Time fixed effects* | YES | YES | YES | YES |
| *Observations* | 2336 | 2319 | 2315 | 2315 |
| *Adj R-squared* | 0.568 | 0.584 | 0.689 | 0.694 |
| *F-test* | 4.032 | 2.360 | 16.214 | 16.804 |
| *Prob>F* | 0.063 | 0.113 | 0.000 | 0.000 |

**Table 7. Impact of the NCF on bank exposure to low-risk assets (RWA_LRA).**

This table reports the DID regression estimates examining the effect of Zambia's New Capital Adequacy Framework (NCF) on banks' allocation toward low-risk credit exposures (RWA_LRA). NCF Bank is a dummy equal to 1 for foreign-owned banks subject to substantially higher minimum capital requirements under the NCF, and 0 otherwise. Post is a time dummy equal to 1 for periods after 2012:M1 and 0 otherwise. The interaction term (NCFBank × Post) is the DID estimator, identifying the treatment effect of the NCF. A negative and statistically significant coefficient on the DID term would indicate that banks reduced their holdings of low-risk assets, potentially accompanied by greater exposure to high-risk assets, consistent with risk-shifting toward riskier portfolios. Conversely, a positive coefficient would suggest that the reform encouraged a more conservative and safer portfolio allocation. All continuous variables are Winsorised at the 1st and 99th percentiles. Variable definitions are provided in Table 1. Standard significance levels are denoted by *, **, and *** for the 10%, 5%, and 1% thresholds, respectively.

| | **Excluding All Bank Controls** | **Excluding CAMELS Only** | **Including CAMELS Only** | **Main Specification with All Controls** |
|---|---|---|---|---|
| Dependent Variable: | RWA (LRA) | RWA (LRA) | RWA (LRA) | RWA (LRA) |
| | (1) | (2) | (3) | (4) |
| *NCFBank x Post* | 0.030 | 0.023 | 0.016 | 0.015 |
| | (0.79) | (0.59) | (0.53) | (0.40) |
| **CAMELS:** | | | | |
| *Capital adequacy (CAR)* | | | 0.415*** | 0.424*** |
| | | | (4.27) | (4.55) |
| *Asset quality (NPL)* | | | 0.052 | 0.051 |
| | | | (0.50) | (0.49) |
| *Management soundness (NONIE)* | | | -5.503** | -4.959** |
| | | | (-2.61) | (-2.43) |
| *Earnings (NIM)* | | | 1.507 | 1.060 |
| | | | (1.00) | (0.81) |
| *Liquidity (LDR)* | | | -0.166*** | -0.166*** |
| | | | (-3.12) | (-3.11) |
| *Sensitivity to market risk (FXINC)* | | | 0.042 | 0.059 |
| | | | (1.40) | (1.56) |
| **OTHER CONTROLS:** | | | | |
| *Income diversification (INCDF)* | | 0.010 | | -0.024 |
| | | (0.31) | | (-0.78) |
| *Bank size (ln(GTA))* | | 0.018 | | 0.008 |
| | | (0.40) | | (0.23) |
| *Constant* | 0.326*** | 0.074 | 0.385*** | 0.278 |
| | (19.38) | (0.12) | (7.87) | (0.58) |
| *Bank fixed effects* | YES | YES | YES | YES |
| *Time fixed effects* | YES | YES | YES | YES |
| *Observations* | 1732 | 1731 | 1730 | 1730 |
| *Adj R-squared* | 0.787 | 0.788 | 0.852 | 0.852 |
| *F-test* | 0.628 | 0.304 | 8.843 | 10.897 |
| *Prob>F* | 0.440 | 0.822 | 0.000 | 0.000 |

**Table 8. Impact of the NCF on bank exposure to high-risk assets (RWA_HRA).**
This table presents DID regression results evaluating the impact of Zambia's NCF on banks' allocation toward high-risk credit exposures (RWA_HRA). NCF Bank is a dummy equal to 1 for foreign-owned banks subject to substantially higher minimum capital requirements under the NCF, and 0 otherwise. Post is a time dummy equal to 1 for periods after 2012:M1 and 0 otherwise. The interaction term (NCFBank × Post) is the DID estimator, identifying the treatment effect of the NCF. A positive and significant coefficient on the DID term (NCFBank × Post) would provide evidence of risk-shifting into higher-risk assets following the reform, while a negative coefficient would indicate that the NCF curbed banks' appetite for riskier exposures. All continuous variables are Winsorised at the 1st and 99th percentiles. Variable definitions are provided in Table 1. Standard significance levels are denoted by *, **, and *** for the 10%, 5%, and 1% thresholds, respectively.

| | **Excluding All Bank Controls** | **Excluding CAMELS Only** | **Including CAMELS Only** | **Main Specification with All Controls** |
|---|---|---|---|---|
| Dependent Variable: | RWA (HRA) | RWA (HRA) | RWA (HRA) | RWA (HRA) |
| | (1) | (2) | (3) | (4) |
| *NCFBank x Post* | -0.067 | -0.074 | -0.046 | -0.041 |
| | (-0.86) | (-1.20) | (-0.84) | (-0.78) |
| **CAMELS:** | | | | |
| *Capital adequacy (CAR)* | | | 0.063 | 0.041 |
| | | | (0.39) | (0.26) |
| *Asset quality (NPL)* | | | -0.076 | -0.071 |
| | | | (-0.77) | (-0.71) |
| *Management soundness (NONIE)* | | | -7.304*** | -7.699** |
| | | | (-3.36) | (-2.31) |
| *Earnings (NIM)* | | | 4.396 | 3.498 |
| | | | (1.64) | (1.29) |
| *Liquidity (LDR)* | | | 0.317*** | 0.311*** |
| | | | (3.48) | (3.43) |
| *Sensitivity to market risk (FXINC)* | | | -0.025 | 0.016 |
| | | | (-0.49) | (0.26) |
| **OTHER CONTROLS:** | | | | |
| *Income diversification (INCDF)* | | -0.158* | | -0.053 |
| | | (-2.10) | | (-1.15) |
| *Bank size (ln(GTA))* | | 0.040 | | -0.012 |
| | | (0.60) | | (-0.35) |
| *Constant* | 0.525*** | 0.038 | 0.368*** | 0.573 |
| | (20.56) | (0.04) | (6.22) | (1.08) |
| *Bank fixed effects* | YES | YES | YES | YES |
| *Time fixed effects* | YES | YES | YES | YES |
| *Observations* | 2337 | 2320 | 2316 | 2316 |
| *Adj R-squared* | 0.372 | 0.405 | 0.607 | 0.609 |
| *F-test* | 0.733 | 3.614 | 20.033 | 29.094 |
| *Prob>F* | 0.405 | 0.038 | 0.000 | 0.000 |

**Table 9. Impact of the NCF on bank portfolio credit risk (LLRL).**

This table presents results from difference-in-differences (DID) regressions assessing the effect of Zambia's New Capital Adequacy Framework (NCF) on banks' portfolio credit risk. The primary risk indicator is the loan-loss reserves to total loans ratio (LLRL), an ex-ante credit risk metric, which proxies expected future losses. NCF Bank is a dummy equal to 1 for foreign-owned banks subject to the significantly higher minimum capital requirement under the NCF, and 0 otherwise. Post is a time dummy set to 1 for periods after 2012:M1 and 0 otherwise. The interaction term (NCFBank × Post) is the DID estimator, capturing the post-NCF treatment effect. A significantly positive DID coefficient would suggest that the higher equity capital requirements under the NCF increased banks' *ex ante* portfolio credit risk, whereas a negative coefficient would indicate that the reform reduced portfolio credit risk. All continuous variables are Winsorised at the 1st and 99th percentiles. Variable definitions are provided in Table 1. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

| | **Excluding All Bank Controls** | **Excluding CAMELS Only** | **Including CAMELS Only** | **Main Specification with All Controls** |
|---|---|---|---|---|
| Dependent Variable: | LLRL | LLRL | LLRL | LLRL |
| | (1) | (2) | (3) | (4) |
| *NCFBank x Post* | -0.031 | -0.038 | -0.037* | -0.043* |
| | (-1.46) | (-1.70) | (-1.90) | (-1.99) |
| **CAMELS:** | | | | |
| *Capital adequacy (CAR)* | | | -0.248*** | -0.221*** |
| | | | (-5.05) | (-4.28) |
| *Management soundness (NONIE)* | | | -0.218 | 0.908 |
| | | | (-0.24) | (0.84) |
| *Earnings (NIM)* | | | -0.142 | 0.039 |
| | | | (-0.20) | (0.04) |
| *Liquidity (LIQR)* | | | 0.087*** | 0.087*** |
| | | | (4.53) | (4.31) |
| *Sensitivity to market risk (FXINC)* | | | -0.025 | -0.029* |
| | | | (-1.59) | (-1.99) |
| **OTHER CONTROLS:** | | | | |
| *Income diversification (INCDF)* | | 0.002 | | 0.001 |
| | | (0.17) | | (0.05) |
| *Bank size (ln(GTA))* | | 0.021 | | 0.022 |
| | | (1.71) | | (1.22) |
| *Constant* | 0.073*** | -0.225 | 0.056*** | -0.257 |
| | (10.42) | (-1.30) | (3.42) | (-1.00) |
| *Bank fixed effects* | YES | YES | YES | YES |
| *Time fixed effects* | YES | YES | YES | YES |
| *Observations* | 2334 | 2319 | 2319 | 2319 |
| *Adj R-squared* | 0.520 | 0.539 | 0.570 | 0.580 |
| *F-test* | 2.138 | 1.373 | 14.155 | 7.319 |
| *Prob>F* | 0.164 | 0.289 | 0.000 | 0.001 |

**Table 10. Impact of the NCF on bank portfolio credit risk (NPL).**

This table presents results from difference-in-differences (DID) regressions assessing the effect of Zambia's New Capital Adequacy Framework (NCF) on banks' portfolio credit risk. The primary risk indicator is the non-performing loans to total loans ratio (NPL), an ex-post credit risk metric, which captures realised deterioration in asset quality. NCF Bank is a dummy equal to 1 for foreign-owned banks subject to the significantly higher minimum capital requirement under the NCF, and 0 otherwise. Post is a time dummy set to 1 for periods after 2012:M1 and 0 otherwise. The interaction term (NCFBank × Post) is the DID estimator, capturing the post-NCF treatment effect. A significantly positive DID coefficient would suggest that the higher equity capital requirements under the NCF increased banks' *ex post* portfolio credit risk, whereas a negative coefficient would indicate that the reform reduced portfolio credit risk. All continuous variables are Winsorised at the 1st and 99th percentiles. Variable definitions are provided in Table 1. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

| | **Excluding All Bank Controls** | **Excluding CAMELS Only** | **Including CAMELS Only** | **Main Specification with All Controls** |
|---|---|---|---|---|
| Dependent Variable: | NPL | NPL | NPL | NPL |
| | (1) | (2) | (3) | (4) |
| *NCF Bank x Post* | -0.079 | -0.084* | -0.085* | -0.089** |
| | (-1.71) | (-1.90) | (-2.06) | (-2.15) |
| **CAMELS:** | | | | |
| *Capital adequacy (CAR)* | | | -0.267*** | -0.248** |
| | | | (-3.05) | (-2.64) |
| *Management soundness (NONIE)* | | | -0.329 | 0.132 |
| | | | (-0.17) | (0.09) |
| *Earnings (NIM)* | | | -1.867 | -1.473 |
| | | | (-1.24) | (-0.92) |
| *Liquidity (LIQR)* | | | 0.105*** | 0.104*** |
| | | | (3.17) | (3.10) |
| *Sensitivity to market risk (FXINC)* | | | -0.048** | -0.065** |
| | | | (-2.22) | (-2.19) |
| **OTHER CONTROLS:** | | | | |
| *Income diversification (INCDF)* | | 0.022 | | 0.020 |
| | | (0.63) | | (0.65) |
| *Bank size (ln(GTA))* | | 0.016 | | 0.011 |
| | | (0.79) | | (0.49) |
| *Constant* | 0.118*** | -0.118 | 0.109*** | -0.056 |
| | (7.88) | (-0.41) | (3.88) | (-0.18) |
| *Bank fixed effects* | YES | YES | YES | YES |
| *Time fixed effects* | YES | YES | YES | YES |
| *Observations* | 2333 | 2318 | 2318 | 2318 |
| *Adj R-squared* | 0.536 | 0.543 | 0.565 | 0.567 |
| *F-test* | 2.937 | 1.682 | 5.851 | 4.646 |
| *Prob>F* | 0.107 | 0.213 | 0.003 | 0.005 |

#### 3.5.2.2 Analysis of bank insolvency risk

Binding minimum capital requirements, such as leverage ratios, are intended to reduce the probability of bank insolvency by constraining excessive leverage (Kahane, 1977). Insolvency risk refers to the likelihood that portfolio losses exceed a bank's equity capital within a given period (Mare et al., 2017; Yeyati and Micco, 2007). Both theoretical and empirical studies suggest, however, that binding leverage requirements may alter banks' portfolio incentives and potentially encourage greater risk-taking.

In the framework developed by Fatouh et al. (2024), a bank's aggregate risk profile reflects the interaction between rising portfolio risk and lower leverage. Their model predicts that, when a leverage ratio is introduced into a regime previously governed only by risk-based capital requirements, banks may respond by increasing asset risk while simultaneously reducing total assets for a given level of capital. Consequently, although portfolio risk rises, leverage declines, implying lower insolvency risk. The net effect on overall bank risk therefore depends on the relative strength of these two opposing forces. To evaluate the combined effect of changes in capital structure and portfolio composition on banks' overall risk profiles, the final stage of the analysis employs the Z-score as a comprehensive measure of insolvency risk.

The Z-score is particularly appropriate because it captures a bank's distance to insolvency by jointly incorporating leverage and portfolio risk dimensions (Duchin and Sosyura, 2014). More specifically, the Z-score combines three key determinants of insolvency risk: (i) profitability, (ii) earnings volatility, and (iii) leverage (Yeyati and Micco, 2007). Under hypothesis **H2a**, if banks respond to the introduction of a binding leverage ratio by reducing total assets while simultaneously increasing portfolio risk, and if the increase in asset risk outweighs the stabilising effect of lower leverage, overall insolvency risk may rise. Conversely, under **H2b**, when a binding leverage ratio is enforced and compliance is achieved primarily through fresh equity injections rather than balance-sheet deleveraging, stronger capitalisation leads to an unambiguous reduction in leverage and, consequently, lower insolvency risk.

#### 3.5.2.2.1 Bank leverage and insolvency risk

A sufficiently binding leverage ratio requirement, particularly when enforced through regulatory-driven recapitalisation, is expected to reduce overall leverage and thereby lower bank insolvency risk. To evaluate the effects of the NCF on insolvency risk, we estimate the DID model specified in Equation (1), using the implicit regulatory leverage ratio – defined as Tier 1 capital relative to total assets – as the dependent variable, following Fatouh et al. (2024). The DID coefficient captures the causal effect of the capital reform on treated banks. In this context, a positive and statistically significant coefficient indicates higher capitalisation – implying lower leverage and reduced insolvency risk – whereas a negative and significant coefficient would suggest declining capitalisation and heightened insolvency risk.

As reported in Table 11, the DID coefficient is positive and generally statistically significant across all model specifications, indicating that foreign-owned banks (the treated group) increased their implicit regulatory leverage ratios following the implementation of the New Capital Framework (NCF). This finding points to stronger capital positions and lower insolvency risk among treated banks. The estimated DID effect ranges from 0.045 to 0.062, implying that treated banks increased their leverage ratios by approximately 4.5 to 6.2 percentage points relative to the control group. In the main specification (**Model 4**), the estimated effect is 0.059 ($t = 2.39$), significant at the 5 percent level, suggesting that treated banks increased their equity-to-assets ratios by an average of 5.9 percentage points following the reform. The magnitude of this increase is economically substantial. Relative to the sample average capital adequacy ratio (CAR) of 15.2 percent, the estimated increase corresponds to approximately a 30–39 percent rise in the implicit leverage ratio. Moreover, the increase substantially exceeds the average global increase in leverage ratios observed under Basel III, where the average leverage ratio rose from 3.5 percent in 2011 to 6.5 percent in 2021 (BCBS, 2022, p. 13). In economic terms, the estimated effect therefore reflects a material strengthening of banking-sector solvency and loss-absorbing capacity following the NCF recapitalisation reform.

**Table 11. Effect of the NCF on bank leverage (Insolvency Risk).**

This table presents results from difference-in-differences (DID) regressions evaluating the effect of Zambia's New Capital Adequacy Framework (NCF) on bank leverage (insolvency risk). The dependent variable is the leverage ratio, defined as Tier 1 capital divided by total assets. An increase in the leverage ratio reflects a lower degree of leverage and, hence, reduced insolvency risk. NCF Bank is a dummy equal to 1 for foreign-owned banks subject to the significantly higher minimum capital requirement introduced under the NCF, and 0 otherwise. Post is a time dummy equal to 1 for periods after 2012:M1 and 0 otherwise. The interaction term (NCFBank × Post) is the DID estimator, capturing the causal effect of the reform on treated banks. A positive (negative) and significant coefficient on the DID term denotes a higher (lower) leverage ratio, implying reduced (increased) insolvency risk. All continuous variables are Winsorised at the 1st and 99th percentiles. Variable definitions are provided in Table 1. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

| | **Excluding All Bank Controls** | **Excluding CAMELS Only** | **Including CAMELS Only** | **Main Specification with All Controls** |
|---|---|---|---|---|
| Dependent Variable: | Leverage ratio | Leverage ratio | Leverage ratio | Leverage ratio |
| | (1) | (2) | (3) | (4) |
| *NCFBank x Post* | 0.047* | 0.062** | 0.045* | 0.059** |
| | (1.85) | (2.64) | (1.91) | (2.39) |
| **CAMELS:** | | | | |
| *Asset quality (NPL)* | | | -0.000 | 0.018 |
| | | | (-0.00) | (0.28) |
| *Management soundness (NONIE)* | | | 5.343*** | 2.359 |
| | | | (3.28) | (1.64) |
| *Earnings (NIM)* | | | 3.566 | 2.448 |
| | | | (1.64) | (1.23) |
| *Sensitivity to market risk (FXINC)* | | | 0.064* | 0.108** |
| | | | (1.76) | (2.37) |
| **OTHER CONTROLS:** | | | | |
| *Income diversification (INCDF)* | | -0.033 | | -0.042 |
| | | (-1.15) | | (-1.46) |
| *Bank size (ln(GTA))* | | -0.072*** | | -0.055** |
| | | (-3.71) | | (-2.79) |
| *Constant* | 0.137*** | 1.139*** | 0.052 | 0.854*** |
| | (17.77) | (4.16) | (1.54) | (3.28) |
| *Bank fixed effects* | YES | YES | YES | YES |
| *Time fixed effects* | YES | YES | YES | YES |
| *Observations* | 2529 | 2510 | 2506 | 2506 |
| *Adj R-squared* | 0.511 | 0.603 | 0.592 | 0.623 |
| *F-test* | 3.435 | 7.082 | 3.190 | 5.608 |
| *Prob>F* | 0.081 | 0.003 | 0.033 | 0.002 |

#### 3.5.2.2.2 Aggregate level of insolvency risk

Given the evidence of stable or declining asset risk – reflected in lower average risk weights, stable or increasing allocations to safer assets, declining loan-loss provisions, and reduced non-performing loans (Tables 6–10) – together with a significant strengthening in capitalisation through higher leverage ratios (Table 11), we would expect the overall level of insolvency risk among treated banks (foreign-owned banks) to decline relative to the control group (locally owned banks). To evaluate this proposition, we estimate the DID model specified in Equation (1) using the logarithm of the inverse Z-score as the dependent variable. The Z-score provides a comprehensive measure of insolvency risk because it jointly captures both leverage and portfolio risk, the latter reflected through profitability and earnings volatility.

Table 12 reports the DID estimation results. Across all model specifications, the interaction term (NCFBank × Post) is negative and statistically significant, indicating that the higher equity capital requirements introduced under the NCF reduced the overall level of insolvency risk among treated banks relative to the control group. These findings strongly support Hypothesis **H2b**, which predicts that a binding leverage ratio – when satisfied through genuine equity recapitalisation rather than asset deleveraging – strengthens capital buffers and lowers leverage and insolvency risk. In the more parsimonious specifications, the estimated treatment effects are both economically large and statistically significant at the 1 percent level (**Model 1**: -0.886, t = -3.24; **Model 2**: -0.866, t = -3.62). When bank-specific fundamentals, including income diversification and size, are introduced in Model 2, smaller banks are unexpectedly associated with lower insolvency risk (bank size coefficient: -0.523, t = -2.30). This finding contrasts with the prior expectation that smaller banks, facing pressure to justify substantially higher capital levels, might pursue more aggressive risk-taking strategies through rapid asset expansion. Importantly, however, the inclusion of these controls has only a marginal effect on the DID coefficient, suggesting that the estimated treatment effect is not driven by underlying differences in bank size or income structure.

In **Models 3** and **4**, the inclusion of CAMELS indicators reduces the magnitude of the DID coefficient (**Model 3**: -0.555, t = -2.47; **Model 4**: -0.536, t = -2.55), lowering statistical significance from the 1 percent to the 5 percent level. This attenuation suggests that CAMELS fundamentals explain part of the variation in insolvency risk. In the fully specified model (Model 4), Tier 1 capital enters with a strong negative and statistically significant coefficient, reinforcing its stabilising role, while non-performing loans (NPLs) exhibit a positive – though only marginally significant – relationship with insolvency risk, consistent with deteriorating asset quality increasing financial fragility. Other CAMELS variables behave largely as expected; for example, higher non-interest expenses are associated with greater insolvency risk. Although the negative coefficient on bank size remains economically meaningful in Model 4, it is no longer statistically significant. In the main specification (**Model 4**), the DID coefficient of -0.536 remains statistically significant at the 5 percent level. Economically, this implies that treated banks experienced an average reduction in insolvency risk of approximately 13.8 percent relative to the sample mean following implementation of the NCF.[77] Moreover, a one-standard-deviation increase in the Tier 1 capital ratio (0.242) is associated with a 0.138 standard deviation decline in insolvency risk,[78] underscoring the material contribution of stronger capitalisation to banking-sector resilience and financial stability.

[77] We calculate this value as follows: -0.536/-3.878 = 13.8%. Here, -0.536 represents the regression coefficient on the DID term, and -3.878 is the mean value of the log(Inverse ZScore) in Table 2. For the formula, refer to Berger et al. (2020), p.11.

[78] We assess the economic significance of the estimated effect by evaluating how a one-standard-deviation increase in the Tier 1 capital adequacy ratio (i.e., 0.242) translates into a change in the insolvency risk metric. Specifically, for the DID coefficient reported in regression (**M4**) of Table 12, the economic impact is computed as ((0.242 x -0.536)/0.943 = -0.138), where 0.242 is the standard deviation of the Tier 1 capital ratio, -0.536 is the estimated DID coefficient, and 0.943 is the standard deviation of the log of the inverse Z-score. This calculation implies that a one-standard-deviation increase in capital adequacy reduces insolvency risk by approximately 0.138 standard deviations - a meaningful effect in economic terms (see Laux and Rauter, 2017, pp. 252 - 254).

Overall, the evidence reported in Tables 6–12 provides strong and internally consistent support for the conclusion that the NCF materially reduced insolvency risk among treated banks. Crucially, this reduction occurred without any corresponding increase in portfolio risk and alongside a substantial strengthening in leverage ratios. The findings therefore indicate that the reform achieved its stabilising objective through genuine equity recapitalisation rather than through balance-sheet contraction or risk-shifting behaviour. Collectively, the results provide robust empirical support for the view that materially higher equity capital requirements and binding leverage constraints can enhance bank resilience and financial stability without inducing adverse portfolio adjustments.

**Table 12. Effect of the NCF on bank overall insolvency risk.**
This table reports results from difference-in-differences (DID) regressions evaluating the impact of Zambia's New Capital Adequacy Framework (NCF) on bank insolvency risk. The dependent variable is the logarithm of the inverse Z-Score (Log(Inv. ZScore)), a standard measure of insolvency risk. NCF Bank is a dummy equal to 1 for foreign-owned banks subject to the significantly higher minimum capital requirement introduced under the NCF, and 0 otherwise. Post is a time dummy equal to 1 for periods after 2012:M1 and 0 otherwise. The interaction term (NCFBank × Post) is the DID estimator, capturing the causal effect of the reform on treated banks. A positive and significant coefficient on the DID term would indicate higher insolvency risk (consistent with higher leverage and greater risk-taking), while a negative and significant coefficient would imply reduced risk of bank insolvency following the capital reform. All continuous variables are Winsorised at the 1st and 99th percentiles. Variable definitions are provided in Table 1. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

| | **Excluding All Bank Controls** | **Excluding CAMELS Only** | **Including CAMELS Only** | **Main Specification with All Controls** |
|---|---|---|---|---|
| Dependent Variable: | Log (Inv. ZScore) | Log (Inv. ZScore) | Log (Inv. ZScore) | Log (Inv. ZScore) |
| | (1) | (2) | (3) | (4) |
| *NCFBank x Post* | -0.886*** | -0.866*** | -0.555** | -0.536** |
| | (-3.24) | (-3.62) | (-2.47) | (-2.55) |
| **CAMELS:** | | | | |
| *Capital adequacy (TIER 1)* | | | -1.269** | -1.250** |
| | | | (-2.91) | (-2.83) |
| *Asset quality (NPL)* | | | 1.375** | 1.378* |
| | | | (2.16) | (1.92) |
| *Management soundness (NONIE)* | | | 62.713*** | 47.213*** |
| | | | (3.77) | (3.42) |
| *Earnings (NIM)* | | | -8.240 | -8.933 |
| | | | (-0.63) | (-0.69) |
| *Liquidity (LIQR)* | | | -0.316 | -0.340 |
| | | | (-0.96) | (-0.94) |
| *Sensitivity to market risk (FXINC)* | | | -0.266 | -0.222 |
| | | | (-0.98) | (-0.74) |
| **OTHER CONTROLS:** | | | | |
| *Income diversification (INCDF)* | | 0.145 | | 0.058 |
| | | (0.85) | | (0.36) |
| *Bank size (ln(GTA))* | | -0.523** | | -0.306 |
| | | (-2.30) | | (-1.48) |
| *Constant* | -3.572*** | 3.847 | -3.646*** | 0.825 |
| | (-30.41) | (1.21) | (-14.37) | (0.28) |
| *Bank fixed effects* | YES | YES | YES | YES |
| *Time fixed effects* | YES | YES | YES | YES |
| *Observations* | 1766 | 1766 | 1765 | 1765 |
| *Adj R-squared* | 0.655 | 0.679 | 0.731 | 0.737 |
| *F-test* | 10.478 | 10.806 | 9.692 | 9.600 |
| *Prob>F* | 0.006 | 0.000 | 0.000 | 0.000 |

### 3.6 Additional robustness check

This section presents two robustness checks designed to strengthen the internal validity and causal interpretation of the empirical results. To reduce concerns relating to unobserved heterogeneity and potential model misspecification, we employ complementary identification strategies. First, placebo tests are conducted by simulating fictitious policy interventions during pre-reform periods in order to identify any spurious pre-trends or anticipation effects that could bias the difference-in-differences estimates. Second, recognising that time-varying unobserved factors may still threaten identification, we implement an instrumental variable (IV) approach. This provides an additional layer of causal inference by relying on a valid instrument – one that is strongly correlated with the potentially endogenous capital regulation variable while remaining orthogonal to the error term in the outcome equation.

#### 3.6.1 Placebo test and comparable results

Beyond visual inspection, which is commonly used to assess the plausibility of the parallel trends and no-anticipation assumptions in difference-in-differences analysis, recent studies increasingly advocate the use of formal statistical tests to detect pre-treatment differences (Roth et al., 2023). These regression-based approaches complement graphical diagnostics by providing direct empirical evidence on whether the identifying assumptions underlying the DID framework are likely to hold. Accordingly, we supplement the visual analysis with placebo regression tests designed to detect any spurious pre-treatment effects[79]. Specifically, we simulate a hypothetical intervention by assuming that the Bank of Zambia's New Capital Adequacy Framework (NCF), which was actually implemented in January 2012, had instead been introduced five years earlier in January 2007.

[79] Please see Section 3.5.1.2 for the graphical assessment of the parallel trends assumption.

The 2007–2008 period is particularly relevant because it coincides with the first increase in minimum paid-up capital requirements since 1995, when the Bank of Zambia raised the threshold from K2 million to K12 million (see Section 3.2.1). In addition, between 2009 and 2011, six new foreign-owned banks entered the Zambian banking sector with capital levels substantially above the revised minimum requirement. Of these six institutions, two were later classified as treated banks after 2012, while the remaining four subsequently converted to local ownership status and therefore joined the control group after failing to satisfy the higher capital thresholds imposed on foreign-owned banks. To minimise potential confounding arising from these large recapitalisation events, we exclude all six entrant banks and conduct both the placebo and actual DID analyses using a restricted sample of 12 banks. Within this sample, seven banks form the treated group (NCFBank*), while the remaining five constitute the control group.

In the placebo regressions, the post-treatment indicator ($Post_t$) is redefined as $Post_t$*, taking a value of one during the hypothetical treatment period of 2007–2008 and zero otherwise (e.g., Sobiech et al., 2025, p. 11). Under the presence of differential pre-trends unrelated to the actual reform, the placebo interaction term would be expected to load significantly. However, the results reported in Table 13 indicate that the placebo coefficients are economically small and statistically insignificant (NCFBank* × $Post_t$* = 0.209, t = 0.70 with month fixed effects; 0.204, t = 0.71 with year fixed effects). These findings provide no evidence of spurious differential movements during the placebo period and therefore strengthen confidence in the validity of the identification strategy. By contrast, the actual post-2012 DID estimate using the same restricted sample remains negative and statistically significant (NCFBank* × $Post_t$ coefficient = -0.668, t = -2.84), confirming both the plausibility of the parallel trends assumption and a substantive decline in insolvency risk among treated banks following implementation of the reform.

**Table 13. Placebo tests.**

This table reports placebo DID estimates used to test for potential pre-treatment differences. The dependent variable is insolvency risk, measured as the logarithm of the inverse Z-score. NCFBank* is a binary indicator for foreign-owned banks subject to the higher minimum capital threshold (excluding two banks dropped from the restricted sample), while $Post_t$ is a binary indicator equal to one for the post-policy period (February 2012–February 2019). For the placebo analysis, $Post_t$* is redefined to equal one during 2007-2008, simulating a counterfactual intervention in which the NCF is assumed to have been implemented five years earlier. The interaction term (NCFBank* × Post*) captures the DID estimator, representing the differential effect between treated and control banks under the assumption of no pre-existing trends. Statistical significance is denoted by *, **, and ***, corresponding to the 10%, 5%, and 1% levels.

| | **Placebo Test: Post2007-2008** (Month FE) | **Placebo Test: Post2007-2008** (Year FE) | **Comparable True DID Test** (Post: 2012-2019) |
|---|---|---|---|
| **Dependent Variable:** | Log ( Inverse of Z-Score) | Log ( Inverse of Z-Score) | Log ( Inverse of Z-Score) |
| NCFBank* × Post* | 0.209 | 0.204 | |
| | (0.70) | (0.71) | |
| NCFBank* × Post | | | -0.668** |
| | | | (-2.84) |
| *Constant* | 0.039 | 0.132 | -1.424 |
| | (0.01) | (0.05) | (-0.51) |
| *All Controls Included* | YES | YES | YES |
| *Bank Fixed Effects* | YES | YES | YES |
| *Time Fixed Effects* | YES | YES | YES |
| *Observations* | 1437 | 1437 | 1436 |
| *Adj R-squared* | 0.801 | 0.809 | 0.763 |

### 3.6.2 Endogeneity

A central empirical challenge in evaluating the effects of stricter capital requirements on bank behaviour lies in identifying plausibly exogenous variation in regulatory policy (Gropp et al., 2019, p. 267). Our identification strategy therefore relies on treating Zambia's 2012 New Capital Adequacy Framework (NCF) as a short-run exogenous policy shock (Da Rocha Lopes et al., 2025), largely unrelated to contemporaneous changes in banks' balance-sheet outcomes. Establishing causal relationships in studies of bank capital is inherently difficult because capital, risk-taking, and lending decisions are jointly determined (Evans and Haq, 2022, p. 5). Banks may simultaneously adjust capital positions and portfolio risk in response to common internal incentives or broader macroeconomic conditions. In addition, reverse causality – where changes in bank behaviour influence subsequent regulatory responses – has long been recognised as a major source of identification bias in the capital regulation literature (Acosta-Smith et al., 2024, p. 2; Zheng et al., 2019, p. 17).

#### 3.6.2.1 Instrumental variable analysis

To mitigate potential endogeneity in the relationship between capital and bank risk, we employ an instrumental variable (IV) strategy using a two-stage least squares (2SLS) estimator with both bank and time fixed effects. This approach follows established empirical practice in the banking literature (e.g., Berger and Bouwman, 2009; Nguyen et al., 2023). Specifically, current capital levels are instrumented using their own lagged values – ranging from one to three months – on the basis that these lagged capital measures are predetermined and plausibly exogenous to contemporaneous bank risk-taking behaviour. As such, they satisfy the relevance and exogeneity conditions required for valid instruments (Hansen, 2022, pp. 341-423).

The fixed-effects 2SLS framework is particularly appropriate for panel data because it controls for unobserved heterogeneity across banks and over time, thereby reducing potential omitted variable bias. In addition, the estimator is regarded as relatively robust to model misspecification and less reliant on restrictive functional-form assumptions (Nguyen et al., 2023, p. 884). In the first stage, the potentially endogenous capital variable is regressed on its lagged instruments and the full set of baseline covariates, including bank and time fixed effects.[80] The fitted values from this stage are then used in the second-stage regression to estimate the causal effect of capital on bank insolvency risk.

Table 14 reports the IV estimation results presented in Columns (1) and (2). The first-stage regression in Column (1) confirms strong instrument relevance.[81] The joint F-statistic is exceptionally large ($F(3,15) = 2{,}066$, $p < 0.001$), while the within $R^2$ of 0.85 indicates that the lagged capital variable, $w\_CAR_{t-1}$, is a strong predictor of current capital levels. Additional diagnostic tests further support instrument validity and strength (Cameron and Trivedi, 2022, pp. 310-350). The Kleibergen–Paap LM statistic rejects the null hypothesis of underidentification ($\chi^2(3) = 11.81$, $p = 0.008$), while concerns regarding weak instruments are alleviated by the Cragg–Donald F-statistic (4,224) and the Kleibergen–Paap Wald F-statistic (2,038), both of which substantially exceed conventional Stock–Yogo critical values. Moreover, the Hansen J-test of overidentifying restrictions fails to reject the null hypothesis ($\chi^2(2) = 2.77$, $p = 0.250$), indicating that the instruments are valid and orthogonal to the second-stage error term. The second-stage results reported in Column (2) show that higher capitalisation significantly reduces insolvency risk. The coefficient on w_CAR in the

[80] We adopt the approach employed by Levitt (2002, p. 1246) and Faulkender and Petersen (2006, p. 70), who explicitly incorporate fixed effects in the first-stage regressions of their two-stage least squares (2SLS) estimations. This specification ensures that unobserved heterogeneity across banks and over time is appropriately controlled for in the instrumented model, thereby strengthening the internal validity of our IV estimates.

[81] For consistent identification in instrumental variable estimation, it is essential that the instruments are relevant - that is, they must exhibit a sufficiently strong correlation with the endogenous regressors (Cameron and Trivedi, 2022, pp. 341 - 343). This relevance condition ensures that the instruments can adequately explain variation in the endogenous variable, allowing the two-stage least squares (2SLS) estimator to isolate the exogenous component of interest. In empirical practice, instrument strength is commonly assessed through the first-stage F-statistic, where values exceeding conventional thresholds (e.g., $F > 10$) help guard against weak instrument bias.

w_l_INVZSC equation is -4.898 (standard error = 1.362, $p < 0.001$), implying that a one-percentage-point increase in the capital ratio reduces the log inverse Z-score measure of insolvency risk by approximately 0.05. Notably, once capital is instrumented, the interaction term capturing the regulatory reform (NCFBank × Post) becomes statistically insignificant. This suggests that the decline in insolvency risk following the NCF operated primarily through the increase in bank capital (i.e., reduced leverage) induced by the reform, rather than through an independent policy effect unrelated to capital strengthening.

**Table 14. Impact of the NCF on bank insolvency risk - Instrumental variables (2SLS) estimation.**
This table reports two-stage least squares (2SLS) regression results estimating the causal effect of Zambia's 2012 New Capital Adequacy Framework (NCF) on bank insolvency risk. The dependent variable is the log of the inverse Z-score, a widely used indicator of insolvency risk (where higher values reflect greater risk). The interaction term NCFBank × Post represents the difference-in-differences (DID) treatment effect of the NCF on foreign-owned banks relative to their local counterparts. A positive and significant coefficient on the interaction term would imply that stricter capital requirements led to higher risk-taking, while a negative coefficient suggests a stabilising effect through reduced insolvency risk. All continuous covariates are Winsorised at the 1st and 99th percentiles to mitigate the influence of outliers. Detailed variable definitions are provided in Table 1. Statistical significance at the 10%, 5%, and 1% thresholds is denoted by *, **, and ***, respectively.

| **Test:** | **First Stage Instrumental Variable - 2SLS** | **Final Stage Instrumental Variable - 2SLS** |
|---|---|---|
| **Dependent Variables:** | CAR | Log (Inv. Zscore) |
| **Independent Variables:** | (1) | (2) |
| *L1_w_CAR* | 0.905*** | |
| | (28.46) | |
| *L2_w_CAR* | -0.103* | |
| | (-1.84) | |
| *L3_w_CAR* | 0.061* | |
| | (1.80) | |
| *w_CAR* | | -4.898*** |
| | | (-3.60) |
| *NCFBank x Post* | | 0.029 |
| | | (0.24) |
| *Bank Controls* | YES | YES |
| *Bank Fixed Effects* | YES | YES |
| *Time Fixed Effects* | YES | YES |
| *Observations* | 2288 | 1766 |
| *Underidentification test (p-value)* | | 0.008 |
| *Weak identification test (F-statistic)* | | 2038.4 |
| *Hansen test (p-value)* | | 0.250 |
| *Adjusted R-squared* | 0.944 | |
| *First Stage Wald F-test* | 2065.58*** | |

## 3.7 Policy implications and conclusion

### 3.7.1 Policy implications and regulatory recommendations

The findings of this chapter carry important implications for the ongoing debate on the design, calibration, and implementation of leverage-based capital regulation under Basel III. Most fundamentally, the evidence suggests that materially higher leverage ratio requirements – when implemented through genuine equity recapitalisation rather than balance-sheet contraction – can strengthen bank resilience without inducing destabilising portfolio risk-taking behaviour. This result directly challenges the view that binding leverage constraints necessarily encourage banks to "search for yield" by reallocating toward riskier assets in response to flat, non-risk-sensitive capital requirements.

First, the results provide empirical support for arguments that the Basel III minimum leverage ratio of 3 percent may be too low to exert a meaningful stabilising influence on bank behaviour. The Zambian experience demonstrates that a substantially higher implicit leverage ratio (approximately 15 percent for treated banks) was associated with a significant decline in insolvency risk, while simultaneously generating no evidence of risk-shifting into higher-risk asset classes. This finding lends support to proposals advanced by critics of Basel III (e.g., Admati et al., 2010; Admati and Hellwig, 2013, 2024; Hanson et al., 2011; Goldstein, 2017) advocating materially stronger equity capital standards than those embedded in the current regulatory framework. Importantly, the evidence suggests that stronger capitalisation can improve financial stability even in structurally vulnerable banking systems characterised by macroeconomic volatility, shallow financial markets, and high levels of dollarisation.

Second, the chapter highlights the importance of the mechanism through which banks comply with higher capital requirements. A central contribution of the study is the finding that the stabilising effects of leverage regulation depend critically on whether adjustment occurs through genuine equity injections or through deleveraging and asset contraction. For example, unlike the European Banking Authority post-crisis recapitalisation in 2011/2012 – where most banks met higher capital ratios by shrinking risk-weighted assets (Gropp et al., 2019) – the Zambian 2012 NCF required compliance through actual equity recapitalisation. This distinction appears crucial. The absence of adverse portfolio reallocation among treated banks suggests that equity-based recapitalisation may mitigate the procyclical effects commonly associated with deleveraging-based adjustment. For policymakers, this implies that prudential reforms focused solely on higher capital ratios may be insufficient unless accompanied by credible requirements for equity raising.

Third, the findings suggest that leverage ratios may play a more important macroprudential role in developing and highly dollarised financial systems than is typically recognised within the Basel framework. In many Sub-Saharan African banking systems, weaknesses in risk-weighting methodologies, limited supervisory capacity, shallow domestic capital markets, and large exposures to foreign exchange reserves and domestic sovereigns (i.e., zero risk weighted) may reduce the effectiveness of purely risk-weighted regulatory frameworks. Under such conditions, a simple and transparent leverage constraint can provide a useful complement – or potentially a more credible binding constraint – to risk-based capital requirements. The evidence from Zambia therefore supports the argument that leverage ratios in low-income and lower-middle-income economies should not necessarily be viewed merely as passive "backstops," but potentially as more active macroprudential instruments capable of constraining excessive leverage and strengthening resilience to systemic shocks.

Fourth, the results have important implications for the sequencing and implementation of Basel III reforms in Sub-Saharan Africa. Regulatory authorities across the region have generally adopted a cautious approach toward Basel III implementation because of concerns regarding constrained credit supply, weak banking-sector profitability, and fears that binding leverage ratios may destabilise fragile financial systems. However, the findings of this chapter suggest that stronger leverage-based capital requirements need not undermine financial stability or induce destabilising risk-taking behaviour when reforms are credibly enforced and supported by genuine equity recapitalisation. In this respect, the Zambian case demonstrates that developing economies can implement stronger prudential standards without necessarily triggering adverse portfolio responses or systemic instability.

Finally, the chapter carries broader implications for global post-Basel III policy debates following the 2023 banking turmoil in the United States and Switzerland. The collapse of Credit Suisse and stress episodes involving several regional U.S. banks reignited concerns regarding the adequacy of existing capital frameworks, despite formal compliance with Basel III requirements. The evidence presented here suggests that significantly stronger equity-based leverage requirements may materially improve resilience to systemic stress without generating the adverse incentive effects frequently emphasised in theoretical critiques of flat capital requirements. More broadly, the findings support a regulatory approach that places greater emphasis on high-quality common equity capital and credible recapitalisation mechanisms as central pillars of financial stability policy.

### 3.7.2 Chapter conclusion

This chapter examined whether leverage ratio requirements substantially above Basel III standards increase bank risk-taking or, alternatively, strengthen bank resilience without inducing destabilising behavioural responses. Exploiting Zambia's 2012 New Capital Adequacy Framework (NCF) as a quasi-natural experiment, the analysis evaluated the effects of a large regulatory-driven equity recapitalisation programme that imposed materially higher Tier 1 common equity requirements – particularly for foreign-owned banks – and effectively raised implicit leverage ratios from approximately 10 percent to 15 percent.

The empirical findings provide strong evidence that substantially higher leverage ratio requirements, when implemented through genuine equity recapitalisation, can materially strengthen bank stability without encouraging risk-shifting behaviour. Treated banks significantly increased their equity-to-assets ratios following the reform, yet there was no evidence of migration toward riskier asset classes, higher average portfolio risk, or deterioration in asset quality. Instead, treated banks experienced lower insolvency risk, reflected in improved Z-scores, declining provisioning needs, and lower realised credit losses relative to the control group. These results remained robust across multiple specifications, placebo tests, and instrumental variable estimations.

The chapter therefore contributes to an important and unresolved debate within the Basel III literature. While some theoretical frameworks predict that binding leverage constraints may encourage banks to substitute asset risk for constrained leverage, the evidence from Zambia suggests that these adverse incentives may be substantially mitigated when higher capital requirements are met through actual equity injections rather than through balance-sheet contraction. In this respect, the findings align more closely with the "skin-in-the-game" mechanism emphasised in the moral hazard literature, whereby stronger equity buffers improve incentives for prudent risk management by increasing shareholders' exposure to downside losses.

More broadly, the findings challenge the view that materially stronger leverage-based capital requirements are necessarily destabilising or excessively restrictive. Instead, the chapter provides empirical support for arguments advocating substantially higher common equity requirements than those currently embedded within Basel III. Importantly, these results are obtained within a low-income, highly dollarised, and macro-financially volatile Sub-Saharan African banking system, thereby extending existing evidence beyond advanced economies and demonstrating the relevance of stronger leverage-based prudential regulation in structurally vulnerable financial systems.

Overall, the evidence suggests that leverage ratio requirements substantially above Basel III standards – particularly when combined with mandatory equity recapitalisation – can strengthen bank solvency, reduce insolvency risk, and enhance financial stability without generating adverse portfolio risk-taking incentives. The Zambian experience therefore provides important lessons for both global Basel III debates and the future design of prudential regulation in Sub-Saharan Africa and other developing economies.

# 4 BEYOND BASEL III: STRINGENT LEVERAGE RATIO REQUIREMENTS AND BANK LIQUIDITY CREATION: EVIDENCE FROM A QUASI-NATURAL EXPERIMENT IN ZAMBIA

## 4.1 Introduction

Liquidity creation is the defining function of banks and lies at the core of the financial intermediation process (Diamond and Dybvig, 1986; Berger and Bouwman, 2017). Through maturity transformation, banks convert illiquid assets (primarily loans) into liquid liabilities such as demand deposits (Diamond and Dybvig, 1983, 2000; Bhattacharya and Thakor, 1993; Bouwman, 2018).[82] In doing so, banks create liquidity on both sides of the balance sheet (Diamond and Dybvig, 1986; Allen and Santomero, 1997). On the asset side, banks finance long-term investment and provide firms with financial flexibility through loans and credit lines, while on the liability side deposits function as a liquid and secure medium of exchange that supports transactions and the broader payments system (Beck et al., 2023).

Nonetheless, the maturity transformation process inherently exposes banks to liquidity, credit and solvency risks, making capital regulation central to financial stability (e.g., Dewatripont and Tirole, 1994; Bhattacharya et al., 1998). Adequate equity capital buffers are therefore required to absorb losses and sustain confidence in the banking system (Berger et al., 1995; Berger and Bouwman, 2009). Importantly, equity capital performs not only a loss-absorbing role but may also influence banks' ability to create liquidity itself (e.g., Coval and Thakor, 2005), thereby establishing a direct link between bank capital structure and financial intermediation capacity. From a policy perspective, understanding how stricter capital regulation affects banks' provision of financial services – particularly lending activities that

[82] Liquidity creation can be understood by comparing a world with and without banks (Bouwman, 2018, p. 4). Without banks, savers would lend directly to firms and hold illiquid claims. With banks, however, the bank lends to the firm (i.e., holding an illiquid claim against the firm "an illiquid asset") and issues demand deposits to savers (i.e., savers have a liquid claim against the bank "a liquid liability"). This mismatch between illiquid assets and liquid liabilities is what defines banks' role in creating liquidity.

constitute a key component of liquidity creation – remains critically important (Diamond and Dybvig, 1986, p. 59).

This chapter examines how significantly higher equity-to-assets (leverage ratio) requirements, substantially above Basel III standards, affect bank liquidity creation in low- and lower-middle-income Sub-Saharan African (SSA) economies, using Zambia's 2012 New Capital Adequacy Framework (NCF) as a case study. Zambia, a lower-middle-income and commodity-dependent economy (IMF, 2024), implemented sharp increases in minimum Tier 1 equity capital requirements in 2012, requiring banks to raise new equity capital against total exposures. Under the reform, foreign-owned banks experienced an increase in minimum Tier 1 equity capital from K12 million to K520 million – an increase of more than fortyfold – while locally owned banks faced a smaller but still substantial increase from K12 million to K104 million, approximately ninefold. This pronounced ownership-based differentiation provides an ideal quasi-natural experimental setting and a difference-in-differences (DID) empirical framework for assessing the effects of significantly higher equity capital requirements – well beyond Basel III standards – on bank liquidity creation.

Basel III was introduced following the 2007–2009 Global Financial Crisis (GFC) to address weaknesses in bank capital quality and excessive leverage accumulation. A central component of the reforms involved increasing the share of Common Equity Tier 1 (CET1) capital within Tier 1 capital and introducing a leverage ratio requiring a minimum of 3 percent Tier 1 capital relative to total unweighted exposures (BCBS, 2010c, 2011, 2017). This non-risk-based constraint was designed to limit excessive leverage and reduce the risk of disorderly deleveraging during periods of stress (BCBS, 2022). However, the adequacy of the 3 percent minimum leverage ratio remains widely criticised (e.g., Admati et al., 2010; Hanson et al., 2011; Admati and Hellwig, 2013, 2024; Goldstein, 2017). Admati and Hellwig (2013, 2024), for example, advocate equity-to-assets ratios in the range of 20–30 percent for the U.S. banking system in order to materially strengthen financial stability and resilience. Although global leverage ratios increased modestly following the post-GFC reforms – from 3.5 percent in 2011 to 6.5 percent in 2021 (BCBS, 2022) – the collapse of Basel III-compliant institutions such as Credit Suisse and several U.S. regional banks in 2023 renewed policy concerns regarding the adequacy of existing capital standards (BCBS, 2023; FSB, 2023). While stronger equity requirements are generally regarded as stabilising, other critics also argue that excessively binding capital rules may restrict lending and dampen economic activity, including banks' capacity to create liquidity (e.g., Calomiris and Herring, 2013; Aiyar et al., 2015; Baker and Wurgler, 2015; Cline, 2017).

The relationship between capital and liquidity creation remains theoretically and empirically contested. Berger and Bouwman (2009) classify the literature into two competing perspectives. The first, the "financial fragility crowding-out" hypothesis, argues that higher capital requirements reduce liquidity creation by weakening banks' ability to transform illiquid assets into liquid liabilities (e.g., Diamond and Rajan, 2000, 2001; Gorton and Winton, 2000, 2017). The competing "risk absorption" hypothesis posits that stronger capitalisation enhances banks' capacity to create liquidity by improving their resilience and tolerance for risk (e.g., Bhattacharya and Thakor, 1993; Repullo, 2004; Coval and Thakor, 2005). Empirical evidence remains mixed. A large body of literature reports a negative relationship between capital and liquidity creation (e.g., Evans and Haq, 2022; Kusi et al., 2022; Yeddou and Pourroy, 2020; Berger et al., 2019; Casu et al., 2019), whereas other studies document positive effects (e.g., Bawuah, 2024; Tran et al., 2016). In addition, bank size may moderate this relationship, with larger banks potentially benefiting more from stronger capitalisation in supporting liquidity creation (Berger and Bouwman, 2009).

To investigate the relationship between capital and liquidity creation, the chapter adopts a two-stage empirical strategy. First, fixed-effects panel regressions are estimated using detailed supervisory data from the Bank of Zambia to establish the baseline relationship between bank capital and liquidity creation. The analysis adapts Berger and Bouwman's (2009) "cat fat" and "cat nonfat" liquidity creation measures to reflect the structural characteristics of SSA low- and lower-middle-income economies, including shallow financial markets, elevated macroeconomic volatility, informality in financial services, and governance-related constraints affecting financial intermediation (Beck et al., 2019). The baseline results reveal a strong and statistically significant negative relationship between lagged capital-to-assets ratios (CAR) and total liquidity creation (TLQC) (coefficient = -0.798, t = -9.76), indicating that higher levels of capitalisation are associated with lower liquidity creation, consistent with the "financial fragility crowding-out" hypothesis. Economically, the estimated effect is substantial: a one-percentage-point increase in the capital-to-assets ratio corresponds to an approximately 0.798 percentage-point decline in liquidity creation.

Second, the chapter employs a DID framework to identify the causal effects of Zambia's NCF, which introduced differentiated and exclusively equity-based recapitalisation requirements. Foreign-owned banks, which form the treated group, experienced a substantial increase in equity-to-assets ratios – from an average of 10.6 percent to 15 percent following the reform, significant at the 5 percent level – while locally owned banks experienced only a modest and statistically insignificant increase from 12.9 percent to 13 percent. In the main specification, the DID coefficient is -0.047 (t = -2.12), indicating that foreign-owned banks created relatively less liquidity following implementation of the NCF compared with locally owned banks.

Although statistically significant, the economic magnitude of the effect should be interpreted cautiously. The estimate implies a decline in liquidity creation equivalent to approximately 4.7 percentage points relative to total assets, corresponding to roughly 22.6 percent of the sample mean. While economically meaningful, the reduction appears moderate rather than destabilising, particularly when considered alongside the substantial improvements in solvency and reductions in insolvency risk documented in Chapter 3. The findings therefore suggest the presence of a trade-off between stronger capitalisation and liquidity creation, although not one sufficiently large to offset the broader financial stability benefits associated with materially higher leverage-based equity capital requirements.

This study makes three principal contributions. First, it provides rare empirical evidence on the effects of significantly higher equity-to-assets (leverage ratio) requirements combined with mandatory equity recapitalisation on bank liquidity creation. Unlike conventional capital regulation, which typically emphasises higher capital ratios without explicitly mandating new equity issuance (Aiyar et al., 2015), Zambia's 2012 reform effectively combined substantially higher implicit leverage ratio requirements with compulsory equity recapitalisation. This design reduced the likelihood that banks would satisfy regulatory requirements through balance-sheet contraction, such as cutting lending activity. The study therefore differs from previous analyses of ratio-based recapitalisation exercises, including the 2011–2012 European Banking Authority (EBA) capital exercise, where many banks improved capital ratios primarily through reductions in risk-weighted assets rather than through new equity issuance (Juelsrud, 2018; Gropp et al., 2019; Bostandzic et al., 2022). In doing so, the study contributes to a growing body of literature advocating capital regulation frameworks that place greater emphasis on mandatory equity recapitalisation alongside higher capital ratio requirements (e.g., Hanson et al., 2011; Greenwood et al., 2017; Juelsrud, 2018; Gropp et al., 2019; Bostandzic et al., 2022).

Second, the study contributes causal evidence to the capital–liquidity creation literature by exploiting an exogenous regulatory capital shock. In their seminal study, Berger and Bouwman (2009, p. 3783) acknowledge that, although their findings are broadly consistent with theoretical predictions, the presence of endogeneity between capital and liquidity creation constrains causal interpretation. They suggest that regulatory-induced capital shocks could provide more credible identification strategies. Responding directly to this challenge, the present study treats Zambia's 2012 NCF as a quasi-natural experiment generating plausibly exogenous variation in bank capital levels (e.g., Gropp et al., 2019). Using a DID framework, the analysis isolates the effects of significantly higher equity recapitalisation on liquidity creation while addressing the endogeneity concerns that frequently characterise studies of capital regulation and bank behaviour (e.g., Evans and Haq, 2022; Acosta-Smith et al., 2024).

Third, the study advances empirical methodology by adapting liquidity creation measures to the structural characteristics of banking systems in SSA low- and lower-middle-income economies. Previous applications of Berger and Bouwman's (2009) framework have largely focused on advanced economies or large emerging markets characterised by deeper financial systems and stronger institutional environments. By contrast, banking systems in SSA are shaped by limited economies of scale, high levels of informality, significant exposure to sovereign and foreign currency assets, and persistent institutional and regulatory weaknesses (Beck et al., 2019). The adjusted liquidity creation measures employed in this study account for these structural realities, capturing both asset-side and liability-side constraints affecting banks' liquidity creation capacity. As such, the analysis enhances the relevance of the findings for ongoing policy debates surrounding Basel III implementation across the region.

The remainder of the chapter is organised as follows. Section 4.2 reviews the relevant literature and develops the study hypotheses. Section 4.3 describes the data, sample, and empirical methodology, while Section 4.4 outlines the model specification and regression framework. Section 4.5 presents and discusses the empirical findings, Section 4.6 reports robustness checks and additional analyses, and Section 4.7 outlines the policy implications and concludes the chapter.

## 4.2 Literature review and hypothesis development

### 4.2.1 Theoretical framework

#### 4.2.1.1 Theoretical underpinnings of bank liquidity creation

Liquidity creation is a core function of banks and lies at the heart of the financial intermediation process (Diamond and Dybvig, 1986; Berger and Bouwman, 2017). Traditional theories of financial intermediation, rooted in transaction costs and asymmetric information, explain the role of financial institutions in mobilising deposits, providing insurance-like services, and allocating funds to productive investment (Allen and Santomero, 1997).[83] Foundational theories of liquidity creation emphasise banks' ability to transform illiquid assets into liquid liabilities, thereby enhancing risk-sharing and improving the allocation of resources within the economy (Bouwman, 2018).

The seminal model of Diamond and Dybvig (1983, 2000) demonstrates how banks create liquidity by issuing demand deposits to savers while investing in illiquid long-term loans. Through this maturity transformation process, depositors are able to access funds on demand even though the bank's underlying assets remain illiquid. Demand deposits therefore provide insurance against uncertain liquidity needs (Bryant, 1980; Diamond and Dybvig, 1983), allowing individuals with short-term consumption needs to withdraw funds without imposing losses on longer-term investors. In this way, banks improve upon the outcomes achievable through decentralised markets, which cannot simultaneously provide liquidity and support efficient long-term investment. At the same time, however, the model highlights the inherent fragility of banking structures built on demand deposit contracts. Because deposits are redeemable on demand while assets remain illiquid, banks become vulnerable to self-fulfilling runs driven by panic rather than fundamentals (Diamond and Dybvig, 1983, 2000).

[83] Also, refer to Bhattacharya et al. (1998, p. 747) for a comprehensive summary of theories explaining the existence of banks.

To mitigate this fragility, both Bryant (1980) and Diamond and Dybvig (1983, 2000) emphasise the importance of deposit insurance as a stabilising institutional mechanism. Government-backed guarantees reduce incentives for premature withdrawals, thereby preserving banks' liquidity creation function and preventing disorderly runs. By weakening the link between deposit withdrawals and forced asset liquidation, deposit insurance enables banks to manage liquidity shocks more efficiently while sustaining their intermediation role. Overall, these theoretical foundations establish liquidity creation as a socially valuable yet inherently fragile banking activity that requires robust institutional safeguards, including deposit insurance and adequate capital regulation, to maintain financial stability and resilience.

#### 4.2.1.2 Theoretical foundations: Bank regulation and liquidity creation

The relationship between bank regulation and liquidity creation involves important trade-offs between financial stability and financial intermediation. While banks perform the core economic function of transforming illiquid assets, particularly loans, into liquid claims such as demand deposits, this maturity transformation process also creates inherent vulnerabilities. Historically, the combination of illiquid lending funded by demandable deposits has proven highly fragile, frequently giving rise to destabilising banking panics and systemic crises (Gorton, 1994). Consequently, regulatory frameworks are primarily designed to mitigate market failures arising from asymmetric information and systemic externalities, while preserving banks' capacity to support liquidity creation and economic activity (Diamond and Dybvig, 1986; Berger et al., 1995).

Asymmetric information, where one party possesses superior information relative to another (Akerlof, 1978), gives rise to adverse selection and moral hazard, problems that are particularly pronounced in banking because loan quality and borrower behaviour are inherently difficult to observe (Dell'Ariccia, 2001; Guesnerie et al., 1989). Banks face moral hazard not only from borrowers but also internally due to the separation of ownership and managerial control. At the same time, adverse selection increases the likelihood that lower-quality borrowers dominate credit markets (Darrough and Stoughton, 1986). More broadly, the failure of one or several banks, particularly within opaque financial systems, may trigger panic, contagion, and wider systemic instability (Randall, 1983; Berger et al., 1995).

Maturity transformation, the use of short-term deposits to finance long-term lending, lies at the core of banks' liquidity creation function (Bhattacharya and Thakor, 1993).[84] However, this process exposes banks to liquidity shocks and rollover risk, increasing the likelihood of fire sales and financial crises. Deposit insurance is commonly introduced to mitigate these vulnerabilities (Bhattacharya et al., 1998), but it may simultaneously create additional moral hazard by encouraging insured banks to undertake excessive risk at the expense of taxpayers or deposit insurers (Santos, 2001).[85] Capital regulation addresses these concerns by requiring banks to maintain sufficient loss-absorbing equity capital (Bhattacharya et al., 1998). Dewatripont and Tirole (1994) conceptualise capital requirements as governance mechanisms that compensate for the limited monitoring capacity of small and uninformed depositors. Under their "representation hypothesis," regulators effectively act on behalf of depositors to constrain excessive risk-taking by bank managers. In this sense, capital regulation

[84] Merton (1977) highlights that banks primarily serve two essential functions: providing loans to firms and individuals and acting as a riskless repository for short-term funds of firms and individuals. Depositors benefit from using banks over direct market investments in fixed-income securities due to advantages such as economies of scale, lower transaction costs, liquidity, and convenience. However, these advantages are significant only if deposits are perceived as riskless. Deposit insurance, which guarantees both principal and interest, ensures this riskless status for insured deposits.

[85] Merton (1977, 1978) provides a theoretical framework using modern option pricing theory to demonstrate how deposit insurance can encourage excessive risk-taking by banks. The essence of the argument lies in the implicit put option that deposit insurance creates for bank shareholders. Deposit insurance guarantees the repayment of deposits, regardless of the bank's financial condition, effectively shifting downside risk from shareholders to the insurer (usually the government or taxpayers). Merton's analysis highlights that while deposit insurance serves as an essential safeguard against bank runs, it can distort banks' risk-taking behavior if not accompanied by complementary measures like effective risk-based premiums, regulatory oversight, and adequate capital requirements (e.g., Bhattacharya and Thakor, 1993). These measures are critical to mitigating the moral hazard associated with deposit insurance.

serves as a mechanism for mitigating agency problems and aligning incentives among shareholders, managers, and regulators (Santos, 2001).

The limited liability structure of banks further intensifies moral hazard, since shareholders benefit from upside gains while bearing only limited downside losses. This asymmetry encourages excessive risk-taking, especially where explicit or implicit deposit guarantees exist (Milne and Whalley, 2001). According to the "skin-in-the-game" argument (Hellmann et al., 2000), higher capital requirements discipline bank behaviour by exposing shareholders' own equity to potential losses, thereby strengthening incentives for prudent lending. Milne and Whalley (2001) further argue that binding capital constraints are necessary to prevent banks from operating with insufficient capital and transferring losses to taxpayers or creditors. Beyond controlling moral hazard, capital regulation also addresses adverse selection problems. Morrison and White (2005) and Thakor (1996) show that entry screening and differentiated capital requirements reduce the likelihood that weak or excessively risky institutions gain access to the banking system. Similarly, Campbell et al. (1992) argue that capital regulation can substitute for direct monitoring by deposit insurers, particularly in opaque lending environments where borrower risk is difficult to assess.

Externalities also play a central role in the emergence of systemic risk within financial markets (Berger et al., 1995). These arise when the actions of one economic agent impose costs or benefits on others beyond the direct scope of their transactions (Randall, 1983). In banking systems, the failure of a single systemically important institution – or a broader set of smaller banks – can generate widespread instability through contagion effects. Berger et al. (1995) emphasise that limited public information regarding bank soundness further intensifies this vulnerability, as depositors and market participants may struggle to distinguish isolated institutional failures from broader systemic distress. In such environments, uncertainty regarding the solvency of individual banks can trigger generalised depositor withdrawals across the banking system. Consequently, excessive risk-taking by one bank creates negative externalities for other institutions and for the stability of the financial system as a whole (Gorton, 1994). To mitigate these risks, deposit insurance – whether explicit or implicit – has become the near-universal regulatory response to banking panics. By guaranteeing deposits, deposit insurance reduces depositors' incentives to demand immediate cash withdrawals, thereby helping to stabilise funding conditions and preserve banks' liquidity creation function during periods of stress.

#### 4.2.1.3 Conceptual linkages: Higher equity requirements and liquidity creation

Admati et al. (2012) develop the debt overhang theory to explain how excessive leverage weakens shareholders' incentives to recapitalise banks or support productive lending. When a bank is highly indebted, the benefits of new equity issuance accrue largely to creditors rather than shareholders, reducing incentives to raise capital during periods of distress and thereby prolonging financial fragility. This mechanism constrains both bank resilience and credit intermediation, particularly during downturns. To address these distortions, Admati et al. (2012, 2013) and Admati and Hellwig (2013, 2024) advocate substantially higher equity capital requirements than those prescribed under Basel III, arguing that stronger equity buffers enhance solvency, improve incentive alignment, and reduce systemic risk.

Their argument is illustrated using three stylised balance-sheet adjustment mechanisms. Consider a bank with \$100 in assets financed by \$90 in debt and \$10 in equity, implying a 10 percent capital ratio. The bank could increase its capital ratio to 20 percent through: (1) deleveraging, by shrinking both assets and liabilities (for example, reducing assets to \$50 and debt to \$40); (2) equity issuance, by raising new equity to retire debt while keeping total assets unchanged; or (3) balance-sheet expansion, by financing new asset growth with additional equity capital. The latter two strategies, both forms of equity-based recapitalisation, either preserve or expand lending capacity and are therefore preferable from both financial stability and intermediation perspectives. As Admati et al. (2013, p. 11) argue, substituting debt with equity imposes minimal social costs because it strengthens banks' funding structures without materially impairing their liquidity creation role.

Integrating this framework with Berger and Bouwman's (2009) liquidity creation framework highlights that the effects of higher equity capital depend critically on how capital is raised and allocated. Liquidity creation is maximised when banks finance illiquid assets, such as loans, with liquid liabilities, particularly deposits, and weakened when equity or other illiquid funding sources are used to finance liquid assets such as government securities. Under the debt substitution scenario, liquidity creation may be preserved if new equity replaces long-term debt, but reduced if it displaces deposits. Under the balance-sheet expansion scenario, liquidity creation may either increase or decline depending on whether equity-financed asset growth supports additional lending or merely expands holdings of liquid securities. Overall, this conceptual synthesis suggests that the effects of higher equity requirements on liquidity creation depend fundamentally on the design of recapitalisation – whether adjustment occurs through deleveraging, debt substitution, or equity-financed balance-sheet expansion – and whether the resulting capital structure supports continued financial intermediation.

#### 4.2.1.4 Leverage ratio, bank risk, and liquidity creation: Theoretical insights

Admati and Hellwig (2024, p. 261) argue that the leverage ratio (LR) should occupy a central role in capital regulation, advocating substantially higher equity-to-asset requirements (including off-balance-sheet exposures) of approximately 20–30 percent for the U.S. banking system. They contend that better-capitalised banks are not only more stable but also better positioned to perform core intermediation functions, including lending, deposit mobilisation, and liquidity creation, without taking excessive risks. In this view, stronger equity capital does not undermine financial intermediation; rather, it promotes prudent decision-making, reduces systemic vulnerabilities, and strengthens overall banking-system resilience (Admati et al., 2013). A critical element of this transition is structured recapitalisation through retained earnings, dividend restrictions, or limits on share buybacks, rather than deleveraging through asset sales, which may disrupt credit provision. The distinction between "good" and "bad" deleveraging is therefore essential for achieving a stable transition toward higher capital levels (Blundell-Wignall and Atkinson, 2012).

Similarly, Acosta-Smith et al. (2024) show that although a binding leverage ratio may modestly increase incentives for risk-taking, particularly through expanded lending associated with liquidity creation, the resulting accumulation of stronger equity buffers substantially enhances banks' loss-absorbing capacity and reduces default risk. Their analysis of European banks demonstrates that, when combined with risk-based capital requirements, the leverage ratio strengthens overall financial stability. Importantly, the "skin-in-the-game" effect implies that greater shareholder equity participation encourages more prudent behaviour and discourages excessive or imprudent lending, particularly where raising equity is costly.

Dermine (2015) complements this perspective by introducing a liquidity-risk dimension to capital regulation. He demonstrates that under asymmetric information, lower capital requirements, arising from portfolio diversification or lower expected credit losses, may unintentionally increase the risk of bank runs. To address this, he proposes a dual-capital framework comprising risk-based capital requirements to absorb expected losses and a leverage ratio buffer to protect against unexpected shocks and depositor panic. Unlike Basel III liquidity coverage requirements, which may incentivise banks to hold large quantities of low-yield liquid assets – potentially reducing liquidity creation in the Berger and Bouwman (2009) framework – the leverage ratio provides a more balanced approach. By strengthening solvency, it mitigates run risk while still allowing banks to engage in maturity transformation, the core mechanism underlying liquidity creation. Taken together, the analyses of Acosta-Smith et al. (2024) and Dermine (2015) reinforce the case for the leverage ratio as a non-risk-weighted, stability-enhancing regulatory constraint that complements liquidity regulation while supporting prudent financial intermediation and sustainable liquidity creation.

#### 4.2.1.5 Rethinking the capital-liquidity trade-off: Theoretical insights

Theoretical perspectives on the relationship between bank capital and liquidity creation fall into two contrasting schools: the "financial fragility-crowding out" hypothesis and the "risk absorption" hypothesis (Berger and Bouwman, 2009).

##### 4.2.1.5.1 The "financial fragility-crowding out" theories

The financial fragility–crowding-out hypothesis (Diamond and Rajan, 2000, 2001; Gorton and Winton, 2000, 2017) argues that higher capital requirements may weaken banks' ability to create liquidity. Diamond and Rajan (2000, 2001) contend that fragile funding structures, particularly those reliant on demandable debt, play a disciplining role by constraining bankers' behaviour and supporting liquidity creation, albeit at the cost of greater vulnerability to bank runs. Although higher equity capital reduces this fragility and improves stability, excessive capitalisation may weaken the disciplining effect of fragile liabilities, thereby reducing banks' incentives and capacity to create liquidity. In this framework, the optimal level of capital reflects a trade-off between minimising run risk and preserving banks' ability to transform illiquid assets into liquid claims.

Similarly, Gorton and Winton (2000, 2017) develop a general equilibrium framework emphasising the distinctive costs of bank capital relative to nonbank capital. While stronger capital buffers reduce the probability of bank failure and the associated social costs, they may also generate liquidity costs by crowding out deposits, which are central to banks' liquidity creation function. Their model highlights a fundamental trade-off: higher capital requirements enhance financial stability but may simultaneously reduce banks' capacity to issue safe debt and support credit intermediation. The analysis further suggests that shifting funding from deposits toward bank equity may encourage greater risk-taking without necessarily reducing systemic fragility. Overall, the framework underscores the difficulty of designing welfare-maximising capital requirements that simultaneously preserve stability and sustain liquidity creation.

#### 4.2.1.5.2 The "risk absorption" theory

In contrast, the "risk absorption" hypothesis (Bhattacharya and Thakor, 1993; Coval and Thakor, 2005; Donaldson et al., 2018) posits that stronger capital buffers enhance banks' ability to create liquidity by increasing their capacity to absorb losses. Berger and Bouwman (2009) argue that banks engaged in liquidity creation are inherently exposed to greater default risk, and that higher equity capital mitigates this vulnerability, thereby expanding banks' intermediation capacity. Coval and Thakor (2005) develop a model in which intermediary capital enables financial institutions to bridge differences in beliefs between pessimistic savers and optimistic borrowers. In their framework, capital facilitates credible project screening, improves risk-sharing, and supports financial intermediation, making it a critical prerequisite for liquidity creation. Their approach shifts attention away from traditional information asymmetries toward heterogeneity in expectations, positioning capital as a fundamental mechanism for sustaining trust and facilitating intermediation. Similarly, Donaldson et al. (2018) provide a historical reinterpretation of banking rooted in the evolution of commodity warehouses. Their model suggests that higher capital strengthens enforcement mechanisms within lending and interbank markets, thereby supporting the expansion of privately created money. Stronger capital buffers allow banks to support lending activity even when claims are not fully collateralised, reinforcing the connection between bank capital strength and system-wide liquidity creation.

### 4.2.2 Empirical studies

Empirical evidence on the relationship between bank capital and liquidity creation remains mixed, although the majority of studies report a negative association. This broadly supports the financial fragility–crowding-out hypothesis, which argues that higher capital requirements reduce banks' incentives or capacity to create liquidity. For example, Evans and Haq (2022), Casu et al. (2019), Fu et al. (2016), Mazioud Chaabouni et al. (2018), and Le (2019) consistently find that stronger regulatory capital ratios constrain liquidity-creating activities. Using bank-level data from the United States, the Eurozone, Asia-Pacific economies, and Vietnam, these studies suggest that tighter capital regulation – particularly under Basel III – reduces the credit transformation and deposit intermediation activities central to liquidity creation.

By contrast, a smaller strand of the literature reports either positive or conditional relationships between capital and liquidity creation. Bawuah (2024), for instance, finds that among 41 universal banks across nine Sub-Saharan African countries, a 1 percent increase in capital is associated with a 1.5 percent increase in liquidity creation, particularly in environments characterised by stronger institutional quality. Evans and Haq (2022) further show that the capital–liquidity relationship reversed in the post-crisis U.S. period, with smaller banks increasing liquidity creation following TARP interventions, potentially reflecting changes in regulatory incentives and capital management behaviour. Berger and Bouwman (2009) provide the seminal framework in this literature, demonstrating that the relationship between capital and liquidity creation depends critically on bank size. Using U.S. data from 1993–2003, they show that large banks exhibit a positive capital–liquidity relationship when off-balance-sheet activities are included, whereas smaller banks display a consistently negative relationship. Their influential liquidity creation measures suggest that capital can operate both as a constraint and as a stabilising buffer depending on the scale and complexity of bank operations.

Other studies examine how institutional and behavioural factors shape liquidity creation while treating capital as a control variable. Ownership structure appears particularly important. Kusi et al. (2022) find that state-owned and domestically owned banks in Ghana create more liquidity than private or foreign-owned banks, although higher capitalisation remains negatively associated with liquidity creation across all ownership categories. Similarly, Yeddou and Pourroy (2020) show that greater ownership concentration increases liquidity creation among Western European banks, while capital ratios continue to exhibit a negative relationship. Several studies also emphasise broader institutional and macroeconomic interactions. Lei and Song (2013) find that higher capital reduces liquidity creation in Chinese banks, although foreign banks appear less sensitive to this constraint. Berger et al. (2019) show that Islamic banks generate relatively more liquidity, particularly through asset-side activities, yet still exhibit a negative capital–liquidity relationship. Davydov et al. (2018) report that liquidity creation is procyclical in Russia and less pronounced among well-capitalised banks. Beck et al. (2023) demonstrate that bank liquidity creation supports economic growth primarily through higher tangible investment, although its effects are weaker in economies dependent on intangible assets. Governance factors also matter: Díaz and Huang (2017) show that stronger internal governance improves liquidity creation, although capital remains negatively associated with it. Finally, Jiang et al. (2019) document that intensified regulatory competition in the United States reduces liquidity creation, particularly among weakly capitalised banks.

Taken together, the empirical literature suggests that the relationship between capital and liquidity creation is highly context-dependent and shaped by institutional, regulatory, and bank-specific characteristics. Although stronger capital buffers improve stability and resilience, they may also constrain financial intermediation, particularly among smaller banks and within underdeveloped financial systems. These findings underscore the importance of designing nuanced and proportionate capital regulation frameworks capable of balancing prudential objectives with banks' liquidity creation role.

.

#### 4.2.3 Hypothesis development

In this section, we formulate our hypotheses regarding the interplay between bank capital regulation and liquidity creation. We propose two alternative, testable hypotheses to investigate how bank liquidity creation might respond to equity requirements that significantly exceed Basel III standards.

##### 4.2.3.1 Higher equity requirements may reduce liquidity creation

Theoretical and empirical literature suggests that substantially higher equity capital requirements may constrain banks' capacity to create liquidity. Diamond and Rajan's (2000, 2001) financial fragility theory argues that a bank's ability to provide liquidity depends on maintaining a fragile capital structure; excessive equity dilutes this fragility and undermines the disciplining role of deposits, thereby weakening liquidity provision incentives. Gorton and Winton's (2000, 2017) deposit crowding-out theory similarly posits that higher equity requirements displace deposits, critical for liquidity creation, by altering banks' funding mix, potentially reducing their liquidity-generating capacity. Empirical evidence broadly supports this view. Studies across advanced and emerging economies (e.g., Evans and Haq, 2022; Le, 2019; Casu et al., 2019; Díaz and Huang, 2017) consistently find a negative relationship between capital ratios and liquidity creation, indicating that higher capital levels often coincide with reduced transformation of illiquid assets into liquid liabilities.

Beyond funding structure, portfolio adjustment mechanisms offer a second explanatory pathway. When faced with large recapitalisation mandates, especially under tight compliance timelines, banks may respond by rebalancing portfolios away from high-risk loans and toward safer, lower-risk-weight assets such as sovereign bonds and foreign currency reserves (e.g., Fatouh et al., 2024). This risk-averse response prioritises regulatory compliance and shareholder value preservation over credit expansion. As Funyina (2023) shows in the Zambian context, higher capital ratios are positively associated with increased holdings of government securities. However, such shifts away from lending to business borrowers toward liquid, low-risk assets diminish liquidity creation (Berger and Bouwman, 2009), particularly when new equity is not deployed toward supporting intermediation activities. Accordingly, we derive the following hypothesis:

***Hypothesis (H1):***

*Significantly raising equity-to-assets (leverage ratio) capital requirements beyond Basel III norms, particularly when enforced through mandatory equity injections, reduces bank liquidity creation by discouraging risk-bearing lending and incentivising safer asset allocations.*

#### 4.2.3.2 Higher equity requirements may enhance liquidity creation

In contrast to theories emphasising the liquidity-reducing effects of higher equity, alternative models suggest that stronger capital buffers can enhance banks' capacity for liquidity creation. Coval and Thakor (2005) argue that well-capitalised intermediaries are more effective at bridging belief heterogeneity between savers and borrowers, particularly in pessimistic environments, by issuing liquidity-enhancing liabilities while absorbing project-specific risks. Similarly, Donaldson et al. (2018) show that higher capital strengthens banks' ability to support loan creation and interbank enforcement mechanisms, thereby expanding the private money supply and liquidity provision. Admati et al. (2013) further reinforce this perspective through a stylised balance sheet framework, demonstrating that capital increases, when used to expand rather than shrink the asset base, can maintain or even boost intermediation capacity without jeopardising stability. Crucially, the social cost of substituting equity for deposits is minimal when the recapitalisation is designed to preserve lending, not compress it.

Empirical studies support this mechanism. Acosta-Smith et al. (2024) show that a binding leverage ratio may induce a portfolio shift toward higher-yielding assets such as loans, thereby stimulating liquidity creation. While increased equity reduces default risk and improves resilience, it also imposes discipline through the "skin-in-the-game" effect, aligning incentives toward more prudent but sustained lending activity. Similar findings by Choi et al. (2020) and Kiema and Jokivuolle (2014) suggest that leverage constraints, when binding, encourage banks to reallocate toward risk-weight-intensive lending rather than liquid securities, especially in the presence of costly equity. Taken together, these insights suggest that significant equity-to-assets recapitalisation, if implemented through injections that expand rather than contract balance sheets, may enable banks to grow their liquidity-creating activities while remaining solvent and resilient. Accordingly, we formulate the second hypothesis as follows:

> ***Hypothesis (H2):***
>
> *Raising equity-to-assets (leverage ratio) capital requirements significantly beyond Basel III norms, when implemented through equity injections that preserve or expand balance sheet size, enhances bank liquidity creation by enabling greater intermediation and supporting risk-bearing lending activities.*

## 4.3 Data sample and methodology

### 4.3.1 Empirical strategy

Our empirical strategy consists of two complementary components. First, we estimate baseline fixed-effects panel regressions to examine the relationship between bank capital and liquidity creation while controlling for unobserved bank-specific heterogeneity and common time effects. Second, we exploit Zambia's New Capital Adequacy Framework (NCF) as a quasi-natural experiment and employ a standard two-way fixed effects (TWFE) difference-in-differences (DID) framework to identify the causal effect of substantially higher equity capital requirements on bank liquidity creation.

#### 4.3.1.1 Baseline model

To empirically examine bank liquidity creation, we adapt the "cat fat" and "cat nonfat" liquidity creation measures developed by Berger and Bouwman (2009) to better capture the structural characteristics of banking systems in Sub-Saharan Africa, particularly those in low- and lower-middle-income countries. Because the original measures were designed for the U.S. banking system, our adaptation incorporates region-specific features such as shallow financial markets (e.g., Beck et al., 2019), high levels of financial dollarisation, and concentrated holdings of government securities, with particular reference to the Zambian banking sector.

Using confidential supervisory data from the Bank of Zambia, we estimate baseline models within a fixed-effects panel regression framework, consistent with the approach adopted by Berger and Bouwman (2009). The analysis begins by examining the overall relationship between bank equity capital and liquidity creation across the full sample of banks. We subsequently investigate whether this relationship varies systematically across ownership structures by distinguishing between foreign-owned and locally owned institutions. Finally, we decompose total liquidity creation into its asset-side, liability-side, and off-balance-sheet components to assess how bank capital influences the different channels through which liquidity is created, drawing on recent developments in the literature.

#### 4.3.1.2 Zambia's NCF as a quasi-natural experiment in leverage ratio-based recapitalisation beyond Basel III

The implementation of Zambia's New Capital Adequacy Framework (NCF) in January 2012 provides a unique quasi-natural experiment for examining the causal effects of substantially higher equity-to-assets (leverage ratio) requirements – well above Basel III leverage ratio standards – on bank liquidity creation. The reform introduced sharply differentiated minimum capital requirements based solely on ownership structure. Foreign-owned banks were required to increase the level of common equity from Zambian Kwacha (K) 12 million to K520 million, representing an increase of more than forty times, while locally owned banks faced a comparatively smaller increase to K104 million, equivalent to a ninefold rise. Because this regulatory distinction was based on ownership rather than bank size, risk profile, or overall bank condition – factors that typically guide the calibration of capital requirements in practice – it provides a credible setting for a difference-in-differences (DID) analysis, with foreign-owned banks constituting the treated group and locally owned banks serving as the control group.

Quasi-experimental approaches such as DID exploit exogenous policy shocks to estimate counterfactual outcomes in settings where randomised experiments are not feasible (Meyer, 1995; Athey and Imbens, 2017). In this case, the sudden and asymmetric increase in minimum capital requirements, applied uniformly within ownership categories, generates a strong source of exogenous variation for identifying the effects of binding equity constraints on liquidity creation. Since both foreign-owned and locally owned banks operated under the same capital requirements prior to the reform, any systematic divergence observed after implementation can plausibly be attributed to the NCF. Importantly, the design of the reform mitigates the endogeneity concerns commonly associated with capital regulation, as the higher requirements were not linked to individual banks' risk characteristics or size. The uniform application of the policy within ownership groups strengthens the internal validity of the DID framework, while the substantial difference in treatment intensity permits an assessment of both the average and heterogeneous effects of stricter capital requirements (Meyer, 1995; Callaway et al., 2024).

Moreover, the DID approach effectively controls for unobserved time-invariant differences between bank groups and common macroeconomic shocks, making it particularly well suited for evaluating regulatory interventions in environments where capital requirements may otherwise be endogenously related to bank-specific characteristics (Hettinger et al., 2024; Wang et al., 2024; Gropp et al., 2019). To estimate the treatment effect, we employ a two-way fixed effects (TWFE) difference-in-differences specification that controls for both unobserved bank-specific heterogeneity and common time-varying factors (Wooldridge, 2025). Bank fixed effects account for time-invariant characteristics, such as business models, ownership structures, and governance arrangements, while time fixed effects capture macroeconomic conditions, regulatory developments, and other shocks that affect all banks simultaneously (Feng et al., 2024; Wang et al., 2024). Within this framework, the coefficient of interest identifies the average treatment effect on the treated (ATT), thereby isolating the impact of the recapitalisation reform on liquidity creation outcomes (Angrist and Pischke, 2009).

The validity of the DID approach rests on two key identification assumptions (Callaway and Sant'Anna, 2021; Roth et al., 2023). First, the parallel trends assumption requires that, in the absence of the reform, treated and control banks would have followed similar trajectories over time. Second, the no-anticipation assumption requires that banks did not adjust their behaviour in advance of the policy implementation in ways that would affect the estimated treatment effects. Graphical analysis of pre-treatment trends (see Figure 1) provides support for the parallel trends assumption, indicating that treated and control banks followed broadly similar trajectories prior to the 2012 reform. Although Zambia had previously implemented smaller recapitalisation measures, including the 2007 increase in minimum paid-up capital requirements, the magnitude and ownership-based design of the NCF represented a distinct and largely unanticipated policy shock. Moreover, the reform's classification of banks based on foreign ownership through private shareholding – rather than government ownership, as was the case under the differentiated capitalisation requirements associated with Zambia's nationalisation policies of the 1970s (e.g., Harvey, 1973; Beveridge, 1974) – represented a fundamental departure from earlier regulatory practice. This shift reduced the likelihood of anticipatory behavioural adjustments by banks, as ownership-based capital differentiation had been abandoned during the financial sector reforms of the 1990s, when Zambia also adopted key elements of the Basel I capital adequacy framework, thereby strengthening the exogeneity of the policy intervention. Although the fundamental DID assumptions are not directly testable, confidence in the identification strategy is strengthened through placebo analyses and the incorporation of key time-varying covariates, including profitability, credit risk, bank size, and market share, in the full DID framework (Roth et al., 2023; Berger et al., 2020).[86] Taken together, Zambia's NCF provides a rare and compelling setting for evaluating how binding leverage ratio constraints, implemented through actual equity recapitalisation, affect bank liquidity creation, particularly within the shallow and highly dollarised banking systems characteristic of SSA LMICs.

[86] See Section 4.6.1 for the placebo test results, and Sections 4.4.2 and 4.5.4 for details of the full DID specification and empirical findings.

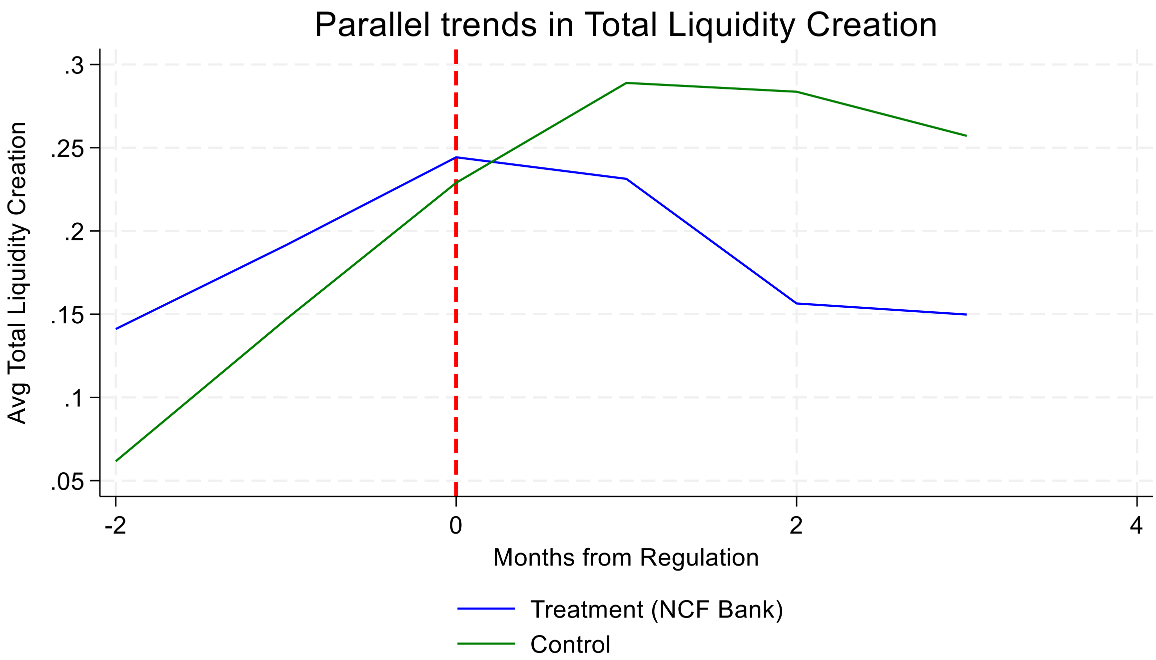



**Figure 1.** The visual plot to test the parallel trends assumption

### 4.3.2 Data sample and variable measurements

#### 4.3.2.1 Sample and data sources

We construct a bank-level panel dataset from the monthly Prudential Returns submitted by all commercial banks regulated by the Bank of Zambia.[87] These returns, reported in Excel format, provide detailed supervisory information essential for this study, including balance sheet and income statement data, off-balance-sheet exposures, regulatory capital positions, risk-weighted assets, loan portfolios, non-performing loans, and loan-loss provisions. The dataset covers the period from January 2006 to February 2019 (2006:M1–2019:M2), providing monthly observations throughout the sample horizon.

Immediately prior to the implementation of the New Capital Adequacy Framework (NCF) on 30 January 2012, Zambia's banking sector comprised 19 commercial banks. The foreign-owned banks, which constitute the treated group in our analysis, dominated the sector, accounting for 69.0 percent of total assets, 68.5 percent of deposits, 67.7 percent of loans, and 67.4 percent of profit before tax as of December 2011.[88] To maintain consistency over time, a bank merger occurring during the sample period is treated as a single institution throughout the dataset. The final sample comprises 18 banks, evenly divided between the treated and comparison groups, with nine banks in each category. Following data cleaning and variable construction, the resulting dataset forms an unbalanced panel, with an average of 2,534 observations across the variables used in the analysis.

[87] We received authorisation from the Bank of Zambia to use the Prudential Returns, which include sensitive supervisory data. To protect confidentiality, we refrain from identifying individual banks in our analysis.

[88] Bank of Zambia Annual Report, 2011, see page 47 for the market share information. Available: https://www.boz.zm/sites/default/files/migrated/annual-reports/2011/BOZANNUALREPORT2011.pdf

#### 4.3.2.2 Variable definitions

Table 1 summarises the principal variables employed in the empirical analysis. **Panel A** presents the dependent variables capturing the different dimensions of bank liquidity creation. **Panel B** reports the capital measures, while **Panel C** describes the bank risk indicators. **Panel D** contains the bank-specific control variables included to account for factors that may influence liquidity creation, and **Panel E** defines the dummy variables used in the difference-in-differences (DID) analysis.

##### 4.3.2.2.1 Dependent variable

Our primary dependent variable is bank liquidity creation, measured using an adapted version of the liquidity creation framework developed by Berger and Bouwman (2009). To ensure methodological consistency, we closely follow their three-step procedure in constructing the liquidity creation measures. The first step classifies all on- and off-balance-sheet activities into three liquidity categories: liquid, semi-liquid, and illiquid. Berger and Bouwman (2009) base this classification on the ease, speed, and cost with which assets can be converted into cash or liabilities settled to meet customers' liquidity demands. The same classification principles are applied to bank liabilities and equity, reflecting the ease with which depositors and other claimholders can obtain liquid funds. Off-balance-sheet exposures, including guarantees and derivative contracts, are similarly classified according to their liquidity characteristics. While our methodology largely follows Berger and Bouwman (2009), we depart from their framework in the classification of loans to better reflect the structural features of banking systems in low- and lower-middle-income countries, particularly those in Sub-Saharan Africa. This adaptation is consistent with recent studies, including Dang (2022), Pham et al. (2021), Fungáčová et al. (2021), Tang et al. (2021), Berger et al. (2019), and Davydov et al. (2018). The rationale for this modification is discussed in the following paragraphs.

Berger and Bouwman (2009) classify loans using either a category-based ("cat") or maturity-based ("mat") approach. They also develop two alternative measures of liquidity creation depending on whether off-balance-sheet activities are included ("fat") or excluded ("nonfat"). Combining these dimensions yields four liquidity creation measures: cat fat, cat nonfat, mat fat, and mat nonfat. This study adopts the two category-based measures, cat fat and cat nonfat, with primary emphasis on the cat fat measure. Berger and Bouwman (2009) identify cat fat as the most comprehensive indicator of bank liquidity creation, and it has subsequently become the preferred measure in the empirical literature (e.g., Dang, 2022; Pham et al., 2021; Dang, 2020; Berger et al., 2019; Zheng et al., 2019; Sahyouni and Wang, 2019; Berger and Sedunov, 2017; Díaz and Huang, 2017; Tran et al., 2016; Fu et al., 2016). By classifying loans according to their economic characteristics and incorporating off-balance-sheet activities, the cat fat measure captures a broader range of liquidity-creating activities, including those arising from securitised assets and contingent commitments.[89] Consequently, Berger and Bouwman (2009) argue that it provides a more complete measure of bank liquidity creation than either the maturity-based ("mat") or off-balance-sheet-excluded ("nonfat") alternatives.

Additionally, we exclude the two liquidity creation measures that classify loans according to maturity, mat fat and mat nonfat, for two reasons. First, the Bank of Zambia's Prudential Returns, from which our dataset is constructed, do not report loan maturities, making the implementation of maturity-based measures infeasible. Second, the maturity-based classification is less appropriate for the institutional characteristics of Sub-Saharan African (SSA) banking systems. Berger and Bouwman (2009) classify loans with maturities of one year or less as semiliquid, reflecting their relatively greater ease of liquidation. However, this

[89] Berger and Bouwman's (2009), using U.S. banking data, show that roughly one-half of total bank liquidity creation originates from off-balance-sheet activities, highlighting the importance of including these exposures in liquidity creation measures. They further demonstrate that illiquid loan commitments and guarantees constitute the largest contributors to off-balance-sheet liquidity creation, providing a key justification for the use of the "cat fat" measure.

assumption is unlikely to hold in SSA. On the one hand, a large proportion of bank lending in the region has maturities of less than one year (Beck et al., 2019, p. 1083).[90] Consequently, a maturity-based approach would classify a substantial share of the loan portfolio as semiliquid, potentially understating banks' liquidity creation. On the other hand, irrespective of contractual maturity, bank loans in SSA are generally illiquid because of the region's shallow and underdeveloped financial markets, where secondary loan markets are either absent or highly inactive (e.g., Tyson, 2021; Allen and Giovannetti, 2011). Accordingly, classifying all loans as illiquid provides a more appropriate representation of their economic liquidity characteristics within the SSA context.

Furthermore, Berger and Bouwman (2009) argue that classifying loans by category, rather than by maturity, provides a more appropriate measure of liquidity creation. From a liquidity creation perspective, the key consideration on the asset side is not contractual maturity but the ease, speed, and cost with which loans can be converted into liquid funds. In the context of SSA, bank loans are more appropriately classified as illiquid assets, irrespective of their maturity, because underdeveloped secondary loan markets make them difficult to sell or securitise to meet liquidity needs (e.g., Tran et al., 2016). This classification is further supported by the structural characteristics of the region's financial systems. Private sector credit remains relatively low compared with other regions, while SSA records the highest and most volatile non-performing loan ratios globally (Eyraud et al., 2021). These conditions reduce marketability and increase the time and cost associated with loan liquidation, reinforcing the treatment of all loans as illiquid for measuring bank liquidity creation.

[90]The predominance of short-term instruments in African banking systems further limits the usefulness of maturity-based liquidity classification. Beck et al. (2019), drawing on Beck et al. (2011) for the period 2005–2009, report that over 80% of deposits were either demand deposits or had maturities of less than one year, while fewer than 2% exceeded ten years. Likewise, approximately 60% of loans had maturities of less than one year, with fewer than 2% extending beyond ten years.

Finally, the category-based classification of loans should reflect the institutional and financial market characteristics of the jurisdiction under study. In Berger and Bouwman (2009), residential mortgages and consumer loans are classified as semiliquid because they can be readily securitised, while loans to depository institutions and governments are also treated as semiliquid owing to the high credit quality, transparency, and marketability of these counterparties. These classifications, however, were developed for the U.S. financial system and are more applicable to advanced economies with deep and liquid capital markets (Berger et al., 2019). Berger et al. (2019) emphasise that liquidity classification should account for cross-country differences in financial market development, particularly the availability of secondary loan and securitisation markets. This consideration is especially important in low- and lower-middle-income countries in Sub-Saharan Africa, where financial systems remain shallow and capital markets are relatively underdeveloped (e.g., Tyson, 2021; Allen and Giovannetti, 2011).[91] Consequently, the markets and institutional infrastructure necessary to support loan securitisation and other sophisticated asset transfer mechanisms are either absent or highly limited. Under these conditions, loans cannot be readily converted into liquid funds regardless of borrower type or contractual maturity. Accordingly, we classify all loan categories as illiquid, reflecting their underlying economic liquidity characteristics within the SSA context.

In the second step, we assign liquidity weights to the balance-sheet and off-balance-sheet activities classified in the first stage, following the framework developed by Berger and Bouwman (2009), which builds on the liquidity creation theory of Diamond and Dybvig (1983). The underlying principle is that banks create liquidity by financing illiquid assets with

[91] Beck et al. (2019, p. 1077) identify four key structural characteristics of banking systems in low- and lower-middle-income Sub-Saharan Africa: small financial markets that limit economies of scale, widespread economic informality, macroeconomic volatility associated with commodity dependence, and persistent governance weaknesses that constrain financial sector development and reform.

liquid liabilities through the process of maturity transformation. Accordingly, positive weights are assigned to illiquid assets and liquid liabilities, reflecting their contribution to liquidity creation. For example, banks create liquidity when highly liquid funding sources, such as demand deposits, are used to finance illiquid assets, including loans. In contrast, negative weights are assigned to liquid assets, illiquid liabilities, and equity because these funding and investment structures reduce liquidity creation. In particular, liquidity is destroyed when relatively illiquid funding sources, such as subordinated debt or equity, are used to finance liquid assets, including government securities and foreign exchange reserves, rather than illiquid lending.

Conceptually, Berger and Bouwman (2009) derive the liquidity weights from a simple dollar-for-dollar accounting framework that reflects the mechanics of bank liquidity creation. Under this framework, a bank creates one dollar of liquidity by funding one dollar of illiquid assets with one dollar of liquid liabilities. Conversely, it destroys one dollar of liquidity when one dollar of liquid assets is financed with one dollar of illiquid liabilities or equity. To operationalise this framework, Berger and Bouwman (2009) assign a weight of +½ to illiquid assets and liquid liabilities, and a weight of −½ to liquid assets, illiquid liabilities, and equity. Consequently, when one dollar of demand deposits finances one dollar of loans, total liquidity creation is calculated as (+½ × \$1) + (+½ × \$1) = \$1. In contrast, when one dollar of subordinated debt or equity finances one dollar of liquid assets, such as government securities or foreign exchange reserves, liquidity creation is (−½ × \$1) + (−½ × \$1) = −\$1, representing the maximum degree of liquidity destruction. This weighting scheme therefore captures the extent to which banks transform liquid funding into illiquid assets, the defining feature of liquidity creation in the Diamond and Dybvig (1983) framework.

Banks do not create liquidity when liquid liabilities (e.g., transaction deposits) are used to finance liquid assets (e.g., government securities or foreign exchange reserves), or when illiquid liabilities or equity are used to finance illiquid assets (e.g., business loans). In both cases, the positive and negative liquidity effects exactly offset each other, yielding a net liquidity creation measure of (−½ × \$1) + (+½ × \$1) = \$0. Berger and Bouwman (2009) therefore assign an intermediate weight of zero to semiliquid assets and liabilities, reflecting the assumption that their liquidity characteristics lie midway between those of liquid and illiquid items. The same weighting principles are extended to off-balance-sheet exposures, including guarantees, loan commitments, and derivative contracts, with weights assigned according to their economic functions and liquidity characteristics relative to comparable on-balance-sheet activities. The complete classification of balance-sheet and off-balance-sheet items from Step 1, together with the corresponding liquidity weights applied in Step 2 under the "cat fat" and "cat nonfat" measures of Berger and Bouwman (2009), is reported in Table A1 of Appendix A7.

In the third step, we aggregate the classified balance-sheet and off-balance-sheet activities using the liquidity weights assigned in the previous stage to construct our two principal liquidity creation measures: total liquidity creation (TLQC), corresponding to Berger and Bouwman's (2009) "cat fat" measure, and on-balance-sheet liquidity creation (ONLQC), corresponding to the "cat nonfat" measure. Following Berger and Bouwman (2009), illiquid assets (IA), liquid liabilities (LL), and illiquid guarantees (IG) receive a weight of +0.5, while liquid assets (LA), illiquid liabilities (IL) or equity (EQ), liquid guarantees (LG), and liquid derivatives (LD) receive a weight of −0.5. Items classified as semiliquid are assigned a weight of zero and therefore do not contribute to the liquidity creation measure.

For each bank-month observation, all activities are first aggregated within their respective liquidity classes before applying the corresponding weights. The weighted components are then summed to obtain the total amount of liquidity created by each bank. To facilitate meaningful comparisons across institutions of different sizes, the resulting liquidity creation measure is normalised by gross total assets (GTA),[92] yielding the amount of liquidity created per unit of bank assets (Berger and Bouwman, 2009). Throughout the remainder of the chapter, this normalised measure is referred to simply as liquidity creation, unless otherwise stated (e.g., Jiang et al., 2019). The principal liquidity creation measures are formally defined as follows:

$$\mathrm{TLQC} = \frac{0.5(\mathrm{IA} + \mathrm{LL} + \mathrm{IG}) - 0.5(\mathrm{LA} + \mathrm{IL} + \mathrm{EQ} + \mathrm{LG} + \mathrm{LD})}{\mathrm{GTA}} \quad \textbf{(1)}$$

$$\mathrm{ONLQC} = \frac{0.5(\mathrm{IA} + \mathrm{LL}) - 0.5(\mathrm{LA} + \mathrm{IL} + \mathrm{EQ})}{\mathrm{GTA}} \quad \textbf{(2)}$$

The total liquidity creation (TLQC) measure, corresponding to Berger and Bouwman's (2009) "cat fat" measure, can be further decomposed into its constituent channels of liquidity creation: asset-side, liability-side, and off-balance-sheet activities (Jiang et al., 2019). Asset-side liquidity creation (ASLQC) is measured as the difference between illiquid assets (IA) and liquid assets (LA). Liability-side liquidity creation (LSLQC) is calculated as liquid liabilities (LL) less the sum of illiquid liabilities (IL) and equity (EQ). Off-balance-sheet liquidity creation (OFFBSLQC) is computed as illiquid guarantees (IG) minus liquid guarantees (LG) and liquid derivatives (LD). Consistent with the construction of the aggregate liquidity creation measure, each component is normalised by gross total assets (GTA) to facilitate comparisons across banks of different sizes. These disaggregated measures are subsequently employed as dependent variables to examine how bank capital influences the distinct channels through which liquidity is created (Berger et al., 2019; Berger and Bouwman, 2009). Formally, the three components are defined as follows:

[92] Berger and Bouwman (2009) describe gross total assets (GTA) as the most straightforward measure of a bank's size. GTA is calculated as total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve, both reserves set aside for potential credit losses. This ensures that the full value of the loans financed by the bank and the liquidity created on the asset side are accurately reflected.

$$\text{ASLQC} = \frac{0.5(\text{IA}) - 0.5(\text{LA})}{\text{GTA}} \quad \textbf{(3)}$$

$$\text{LSLQC} = \frac{0.5(\text{LL}) - 0.5(\text{IL} + \text{EQ})}{\text{GTA}} \quad \textbf{(4)}$$

$$\text{OFFBSLQC} = \frac{0.5(\text{IG}) - 0.5(\text{LG} + \text{LD})}{\text{GTA}} \quad \textbf{(5)}$$

#### 4.3.2.2.1 Main explanatory variables

##### 4.3.2.2.1.1 Measures of bank capital

Our principal explanatory variable is bank capital. Consistent with the literature, we measure capital using two widely employed indicators: the equity-to-gross-total-assets ratio (CAR), which serves as a proxy for the leverage ratio (e.g., Bawuah, 2024; Berger et al., 2019; Casu et al., 2019; Jiang et al., 2019; Mazioud Chaabouni et al., 2018; Tran et al., 2016), and the Tier 1 capital ratio, defined as Tier 1 capital relative to Basel I risk-weighted assets (e.g., Casu et al., 2019; Tran et al., 2016; Fu et al., 2016). Equity capital, comprising primarily common shares and retained earnings, represents the highest-quality and most loss-absorbing form of regulatory capital. By providing a buffer against unexpected losses, higher equity capital strengthens bank solvency and reduces the probability of failure (Betz et al., 2014).

Given the study's emphasis on the Basel III simple leverage ratio, the equity-to-gross-total-assets ratio is adopted as the primary capital measure (e.g., Anguren et al., 2024; Anginer et al., 2024). This choice is also consistent with Berger and Bouwman (2009, p. 3789), who argue that leverage-based capital requirements are more closely associated with reductions in bank lending, supporting the financial fragility–crowding-out hypothesis that higher capital may constrain liquidity creation, whereas risk-based capital requirements appear to have a more limited effect on lending. Similarly, Barth and Miller (2018) show that increasing the regulatory minimum equity-to-assets ratio from 4 to 15 percent substantially lowers the probability of banking crises, albeit at the cost of reduced bank lending. To assess the robustness of our findings, we additionally estimate the models using the Tier 1 capital ratio, which consists predominantly of common equity and non-cumulative preference shares scaled by Basel I risk-weighted assets.

A key empirical challenge is the potential endogeneity between bank capital and liquidity creation. As Evans and Haq (2022) argue, banks' capital, risk-taking, and output decisions (including liquidity creation) are jointly determined, giving rise to possible reverse causality. Following the established literature (e.g., Berger and Bouwman, 2009; Manu and Qi, 2023; Nguyen et al., 2023), we mitigate this concern by employing one-period lagged capital measures in all baseline regressions. The underlying assumption is that past capital positions influence current liquidity creation, whereas contemporaneous liquidity creation is unlikely to affect previously accumulated capital. Accordingly, the lagged capital ratio serves as the principal explanatory variable throughout the empirical analysis.

**4.3.2.2.1.2 Measures of bank risk**

Berger and Bouwman (2009) emphasise the importance of adequately controlling for bank risk, arguing that banks primarily hold capital to absorb risk. Consequently, incorporating risk measures is essential to distinguish the role of capital in facilitating liquidity creation from its broader function as a buffer against risk. Following the empirical literature, we control for bank risk using three widely adopted indicators: the ratio of Basel I risk-weighted assets to gross total assets (RWATA) (e.g., Berger and Bouwman, 2009; Tran et al., 2016; Díaz and Huang, 2017; Mazioud Chaabouni et al., 2018; Casu et al., 2019); the ratio of non-performing loans to total loans (NPL) (e.g., Le, 2019; Mazioud Chaabouni et al., 2018; Casu et al., 2019; Kusi et al., 2022); and the ratio of loan-loss reserves to total loans (LLRL) (e.g., Fu et al., 2016; Hsieh et al., 2022).

All three measures primarily capture credit risk. This focus is appropriate because credit risk is closely linked to banks' liquidity creation activities and is positively associated with liquidity risk (Casu et al., 2019). Theoretical models of financial intermediation (e.g., Bryant, 1980; Diamond and Dybvig, 1983) and empirical evidence (e.g., Imbierowicz and Rauch, 2014) both suggest that higher credit risk is accompanied by greater liquidity risk. Accordingly, we expect the estimated coefficient on the risk variables to be positive, reflecting the tendency for banks engaged in greater liquidity creation to assume higher levels of credit risk.

#### 4.3.2.2.2 Controls

To isolate the effect of bank capital on liquidity creation, we include three additional bank-specific control variables that have been widely identified in the literature as important determinants of liquidity creation: profitability, market share, and bank size (e.g., Berger and Bouwman, 2009).

Bank profitability is measured using either return on assets (ROA) or return on equity (ROE). ROA is defined as net income divided by gross total assets, whereas ROE is measured as net income relative to total equity capital. Both indicators are widely used in the liquidity creation literature. For example, ROA is employed by Bawuah (2024), Kusi et al. (2022), Díaz and Huang (2017), and Tran et al. (2016), while ROE is adopted by Casu et al. (2019), Mazioud Chaabouni et al. (2018), Díaz and Huang (2017), Tran et al. (2016), and Fu et al. (2016). Profitability is expected to be positively associated with liquidity creation, as more profitable banks possess greater financial capacity to expand lending and other liquidity-creating activities. Consistent with this view, Duan and Niu (2020), using a panel of 9,074 U.S. banks over the period 2001:Q1–2016:Q4, show that liquidity creation is positively associated with bank profitability across institutions of different sizes. Accordingly, we expect a positive coefficient on the profitability variable.

To account for differences in market power and competitive conditions, we include each bank's deposit market share, following Berger and Bouwman (2009). Distinguin et al. (2013) argue that banks with greater market power are better positioned to attract deposits and other funding sources, enabling them to expand lending and other maturity transformation activities. A larger deposit market share therefore reflects stronger funding capacity and is expected to support greater liquidity creation. Consequently, we anticipate a positive relationship between deposit market share and liquidity creation.

Finally, we control for bank size, recognising that the contribution of banks to liquidity creation may vary systematically with scale (Berger and Bouwman, 2009). Larger banks may create more liquidity because they benefit from greater access to wholesale funding, lender-of-last-resort facilities, and implicit too-big-to-fail guarantees (Casu et al., 2019). Conversely, several studies report that smaller banks create relatively more liquidity per unit of assets owing to their stronger focus on traditional relationship lending. The overall effect of bank size on liquidity creation is therefore theoretically ambiguous. Consistent with the literature, bank size is measured as the natural logarithm of total assets (e.g., Bawuah, 2024; Kusi et al., 2022; Berger et al., 2019; Casu et al., 2019; Le, 2019; Jiang et al., 2019; Mazioud Chaabouni et al., 2018; Díaz and Huang, 2017; Tran et al., 2016; Fu et al., 2016).

**Table 1. Description of the variables.**
This table summarises the dependent and explanatory variables used in the empirical analysis, including their mnemonics, variable definitions, and corresponding literature references. All variables are constructed from raw supervisory data obtained from the Bank of Zambia's Prudential Returns.

| **Panel A: Dependent variables** | | | |
|---|---|---|---|
| Mnemonic | Variable name | Definition | References |
| TLQC | Liquidity creation | Total liquidity creation ("cat fat") | Dang (2022); Pham et al. (2021); Fungacova et al. (2021); Tang et al. (2021); Berger et al. (2019); Davydov et al. (2018); Berger and Bouwman, 2009 |
| ONLQC | Liquidity creation | On-balance sheet liquidity creation ("cat nonfat") | Dang (2022); Pham et al. (2021); Fungacova et al. (2021); Tang et al. (2021); Berger et al. (2019); Davydov et al. (2018); Berger and Bouwman, 2009 |
| ASLQC | Liquidity creation | Asset-side liquidity creation | Jiang et al. (2019) |
| LSLQC | Liquidity creation | Liability-side liquidity creation | Jiang et al. (2019) |
| OFFBLQC | Liquidity creation | Off-balance sheet liquidity creation | Jiang et al. (2019) |
| **Panel B: Independent variables (Capital measures)** | | | |
| TIER1 | Risk-based ratio | The ratio of Tier 1 equity capital to risk-weighted assets | Casu et al. (2019); Tran et al. (2016); Fu et al. (2016) |
| CAR | Leverage ratio | The ratio of Tier 1 equity capital to gross total assets | Bawuah (2024); Berger et al. (2019); Casu et al. (2019); Jiang et al. (2019); Mazioud Chaabouni et al. (2018); Tran et al. (2016) |
| **Panel C: Independent variables (Risk measures)** | | | |
| RWATA | Credit risk | The ratio of a bank's Basel I risk-weighted assets to gross total assets | Casu et al. (2019); Mazioud Chaabouni et al. (2018); Díaz and Huang (2017); Tran et al. (2016); Berger and Bouwman (2009) |
| LLRL | Credit risk | The ratio of loan loss reserves to total loans | Hsieh et al. (2022); Fu et al. (2016) |
| **Panel D: Independent Variables (Bank fundamentals)** | | | |
| ROA | Profitability | The ratio of profit after taxes to total gross assets | Bawuah (2024); Kusi et al. (2022); Díaz and Huang (2017); Tran et al. (2016) |
| ROE | Profitability | The ratio of profit after taxes to total equity | Casu et al. (2019); Mazioud Chaabouni et al. (2018); Díaz and Huang (2017); Tran et al. (2016); Fu et al. (2016) |
| MKTSHR | Market power | Market share of each bank's deposits in the banking sector | Berger and Bouwman (2009) |
| SIZE | Bank size | Natural log of gross total assets | Bawuah (2024); Kusi et al. (2022); Berger et al. (2019); Casu et al. (2019); Le (2019); Jiang et al. (2019); Mazioud Chaabouni et al. (2018); Díaz and Huang (2017); Tran et al. (2016); Fu et al. (2016) |
| **Panel E: Treatment Variables** | | | |
| NCFBank | A dummy variable set to 1 if a bank was foreign-owned and met the higher minimum capital requirement, and 0 otherwise | | |
| Post | A binary variable set to 1 for the period from February 2012 to February 2019 after the NCF enforcement on January 30, 2012, and set to 0 for all other periods | | |
| NCFBank x Post | The interaction term of NCFBank and Post that captures the estimated policy effect under the assumptions of DID, and 0 otherwise | | |

### 4.3.3 Summary statistics, correlation analysis and collinearity diagnostics

This section reports the summary statistics, pairwise correlation analysis, and multicollinearity diagnostics for the variables employed in the regression analysis. The results are based on a supervisory panel dataset comprising 18 Zambian commercial banks over the period January 2006 to February 2019.

#### 4.3.3.1 Summary statistics

Table 2 reports the summary statistics for the variables used in the empirical analysis, with detailed definitions provided in Table 1. To mitigate the influence of extreme observations, all continuous variables, except the dummy variables, are Winsorised at the 1st and 99th percentiles, following Dang et al. (2022) and Kanga et al. (2020).

**Panel A** summarises the liquidity creation measures. The mean (median) of total liquidity creation (TLQC), scaled by gross total assets, is 20.8% (23.8%), while on-balance-sheet liquidity creation (ONLQC) averages 14.3% (17.8%). Liquidity creation is driven predominantly by the liability side of banks' balance sheets, with liability-side liquidity creation (LSLQC) averaging 14.6% (16.5%) of gross total assets, followed by off-balance-sheet liquidity creation (OFFBSLQC) at 6.5% (3.6%). **Panel B** presents the capital measures. The mean (median) Tier 1 capital ratio (TIER1) is 29.8% (20.1%), while the equity-to-assets (leverage) ratio (CAR) averages 15.2% (11.5%), indicating that banks maintained capital levels well above the regulatory minimum requirements over the sample period.

**Panel C** reports the risk indicators, with risk-weighted assets to gross total assets (RWATA) averaging 54.1% (55.2%) and loan-loss reserves to total loans (LLRL) averaging 6.1% (4.5%), suggesting a relatively high level of credit risk across the banking sector. **Panel D** reports the bank-specific control variables. The mean (median) deposit market share is 6.2% (3.1%), while monthly return on equity (ROE) averages 0.6% (1.7%). Average bank size, measured as the natural logarithm of gross total assets, is 13.843 (13.915). Finally, **Panel E**

presents the treatment variables used in the difference-in-differences analysis. Foreign-owned banks, which constitute the treated group under Zambia's New Capital Adequacy Framework (NCF), account for 52.3% of the sample. In addition, 59.9% of the observations fall within the post-reform period (2012:M2–2019:M2), while 29.9% represent treated observations in the post-NCF period.

**Table 2. Summary statistics.**

Table 2 reports descriptive statistics for the key variables used in the empirical analysis, including the dependent variables and covariates. Variable definitions and corresponding references are provided in Table 1. All variables are constructed from supervisory data obtained from the Bank of Zambia.

| Variable | Mean | SD | p25 | Median | p75 | N |
|---|---|---|---|---|---|---|
| ***Panel A. Liquidity creation measures*** | | | | | | |
| Total liquidity creation (TLQC) | 0.208 | 0.175 | 0.089 | 0.238 | 0.336 | 2,528 |
| On-balance sheet liquidity creation (ONLQC) | 0.143 | 0.188 | -0.002 | 0.178 | 0.276 | 2,528 |
| Asset-side liquidity creation (ASLQC) | -0.004 | 0.192 | -0.100 | 0.025 | 0.122 | 2,528 |
| Liability-side liquidity creation (LSLQC) | 0.146 | 0.117 | 0.079 | 0.165 | 0.220 | 2,528 |
| Off-balance sheet liquidity creation (OFFBLQC) | 0.065 | 0.077 | 0.017 | 0.036 | 0.084 | 2,528 |
| ***Panel B. Capital measures*** | | | | | | |
| Tier 1 equity capital to risk-weighted assets (TIER1) | 0.298 | 0.242 | 0.147 | 0.201 | 0.388 | 2,528 |
| Tier 1 equity-to-gross total assets ratio (CAR) | 0.152 | 0.103 | 0.083 | 0.115 | 0.195 | 2,529 |
| ***Panel C. Risk measures*** | | | | | | |
| Average risk-weight (RWATA) | 0.541 | 0.170 | 0.444 | 0.552 | 0.644 | 2,528 |
| Loan loss reserves to total loans ratio (LLRL) | 0.061 | 0.057 | 0.020 | 0.045 | 0.083 | 2,526 |
| ***Panel D. Bank fundamentals*** | | | | | | |
| Profitability (ROA) | 0.000 | 0.006 | -0.001 | 0.001 | 0.003 | 2,529 |
| Profitability (ROE) | 0.006 | 0.052 | -0.005 | 0.017 | 0.032 | 2,528 |
| Market share (MKTSHR) | 0.062 | 0.065 | 0.011 | 0.031 | 0.122 | 2,529 |
| Bank size (SIZE) | 13.843 | 1.380 | 12.770 | 13.915 | 14.923 | 2,529 |
| ***Panel E. Treatment variables*** | | | | | | |
| NCFBank | 0.523 | 0.500 | 0.000 | 1.000 | 1.000 | 2,560 |
| Post | 0.599 | 0.490 | 0.000 | 1.000 | 1.000 | 2,560 |
| NCFBank x Post | 0.299 | 0.458 | 0.000 | 0.000 | 1.000 | 2,560 |

#### 4.3.3.2 Correlation analysis and collinearity diagnostics

Table 3 reports the pairwise correlation matrix for the full sample. The results reveal strong negative correlations between both total liquidity creation (TLQC) and on-balance-sheet liquidity creation (ONLQC) and the two capital measures: Tier 1 capital (TIER1) and the equity-to-assets ratio (CAR). These preliminary findings are consistent with the financial fragility–crowding-out hypothesis, which predicts that higher capital reduces banks' liquidity creation (Diamond and Rajan, 2000, 2001; Gorton and Winton, 2017).

The correlation analysis further shows that TLQC and ONLQC are positively associated with the bank risk measures (RWATA and LLRL), deposit market share (MKTSHR), and bank size (SIZE). These relationships suggest that larger, riskier, and more dominant banks tend to create more liquidity. By contrast, both liquidity creation measures are negatively correlated with bank profitability (ROA and ROE). The only exception is the relationship between TLQC and ROA, which, although negative, is statistically insignificant. Overall, apart from variables that serve as alternative specifications in the regressions (e.g., ROA versus ROE, and CAR versus TIER1), pairwise correlations among the explanatory variables are generally modest, with most coefficients below 0.50.[93]

To further assess potential multicollinearity, we estimate alternative model specifications in which the correlated explanatory variables are introduced individually (e.g., Wooldridge, 2016, p. 85; Kennedy, 2008, pp. 192–202). We also compute variance inflation factors (VIFs), the results of which are reported in Table 4. All VIF values are well below the conventional threshold of 10, with mean VIFs ranging from 1.19 to 8.72, indicating that multicollinearity is unlikely to affect the reliability of the regression estimates (Wooldridge,

[93] Wooldridge (2016, pp. 85–86) explains that, holding other factors constant, lower correlation between $x_j$ and the other explanatory variables improves the precision of the estimator $\beta_j$. Nevertheless, there is no universally accepted threshold for determining when correlation among regressors becomes problematic. Furthermore, high correlation between certain explanatory variables does not necessarily reduce the precision of the estimated coefficients on the remaining regressors.

2016, pp. 84–86; Gujarati and Dawn, 2009, p. 340). This conclusion is further supported by tolerance values exceeding 0.10 for all explanatory variables, confirming the absence of serious multicollinearity and providing confidence that the estimated coefficients and their standard errors are not materially distorted.

**Table 3. Pairwise correlations.**

This table reports pairwise Pearson correlation coefficients for the main variables in the sample. Variables are Winsorized at the 1st and 99th percentiles (definitions in Table 1; summary statistics in Table 2). Correlations significance is denoted by *, **, and ***, indicating 10%, 5%, and 1% levels, respectively.

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) TLQC | 1.000 | | | | | | | | | | |
| (2) ONLQC | 0.908*** | 1.000 | | | | | | | | | |
| (3) NCFBankxPost | -0.030 | -0.089*** | 1.000 | | | | | | | | |
| (4) TIER1 | -0.731*** | -0.730*** | 0.064*** | 1.000 | | | | | | | |
| (5) CAR | -0.515*** | -0.546*** | -0.011 | 0.811*** | 1.000 | | | | | | |
| (6) RWATA | 0.626*** | 0.526*** | -0.059*** | -0.402*** | 0.080*** | 1.000 | | | | | |
| (7) LLRL | 0.229*** | 0.303*** | -0.137*** | -0.340*** | -0.306*** | 0.130*** | 1.000 | | | | |
| (8) ROE | -0.115*** | -0.125*** | 0.160*** | 0.011 | -0.088*** | -0.236*** | -0.127*** | 1.000 | | | |
| (9) ROA | -0.020 | -0.060*** | 0.182*** | -0.106*** | -0.226*** | -0.191*** | -0.089*** | 0.749*** | 1.000 | | |
| (10) MKTSHR | 0.188*** | 0.236*** | 0.226*** | -0.288*** | -0.403*** | -0.221*** | 0.031 | 0.370*** | 0.262*** | 1.000 | |
| (11) SIZE | 0.182*** | 0.177*** | 0.592*** | -0.261*** | -0.386*** | -0.196*** | 0.036* | 0.357*** | 0.398*** | 0.747*** | 1.000 |

**Table 4. Collinearity diagnostics.**

The table reports the variance inflation factor (VIF) and its reciprocal, tolerance (1/VIF), for all explanatory variables. The VIF measures the extent to which the variance of an estimated coefficient is inflated because of linear dependence among the regressors, while tolerance provides the corresponding reciprocal measure. As a rule of thumb, VIF values exceeding 10 (or, equivalently, tolerance values below 0.10) indicate potentially problematic multicollinearity. Values well within these thresholds suggest that multicollinearity is unlikely to materially affect the precision of the coefficient estimates or inflate their standard errors.

| **Variable** | **VIF** | **Tolerance** |
|---|---|---|
| NCFBankxPost | 2.110 | 0.474 |
| TIER1 | 8.720 | 0.115 |
| CAR | 7.160 | 0.140 |
| RWATA | 3.170 | 0.315 |
| LLRL | 1.190 | 0.838 |
| ROA | 2.690 | 0.372 |
| ROE | 2.670 | 0.374 |
| MSHR_DEP | 3.160 | 0.317 |
| SIZE | 4.800 | 0.208 |
| **Mean VIF** | **3.96** | |

## 4.4 The model and regression frameworks

### 4.4.1 Baseline model

Following Berger and Bouwman (2009), we estimate the baseline relationship between bank capital and liquidity creation using a fixed-effects panel regression model, specified as in Equation (6):

$$Y_{i,t} = \alpha + \beta \cdot CAP_{i,t\text{-}1} + \gamma. \Sigma X_{i,t} + \lambda_i + \lambda_t + \varepsilon_{i,t} \qquad \textbf{(6)}$$

where $Y_{i,t}$ denotes one of the liquidity creation measures (see Table 1), scaled by gross total assets, for bank $i$ in year-month $t$, where $i = 1, \ldots, N$, and $t = 1, \ldots, T$. The principal explanatory variable, $CAP_{i,t\text{-}1}$, represents bank capital, measured alternatively by the equity-to-gross-total-assets ratio (CAR) and the Tier 1 capital ratio (TIER1). The coefficient β captures the marginal effect of bank capital on liquidity creation. To mitigate potential endogeneity arising from reverse causality, the capital variable is lagged by one period.

The vector $\Sigma X_{i,t}$ comprises the bank-specific control variables included in the analysis, namely bank risk, profitability, market share, and bank size, while γ denotes the corresponding vector of coefficients. Bank fixed effects $\lambda_i$ control for unobserved, time-invariant bank characteristics, such as business models and governance structures, thereby reducing omitted variable bias. Year-month fixed effects $\lambda_t$ capture common macroeconomic, regulatory, and seasonal shocks affecting all banks over time. Consistent with Berger and Bouwman (2009), all regressions are estimated using robust standard errors clustered at the bank level to account for heteroskedasticity and serial correlation within banks over time. Finally, $\varepsilon_{i,t}$ denotes the idiosyncratic error term.

### 4.4.2 Differences-in-differences approach

To estimate the causal effect of Zambia's New Capital Adequacy Framework (NCF) on bank liquidity creation, we employ a standard two-way fixed effects (TWFE) difference-in-differences (DID) specification. The TWFE estimator identifies the treatment effect by controlling for both bank fixed effects and year-month fixed effects, while exploiting the interaction between the treatment-group indicator and the post-reform period (Callaway et al., 2024; Roth et al., 2023; De Chaisemartin and d'Haultfoeuille, 2020). Because the treatment indicator ($NCFBank_i$) and the post-treatment indicator ($Post_t$) are perfectly collinear with the bank and time fixed effects, respectively, their main effects are absorbed and cannot be estimated separately.[94] Consequently, identification relies exclusively on the interaction term, $NCFBank_i \times Post_t$, which constitutes the DID estimator (Corral and Yang, 2024; Choi et al., 2020). The model is specified as in Equation (7):

$$Y_{i,t} = \alpha + \beta \cdot NCFBank_i \text{ x } Post_t + \gamma. \Sigma X_{i,t-1} + \lambda_i + \lambda_t + \varepsilon_{i,t} \qquad \textbf{(7)}$$

where $Y_{i,t}$ denotes one of the liquidity creation measures (see Table 1), scaled by gross total assets, for bank $i$ in year-month $t$, where $i = 1,\ldots, N$ and $t = 1,\ldots,T$. $NCFBank_i$ is a binary indicator equal to one for foreign-owned banks subject to the substantially higher minimum equity capital requirements introduced under the NCF, and zero otherwise. $Post_t$ equals one for the post-reform period (February 2012 to February 2019) and zero for the pre-reform period. The vector $\Sigma X_{i,t-1}$ contains the bank-specific control variables, lagged by one period, including

[94] The treatment indicator varies only across banks (i) and is time invariant, while the post-treatment indicator varies only over time (t) and is common to all banks. Consequently, the treatment indicator is absorbed by the bank fixed effects, and the post-treatment indicator by the time fixed effects. Both main effects are therefore omitted because they are perfectly collinear with the corresponding fixed effects. See Jeff Wooldridge (21 June 2021, 15:22), Statalist discussion on omitted variables due to collinearity with fixed effects.
Available: (https://www.statalist.org/forums/forum/general-stata-discussion/general/1429277-omitted-because-of-collinearity-with-fixed-effects.

capital, bank risk, profitability, market share, and bank size. Further, $\gamma$ denotes the corresponding vector of coefficients.

Bank fixed effects $\lambda_i$ control for unobserved, time-invariant bank characteristics, while year-month fixed effects $\lambda_t$ capture common macroeconomic, regulatory, and seasonal shocks affecting all banks. Consistent with Berger and Bouwman (2009), all regressions are estimated using robust standard errors clustered at the bank level to account for heteroskedasticity and serial correlation within banks over time. The term $\varepsilon_{i,t}$ denotes the idiosyncratic error term.

The coefficient on the interaction term, $NCFBank_i \times Post_t$, (i.e., $\beta$) represents the average treatment effect on the treated (ATT) under the DID framework. It captures the causal impact of the substantially higher equity capital requirements imposed on foreign-owned banks relative to locally owned banks following the implementation of the NCF. A positive coefficient indicates that the reform increased liquidity creation among treated banks relative to the comparison group, whereas a negative coefficient implies that the higher equity capital requirements reduced liquidity creation.

### 4.5 Empirical results and discussions

This section is organised into four main parts. Section **4.5.1** presents the baseline analysis, which examines the relationship between bank capital and liquidity creation in Zambia. The objective is to assess whether the observed dynamics are more consistent with the financial fragility–crowding-out hypothesis or the risk-absorption hypothesis advanced by Berger and Bouwman (2009). Section **4.5.2** then evaluates the net effect of capital on liquidity creation by separately analysing the asset and liability sides of banks' balance sheets. Section **4.5.3** further investigates whether the capital–liquidity relationship differs systematically across ownership structures, specifically between foreign-owned and locally owned banks. These preliminary analyses provide the foundation for the core investigation presented in Section **4.5.4**, which tests the study's central hypotheses.

Specifically, the analysis evaluates whether significantly higher equity-to-assets (i.e., leverage ratio) requirements – substantially above Basel III standards – and mandatory equity recapitalisation reduce liquidity creation (**Hypothesis 1**) or instead enhance it (**Hypothesis 2**). To identify the causal effects, the study exploits Zambia's 2012 New Capital Adequacy Framework (NCF) as a quasi-natural experiment and employs a difference-in-differences (DID) estimation strategy. All regression specifications include a comprehensive set of time-varying bank-level control variables together with both bank and time fixed effects, thereby accounting for unobserved heterogeneity across banks and common macroeconomic shocks over time. Additional specifications retain these fixed effects while incorporating the primary explanatory variables, interaction terms, and further controls where appropriate.

### 4.5.1 The effect of capital on bank liquidity creation: Baseline results

Table 5 reports the baseline regression results for the full sample of banks, examining the relationship between capital and liquidity creation. The main explanatory variable is the lagged capital-to-assets ratio (CAR), measured as total equity relative to gross total assets (GTA), while the dependent variable is total liquidity creation (TLQC), constructed using an adapted version of Berger and Bouwman's (2009) "cat fat" liquidity creation measure and scaled by GTA. The regressions estimate Equation (6) to assess how bank capital affects liquidity creation within the Zambian banking sector.

**Model (1)** presents the baseline specification, which includes bank and time fixed effects but excludes additional control variables. The results reveal a strong and statistically significant negative relationship between lagged CAR and TLQC (coefficient = -0.926, t = -10.98), indicating that higher levels of capitalisation are associated with lower liquidity creation. **Model (2)** introduces bank size as a control variable, reflecting the literature emphasising differences in liquidity creation between small and large banks (e.g., Berger and Bouwman, 2009; Evans and Haq, 2022). However, bank size is statistically insignificant (coefficient = 0.007, t = 0.18), suggesting limited explanatory power within the Zambian context. Importantly, the coefficient on lagged CAR remains strongly negative and significant (-0.912, t = -7.61). **Model (3)** further incorporates a proxy for bank risk in order to distinguish capital's liquidity-creation role from its risk-absorption function (Berger and Bouwman, 2009). The estimated coefficient on bank risk is positive and statistically significant (coefficient = 0.747, t = 9.17), implying that banks with greater risk exposure tend to create more liquidity. Although the magnitude of the capital coefficient declines slightly, the relationship remains negative and statistically significant (coefficient = -0.755, t = -9.17). **Model (4)** additionally controls for bank market power, proxied by deposit market share, following studies highlighting the importance of market dominance in shaping liquidity creation (e.g., Distinguin et al., 2013). The market share variable enters positively and significantly (coefficient = 1.578, t = 3.47), indicating that more dominant banks create more liquidity. The inverse relationship between capital and liquidity creation remains robust (coefficient = -0.798, t = -9.80).

**Model (5)** presents the fully specified regression, introducing profitability, measured by return on equity (ROE), as an additional control variable. Although prior studies (e.g., Duan and Niu, 2020) generally associate greater profitability with stronger liquidity creation, profitability is not statistically significant in this setting. This outcome is plausible given that a substantial share of Zambian banks' operating income derives from activities such as government securities investments and foreign exchange trading,[95] both of which are generally liquidity-destroying rather than liquidity-creating activities (Berger and Bouwman, 2009). Crucially, the coefficient on lagged CAR remains negative and highly significant in the fully controlled specification (coefficient = -0.798, t = -9.76), reinforcing the robustness of the inverse relationship between capitalisation and liquidity creation even after controlling for profitability and other bank characteristics. Economically, the estimated effect is substantial. A one-percentage-point increase in the capital-to-assets ratio is associated with approximately a 0.798 percentage-point decline in liquidity creation. Moreover, a one-standard-deviation increase in CAR (10.3 percent) corresponds to an approximate 0.47 standard deviation decline in liquidity creation, highlighting the economic significance of the relationship.[96]

---

[95] For instance, during 2024, interest income from government securities represented the second-largest source of operating income, with interest income from loans and advances ranking first, though only marginally higher. Additionally, foreign exchange income accounted for the third-largest share of total operating income (see Bank of Zambia Annual Report, 2024, p. 48, available at https://www.boz.zm/Bank_of_Zambia_2024_Annual_Report.pdf).

[96] We assess the economic significance of the estimated effect by evaluating how a one-standard-deviation increase in the CAR (i.e., 10.3%) translates into a change in the liquidity creation metric (TLQC). Specifically, for the lagged CAR coefficient reported in Model 5 of Table 5, the economic impact is computed as ((0.103 x -0.798)/0.175 = -0.47), where 0.103 is the standard deviation of CAR, -0.798 is the estimated coefficient on lagged CAR, and 0.175 is the standard deviation of the Total liquidity creation (TLQC) metric (Table 2). This calculation implies that a one-standard-deviation increase in capital adequacy reduces liquidity creation by approximately 0.47 standard deviations - a meaningful effect in economic terms (see Laux and Rauter, 2017, pp. 252 - 254).

Overall, the results across all five specifications consistently reveal a negative and statistically significant relationship between lagged capital and liquidity creation, providing strong support for the financial fragility–crowding-out hypothesis rather than the risk-absorption hypothesis. These findings are broadly consistent with evidence from other developing economies (e.g., Fu et al., 2016; Umar et al., 2018; Kusi et al., 2022; Toh, 2019), although they differ from Bawuah (2024), who reports a positive relationship using a broader cross-country Sub-Saharan African sample. One possible explanation for this divergence is that Bawuah's sample includes relatively advanced banking systems such as South Africa and Mauritius, whose financial structures and institutional characteristics differ substantially from those of a typical low- and lower-middle-income Sub-Saharan African economy (e.g., Beck et al., 2019, p. 1077).

### 4.5.2 Disaggregating the net effect of capital on liquidity creation across the bank balance Sheet

Building on the preceding findings, which consistently demonstrate a strong negative relationship between bank capitalisation and aggregate liquidity creation across all five baseline specifications, this section examines how capital affects the individual components of liquidity creation on both sides of banks' balance sheets. According to Diamond and Rajan (2001), banks create liquidity through activities on both the asset and liability sides of the balance sheet. Banks transform liquid liabilities into illiquid assets by allowing depositors to withdraw funds on demand while simultaneously financing longer-term and relatively illiquid investments such as loans. In doing so, banks insulate borrowers from depositors' liquidity needs. As Beck et al. (2023, p. 303) explain, banks create liquidity on the asset side by financing long-term investment projects and extending flexible funding arrangements such as credit lines, while on the liability side deposits function as liquid and secure means of payment that facilitate transactions and support the broader financial system.

To examine these balance-sheet channels in greater detail, including off-balance-sheet liquidity creation, we estimate a series of regressions using the disaggregated components of total liquidity creation – each scaled by gross total assets (GTA) – as dependent variables. Following Berger and Bouwman (2009) and Berger et al. (2019), all specifications include the full set of control variables together with bank and time fixed effects. Specifically, Equation (6) is estimated using the following liquidity creation measures: asset-side liquidity creation (ASLQC), liability-side liquidity creation (LSLQC), and off-balance-sheet liquidity creation (OFFBSLQC), alongside their underlying balance-sheet components: illiquid assets (IA), such as loans; liquid assets (LA), such as government securities; liquid liabilities (LL), including deposits; illiquid liabilities (IL), such as subordinated debt; and equity (EQ).

The regression results, reported in Table 6, indicate that higher lagged capital ratios significantly reduce liquidity creation on both the asset and liability sides of the balance sheet, while exerting only limited effects on off-balance-sheet activities. On the asset side, a one-percentage-point increase in the lagged capital ratio is associated with a 0.267 percentage-point decline in illiquid assets, particularly loans (t = -3.16). At the same time, better-capitalised banks exhibit a modest increase in liquid asset holdings, such as government securities, reflected in a positive but only weakly significant coefficient of 0.232 (t = 1.89). These results suggest a gradual portfolio shift away from illiquid lending activities toward safer and more liquid assets. On the liability side, the strongest effect is observed for liquid liabilities, particularly deposits, which decline significantly as capitalisation increases (coefficient = -0.464, t = -4.35). Illiquid liabilities, including subordinated debt, also decline (coefficient = -0.143, t = -1.82). However, because illiquid liabilities receive a negative weight within the liquidity creation measure, this decline partially offsets the overall reduction in liquidity creation. In addition, banks with higher lagged capital ratios tend to maintain stronger contemporaneous capital positions (coefficient = 0.883, t = 35.56), further reinforcing the reduction in liquidity creation across both sides of the balance sheet.

These findings are broadly consistent with two influential theoretical frameworks. First, the results support the financial fragility theory of Diamond and Rajan (2000, 2001), which predicts that stronger capitalisation weakens banks' ability to commit credibly to illiquid lending activities, thereby encouraging a substitution away from loans toward more liquid assets such as government securities. Second, the findings are consistent with the deposit crowding-out hypothesis (Gorton and Winton, 2000, 2017), whereby higher capital ratios partially substitute for deposits, reducing the stock of liquid liabilities that underpin banks' liquidity transformation function. Collectively, the results suggest that stronger capitalisation affects liquidity creation through adjustments on both the asset and liability sides of the balance sheet, primarily by reducing illiquid lending and deposit-based funding activities.

### 4.5.3 Disaggregated effects of capital on liquidity creation by bank ownership type

The role of bank ownership in shaping liquidity creation has attracted considerable attention in the literature, although existing evidence remains mixed. Some studies suggest that government-owned or bank-owned institutions tend to engage more actively in liquidity creation (Yeddou and Pourroy, 2020),[97] whereas foreign-owned and privately owned banks are generally found to create less liquidity than domestic private or state-owned institutions (Kusi et al., 2022). Examining these dynamics within the Zambian context is therefore important, as ownership structure may influence both the theoretical interpretation and policy implications of the capital–liquidity relationship. In our sample, locally owned banks comprise both privately owned institutions and banks with partial or majority government ownership, while

[97] According to the full results by Yeddou and Pourroy (2020), other bank ownership types are able to influence bank liquidity creation, but they only do so effectively when they control nearly all the capital. In contrast, both banks and government can influence liquidity creation once they own 50% of the equity.

foreign-owned banks consist exclusively of subsidiaries of publicly listed international banking groups.

Table 7 extends the baseline specification reported in Table 5 by introducing interaction terms between the capital-to-assets ratio (CAR) and ownership-type dummies for foreign-owned and locally owned banks. **Panel A** presents the results for foreign-owned banks, while **Panel B** reports the corresponding estimates for locally owned banks. The results in **Panel A** show that lagged CAR is negatively and significantly associated with liquidity creation across all specifications, with significance generally at the 1 percent level (except Model 2, where significance falls to the 5 percent level). The interaction term between the foreign-owned bank dummy and CAR is also strongly negative and statistically significant (coefficient = -0.615, t = -8.97), reinforcing the baseline finding that higher capitalisation significantly crowds out liquidity creation among foreign-owned banks. This result is unsurprising given that foreign-owned banks dominate banking activity in Zambia and therefore exert substantial influence on the full-sample estimates.[98] **Panel B** reveals a somewhat different pattern for locally owned banks. The lagged CAR variable remains negatively and significantly associated with liquidity creation in **Models 1–5**. However, once the interaction term for locally owned banks is introduced in **Model 6**, the direct effect of capital becomes statistically insignificant (coefficient = -0.162, t = -1.10), while the interaction term itself remains strongly negative and significant (coefficient = -0.697, t = -4.41). These results suggest heterogeneity within the locally owned bank category, potentially reflecting differences between privately owned

[98] As of December 31, 2011, just before the New Capital Adequacy Framework was implemented on January 30, 2012, foreign-owned banks held a substantial market share, accounting for 73.3% of total assets, 74.6% of total deposits, 72.0% of total loans, and 80.7% of profit before tax (refer to page 47 of the Bank of Zambia Annual Report, 2011, accessible at https://www.boz.zm/BOZANNUALREPORT2011.pdf ). Additionally, by December 31, 2018, shortly before the end of the sample period in February 2019, the combined market share of foreign-owned banks was 73.0% in total assets, 72.2% in total deposits, 67.9% in total loans, and 68.3% in profit before tax (see page 33 of the Bank of Zambia Annual Report, 2018, accessible at https://www.boz.zm/BOZ_annual_REPORT_2018.pdf ).

domestic banks and institutions with varying degrees of government ownership, as highlighted by Kusi et al. (2022) and Yeddou and Pourroy (2020).

To further examine these ownership-related differences, Table 8 analyses the effects of capital on the individual components of liquidity creation across asset-side, liability-side, and off-balance-sheet channels, again disaggregated by ownership structure. For foreign-owned banks (**Panel A**), higher lagged CAR is negatively associated with illiquid assets, particularly loans, and with liquid liabilities, mainly deposits, while positively associated with liquid assets such as government securities. These patterns are consistent with both the financial fragility theory (Diamond and Rajan, 2000, 2001) and the deposit crowding-out hypothesis (Gorton and Winton, 2017). Higher capitalisation appears to reduce incentives for illiquid lending, encourage substitution toward safer liquid assets, and partially crowd out deposits as investors shift toward equity holdings. By contrast, for locally owned banks (**Panel B**), the effect of capital is concentrated primarily on the liability side of the balance sheet. Higher capitalisation significantly reduces liquid liabilities but has no statistically significant impact on asset-side liquidity creation. Interestingly, the negative relationship between capital and illiquid liabilities – which receive a negative weight in the liquidity creation index mechanically increases measured total liquidity creation, although this reflects a construction effect rather than a substantive increase in liquidity provision. Overall, the evidence for locally owned banks provides support mainly for the deposit crowding-out mechanism rather than the broader financial fragility channel.

Taken together, the results indicate that higher capital ratios are consistently associated with lower overall liquidity creation across ownership structures. These findings differ from studies emphasising ownership-related differences in liquidity creation (e.g., Yeddou and Pourroy, 2020) and from evidence reporting positive capital–liquidity relationships, particularly among larger banks (e.g., Berger and Bouwman, 2009). In the Zambian context, however, foreign-owned banks – many of which are among the largest institutions in the sector – appear to drive the overall negative relationship between capitalisation and liquidity creation. For locally owned banks, the relationship is more nuanced and likely reflects heterogeneity between privately owned and state-affiliated institutions. The insignificant direct effect of capital in **Model 6** (**Panel B**) further suggests that, while some locally owned banks may exhibit behaviour consistent with the risk-absorption hypothesis, this effect is dominated overall by the stronger financial fragility–crowding-out mechanism observed across the banking sector.

#### 4.5.4 Assessing the effect of significantly higher capital requirements on foreign-owned banks' liquidity creation: A Difference-in-Differences Approach

Building on the previously established negative relationship between lagged capital and liquidity creation among foreign-owned banks, this section examines whether the substantial increase in minimum equity capital requirements introduced under Zambia's 2012 New Capital Adequacy Framework (NCF) led to a relative decline in liquidity creation by foreign-owned banks. Under the reform, the minimum paid-up equity requirement for foreign-owned banks increased from K12 million to K520 million (a more than fortyfold increase) compared with an increase to K104 million for locally owned banks. The analysis is motivated by the theoretical predictions of the financial fragility hypothesis and the deposit crowding-out hypothesis, both of which suggest that higher equity capital requirements may reduce banks' liquidity creation capacity (Berger and Bouwman, 2009).

The pronounced ownership-based differentiation in regulatory treatment between foreign-owned and locally owned banks provides an ideal setting for a difference-in-differences (DID) empirical design. Foreign-owned banks, which were subject to substantially higher capital requirements, are classified as the treated group based on the intensity of the recapitalisation shock, while locally owned banks serve as the control group. Accordingly, the causal effect of the NCF reform on foreign-owned banks is identified using a DID framework. This approach is particularly advantageous because it controls for both observed and unobserved time-invariant heterogeneity between treated and control banks (e.g., Hettinger et al., 2024; Wang et al., 2024; Evans and Haq, 2022; Gropp et al., 2019). The baseline specification estimates Equation (7), where total liquidity creation (TLQC), scaled by gross total assets (GTA), is used as the dependent variable.

Table 9 reports the DID estimates across six alternative model specifications. Following Jiang et al. (2019), the models are estimated both with and without additional controls to account for the possibility that some bank-specific covariates may themselves be endogenous to the treatment. This approach is consistent with Berger and Bouwman (2009), who show that the relationship between capital and liquidity creation remains robust across alternative specifications. The sequential modelling strategy begins with a parsimonious specification including only the DID interaction term and fixed effects (**Model 1**), before progressively introducing lagged capital (**Model 2**), bank size (**Model 3**), bank risk (**Model 4**), market share (**Model 5**), and profitability (**Model 6**), which constitutes the main specification. Across all specifications, the DID coefficient remains negative and statistically significant at either the 5 percent or 10 percent level, except in **Model 2** where significance weakens temporarily following the inclusion of lagged capital. In the main specification (**Model 6**), the DID coefficient is -0.047 (t = -2.12), indicating that foreign-owned banks created relatively less liquidity following the implementation of the NCF compared with locally owned banks.

Although statistically significant, the magnitude of the estimated effect should be interpreted carefully from a policy perspective. The coefficient implies a decline in liquidity creation equivalent to approximately 4.7 percentage points relative to total assets, translating into a reduction of roughly 22.6 percent relative to the sample mean.[99] In standard deviation terms, a one-standard-deviation increase in treatment intensity reduces liquidity creation by approximately 0.022 percentage points (i.e., 0.458 x -0.047), equivalent to around 10.3 percent of the sample standard deviation in TLQC.[100] While economically meaningful, this effect is moderate rather than destabilising in magnitude, particularly when weighed against the substantial improvements in solvency and reductions in insolvency risk documented in Chapter 3. The findings therefore suggest the existence of a trade-off between stronger capitalisation and banks' liquidity creation capacity, but not one sufficiently large to outweigh the broader financial stability benefits associated with significantly higher leverage-based capital requirements.

The control variables reported in **Model 6** provide further insight into the mechanisms underlying this relationship. The negative and highly significant coefficient on lagged capital supports the financial fragility hypothesis (Diamond and Rajan, 2000, 2001), which argues that stronger capitalisation may weaken banks' incentives or ability to engage in liquidity creation through relationship lending. The results are also consistent with the deposit crowding-out hypothesis (Gorton and Winton, 2017), whereby equity funding partially substitutes for deposits, which are central to banks' liquidity transformation function. Bank risk is positively associated with liquidity creation, suggesting that greater credit risk accompanies more aggressive liquidity provision (e.g., Mazioud Chaabouni et al., 2018; Díaz and Huang, 2017).

---

[99] We calculate this value as follows: -0.047/0.208 = -22.6%. Here, -0.047 represents the regression coefficient for the NCFBank x Post in **Model 6** of Table 9, and 0.208 is the mean value of TLQC (Table 2). For the formula, refer to Berger et al. (2020, p.11).

[100] We determine this by measuring the change in a liquidity creation metric, relative to its mean value, resulting from a one-standard-deviation increase in the treatment intensity (i.e., by 0.458). For example, the economic significance related to the NCFBank x Post estimate in **Model 6** of Table 9 is calculated as (0.458 × -0.047)/0.208 = -10.3%, where 0.458 represents the standard deviation of NCFBank x Post, -0.047 is the regression coefficient for NCFBank x Post, and 0.208 is the mean value of TLQC (Table 2). For the formula, refer to Evans and Haq (2022, p. 6).

Similarly, market share exhibits a positive and statistically significant relationship with liquidity creation, consistent with the view that larger and more dominant banks possess stronger funding advantages and greater lending capacity (Distinguin et al., 2013).

To further disentangle these effects, Table 10 decomposes liquidity creation into its asset-side (ASLQC), liability-side (LSLQC), and off-balance-sheet (OFFBLQC) components. As shown earlier in Table 2, liquidity creation in Zambia is concentrated predominantly on the liability side of bank balance sheets. However, the DID results indicate that the negative treatment effect is driven primarily by a reduction in asset-side liquidity creation. The DID coefficient for ASLQC is weakly significant at the 10 percent level, implying that a one-standard-deviation increase in treatment intensity is associated with a 3.34-percentage-point (i.e., 0.458 x -0.073) decline in asset-side liquidity creation. By contrast, no statistically significant effects are observed for liability-side or off-balance-sheet liquidity creation. Taken together, the evidence from Tables 7–10 suggests that significantly higher equity capital requirements can constrain banks' liquidity creation capacity, particularly through reduced asset-side intermediation. However, the results do not indicate a severe contraction in overall liquidity creation or a destabilising collapse in credit intermediation. Instead, the findings point to a manageable trade-off between stronger solvency buffers and somewhat lower liquidity creation among the foreign-owned banks (i.e., treated banks).

Importantly, the evidence should be interpreted within the broader context of the reform's substantial financial stability gains. The NCF generated a significant increase in leverage ratios, reduced insolvency risk, and did so without inducing adverse portfolio risk-shifting behaviour (see Chapter 3). In this respect, the moderate decline in liquidity creation appears to represent the cost of achieving materially stronger banking-sector resilience. Moreover, the results suggest that the design and implementation mechanism of the reform are critical. Zambia's NCF imposed exceptionally large increases in paid-up equity capital requirements – particularly for foreign-owned banks – within a relatively compressed adjustment period and irrespective of bank size differences. Unsurprisingly, some balance-sheet adjustment occurred, including a shift toward more liquid and lower-risk assets such as government securities and foreign currency positions. These findings are consistent with Funyina (2023), who documents a positive relationship between capital adequacy and government securities holdings among foreign-owned banks in Zambia.

From a policy perspective, the results therefore do not suggest that significantly higher leverage-based capital requirements should be avoided. Rather, they imply that regulators should implement such reforms carefully and gradually in order to minimise potentially adverse effects on banks' liquidity creation function. In structurally vulnerable and highly dollarised banking systems – such as those in many Sub-Saharan African low- and middle-income countries – the benefits of substantially stronger equity capital buffers in reducing insolvency risk and strengthening resilience are likely to outweigh the moderate reduction in liquidity creation identified in this study. Nevertheless, a gradual phase-in approach, allowing banks to build capital buffers through retained earnings, staggered equity injections, or transitional recapitalisation arrangements, may help reduce abrupt balance-sheet adjustments and preserve credit intermediation capacity (e.g., Kashyap et al., 2010). Overall, the findings support the view that stronger leverage-based capital regulation can enhance financial stability without generating disproportionately large costs to liquidity creation, provided implementation is appropriately calibrated and credibly managed.

### 4.6 Additional robustness check

This section introduces two additional robustness checks designed to further strengthen the internal validity and causal interpretation of the empirical findings. To address concerns relating to unobserved heterogeneity and potential model misspecification, we employ complementary identification strategies aimed at reducing threats to causal inference. First, placebo tests are conducted by simulating hypothetical policy interventions during pre-treatment periods (2007–2009 and 2009–2011). These placebo regressions enable us to assess whether any spurious pre-trends or anticipation effects exist that could weaken the credibility of the difference-in-differences estimator. Nevertheless, unobserved time-varying confounders may still pose identification challenges. To address this concern, we additionally implement an instrumental variable (IV) approach. This strategy provides a more robust identification framework by relying on a valid instrument – one that is strongly correlated with the potentially endogenous capital regulation variable while remaining orthogonal to the error term in the outcome equation.

#### 4.6.1 Placebo tests

In addition to the visual inspection commonly used to assess the plausibility of the parallel trends and no-anticipation assumptions within the DID framework, Roth et al. (2023) emphasise the growing use of formal statistical tests to detect pre-treatment differences. These regression-based approaches provide an important complement to graphical diagnostics by offering direct empirical evidence on the validity of the identifying assumptions underlying the DID estimator. Accordingly, we complement the visual analysis presented in Figure 1 with placebo regression tests designed to identify any spurious pre-treatment effects that may indicate violations of these core assumptions.

Specifically, we simulate two hypothetical policy interventions by assuming that the Bank of Zambia's New Capital Adequacy Framework (NCF), which was actually implemented in January 2012, had instead been introduced five years earlier (January 2007) and three years earlier (January 2009).[101] In each case, the post-treatment indicator variable ($Post_t$) is redefined as $Post_t$*, taking a value of one during the placebo treatment windows of 2007–2009 and 2009–2011, respectively, and zero otherwise. This procedure follows the approach adopted by Sobiech et al. (2025, p. 11). The placebo regression results reported in Table 11 show that the estimated treatment effects are statistically insignificant in both cases. These findings provide no evidence of anticipation effects or spurious differential pre-trends, thereby offering additional support for the validity of the identification strategy.

#### 4.6.2 Endogeneity

A central challenge in empirically identifying the effects of heightened capital requirements on bank behaviour is isolating plausibly exogenous variation in capital regulation (Gropp et al., 2019, p. 267). Our identification strategy therefore relies on treating the implementation of Zambia's New Capital Adequacy Framework (NCF) in January 2012 as an exogenous regulatory shock with respect to the balance-sheet outcomes examined in this study. Establishing causal relationships in empirical analyses of bank capital, risk-taking, and output is inherently difficult because these variables are jointly determined (Evans and Haq, 2022, p. 5). For example, banks may simultaneously adjust their capital positions and risk exposures in response to common internal incentives or broader macroeconomic conditions. The empirical literature on bank capital and risk has long recognised endogeneity as a major challenge, particularly the problem of reverse causality, whereby changes in bank behaviour may themselves influence subsequent regulatory actions (Acosta-Smith et al., 2024, p. 2; Zheng et al., 2019, p. 17). This section therefore explicitly addresses potential endogeneity concerns

[101] The period 2007 to 2009 aligns with the Bank of Zambia's implementation of the initial increase in minimum paid-up capital requirements for all banks, raising the threshold from K2 million to K12 million in January 2007, as discussed in Section 2. Additionally, the years 2009 to 2011 marked the entry of several new banks into the Zambian banking sector, each of which injected fresh capital to meet the revised K12 million requirement.

associated with Zambia's NCF, with particular emphasis on mitigating the risk of reverse causality that could otherwise bias the empirical estimates.

**4.6.2.1 Instrumental variable analysis**

To address potential endogeneity in the relationship between bank capital and liquidity creation, we employ an instrumental variable (IV) estimation strategy within a two-stage least squares (2SLS) framework that incorporates both bank and time fixed effects. This approach follows established empirical methodologies in the banking literature (e.g., Berger and Bouwman, 2009; Nguyen et al., 2023). Specifically, current capital ratios are instrumented using their own lagged values – ranging from one to three months – which are predetermined, plausibly exogenous, and unlikely to be influenced by contemporaneous liquidity creation behaviour. As such, these lagged capital measures satisfy the relevance and exogeneity conditions required for valid instruments (Hansen, 2022, pp. 341-423).

Given the panel structure of the dataset and the importance of controlling for unobserved bank-specific and time-specific heterogeneity, the use of fixed effects within the IV framework is both appropriate and consistent with best practice in the literature (see Berger and Bouwman, 2009, p. 3829). In addition, the fixed-effects 2SLS estimator is recognised for its robustness to model misspecification and reduced sensitivity to restrictive functional-form assumptions (Nguyen et al., 2023, p. 884). In the first stage of estimation, the endogenous capital variable is regressed on its lagged values together with the full set of baseline control variables, while accounting for bank and time fixed effects.[102] The fitted values obtained from this stage are subsequently used in the second-stage regression to estimate the effect of capital on liquidity creation.

[102] We adopt the approach employed by Levitt (2002, p. 1246) and Faulkender and Petersen (2006, p. 70), who explicitly incorporate fixed effects in the first-stage regressions of their two-stage least squares (2SLS) estimations. This specification ensures that unobserved heterogeneity across banks and over time is appropriately controlled for in the instrumented model, thereby strengthening the internal validity of our IV estimates.

Table 12 reports the instrumental variable estimation results across **Columns (1)–(3)**. The first-stage estimates presented in **Column (1)** indicate strong instrument relevance. In particular, the first lag of the capital-to-assets ratio (*L1_w_CAR*) is highly predictive of the contemporaneous capital ratio, with a coefficient of approximately 0.93 ($p < 0.01$) and a first-stage F-statistic of 896 – well above the conventional threshold of 10 – thereby eliminating concerns regarding weak instruments.[103] Furthermore, the Kleibergen–Paap rk Wald F-statistics exceed 2,700 across all specifications, providing additional evidence of instrument strength even in the presence of heteroskedasticity and clustered standard errors. The Hansen J-statistics generate p-values between 0.20 and 0.22, implying no evidence against the null hypothesis of joint instrument validity. Collectively, these diagnostics confirm that the lagged capital ratios constitute strong and valid instruments within the empirical framework.

The second-stage results reported in **Column (2)** closely mirror the baseline findings presented in Table 5 (**Model 5**). Specifically, a one-unit increase in the capital ratio is associated with a 0.93-unit decline in total liquidity creation, with the relationship remaining statistically significant at the 1 percent level. Column (3) further incorporates the post-reform interaction term (NCFBankxPost) to assess whether the regulatory reform altered the marginal effect of capital on liquidity creation. Although the interaction coefficient is negative, it is not statistically significant, suggesting that the reform did not materially change the slope of the capital–liquidity relationship. Overall, the IV estimates reinforce the baseline results by showing that higher capital levels are robustly associated with lower bank liquidity creation, even after accounting for potential endogeneity. The findings therefore strengthen the

[103] For consistent identification in instrumental variable estimation, it is essential that the instruments are relevant - that is, they must exhibit a sufficiently strong correlation with the endogenous regressors (Cameron and Trivedi, 2022, p. 341 - 343). This relevance condition ensures that the instruments can adequately explain variation in the endogenous variable, allowing the two-stage least squares (2SLS) estimator to isolate the exogenous component of interest. In empirical practice, instrument strength is commonly assessed through the first-stage F-statistic, where values exceeding conventional thresholds (e.g., $F > 10$) help guard against weak instrument bias.

conclusion that, while increased capitalisation enhances solvency and resilience, it may simultaneously constrain banks' liquidity creation function.

**Table 5. The effect of capital on bank liquidity creation.**
This table reports estimates from the baseline model for analysing the effect of bank capital on liquidity creation. The main exogenous variable is the lagged capital ratio (equity-to-asset), and the primary dependent variable is total liquidity creation (TLQC), based on an adapted version of Berger and Bouwman's (2009) "cat fat" measure. All variables are Winsorised at the 1/99 percentiles and are defined in Table 1 and summary statistics in Table 2. *, **, and *** denote significance at 10%, 5%, and 1% level.

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|---|---|---|---|---|---|
| **Dependent Variable:** | **TLQC** | **TLQC** | **TLQC** | **TLQC** | **TLQC** |
| *Bank capital* | -0.926*** | -0.912*** | -0.755*** | -0.798*** | -0.798*** |
| | (-10.98) | (-7.61) | (-9.67) | (-9.80) | (-9.76) |
| **CONTROLS:** | | | | | |
| *Bank size* | | 0.007 | 0.052** | -0.004 | -0.004 |
| | | (0.18) | (2.29) | (-0.13) | (-0.12) |
| *Bank risk (RWATA)* | | | 0.747*** | 0.741*** | 0.741*** |
| | | | (9.17) | (9.33) | (9.38) |
| *Market share* | | | | 1.578*** | 0.741*** |
| | | | | (3.47) | (3.39) |
| *Profitability (ROE)* | | | | | 0.003 |
| | | | | | (0.03) |
| *Constant* | 0.351*** | 0.256 | -0.794** | -0.120 | -0.117 |
| | (27.44) | (0.47) | (-2.41) | (-0.31) | (-0.29) |
| *Bank Fixed Effects* | YES | YES | YES | YES | YES |
| *Time Fixed Effects* | YES | YES | YES | YES | YES |
| *Observations* | 2,510 | 2,510 | 2,509 | 2,509 | 2,509 |
| *Adj R-squared* | 0.566 | 0.566 | 0.782 | 0.793 | 0.793 |
| *F-test (p-value)* | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

**Table 6. The effect of capital on components of bank liquidity creation.**
This table presents regression results with dependent variables representing each component of total liquidity creation (TLQC), specifically asset-side liquidity creation (ASLQC), liability-side liquidity creation (LSLQC), and off-balance sheet liquidity creation (OFFBSLQC), all normalized by gross total assets. Additionally, the sub-components of these measures are also used as dependent variables: Illiquid assets (IA), Liquid assets (LA), Liquid liabilities (LL), Illiquid liabilities (IL), and Equity (EQ). For the sake of brevity, we present only the coefficients for bank capital, though the regressions include all exogenous variables from the full specification in Table 5. Each regression is conducted with both time and bank fixed effects, and all variables are Winsorized at the 1st and 99th percentiles. *, **, and *** denote significance at 10%, 5%, and 1% level.

| | Asset-side liquidity creation | | | Liability-side liquidity creation | | | | Off-balance sheet liquidity creation |
|---|---|---|---|---|---|---|---|---|
| **Dependent Variable:** | **ASLQC** | IA | LA | **LSLQC** | LL | IL | EQ | **OFFBSLQC** |
| Weight | | ½ | −½ | | ½ | −½ | −½ | |
| *Bank capital* | -0.243** | -0.267*** | 0.232* | -0.601*** | -0.464*** | -0.143* | 0.883*** | 0.086 |
| | (-2.41) | (-3.16) | (1.89) | (-12.54) | (-4.35) | (-1.82) | (35.56) | (0.76) |
| *Controls included* | YES | YES | YES | YES | YES | YES | YES | YES |
| *Bank Fixed Effects* | YES | YES | YES | YES | YES | YES | YES | YES |
| *Time Fixed Effects* | YES | YES | YES | YES | YES | YES | YES | YES |
| *Observations* | 2,509 | 2,509 | 2,509 | 2,509 | 2,509 | 2,509 | 2,509 | 2,509 |
| *Adj R-squared* | 0.852 | 0.846 | 0.846 | 0.796 | 0.774 | 0.553 | 0.945 | 0.528 |
| *F-test (p-value)* | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

**Table 7. Panel A (foreign banks): The impact of capital on bank liquidity creation by ownership type.** This table reports regression results examining the relationship between bank capital and liquidity creation across ownership types. The key explanatory variable is the lagged equity-to-asset ratio (capital ratio), while the dependent variable is total liquidity creation (TLQC), derived from a modified version of Berger and Bouwman's (2009) "cat fat" measure. Interaction terms between the capital ratio and a foreign bank dummy (equal to 1 for foreign-owned banks, and 0 otherwise) are included to capture ownership-specific effects. All variables, except ownership dummies, are Winsorized at the 1st and 99th percentiles. Variable definitions are provided in Table 1, with descriptive statistics in Table 2. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|---|---|---|---|---|---|---|
| **Dependent Variable:** | **TLQC** | **TLQC** | **TLQC** | **TLQC** | **TLQC** | **TLQC** |
| *CAR* | -0.987*** | -0.873** | -0.683*** | -0.766*** | -0.777*** | -0.244*** |
| | (-4.56) | (-2.86) | (-8.83) | (-7.63) | (-8.36) | (-4.04) |
| *CAR * Foreign-owned banks* | | | | | | -0.615*** |
| | | | | | | (-8.97) |
| **CONTROLS:** | | | | | | |
| *Bank size* | | 0.030 | 0.085*** | 0.025 | 0.035 | 0.033 |
| | | (0.55) | (4.03) | (0.74) | (1.32) | (1.36) |
| *Bank risk (RWATA)* | | | 0.822*** | 0.806*** | 0.807*** | 0.807*** |
| | | | (10.01) | (10.14) | (9.88) | (10.22) |
| *Market share* | | | | 1.266** | 1.112** | 1.083** |
| | | | | (2.41) | (2.45) | (2.47) |
| *Profitability (ROE)* | | | | | -0.263** | -0.229** |
| | | | | | (-3.14) | (-2.93) |
| *Constant* | 0.334*** | -0.112 | -1.368*** | -0.586 | -0.720* | -0.675* |
| | (10.98) | (-0.14) | (-4.42) | (-1.30) | (-1.95) | (-2.01) |
| *Bank Fixed Effects* | YES | YES | YES | YES | YES | YES |
| *Time Fixed Effects* | YES | YES | YES | YES | YES | YES |
| *Observations* | 1,330 | 1,330 | 1,329 | 1,329 | 1,329 | 1,329 |
| *Adj R-squared* | 0.593 | 0.597 | 0.848 | 0.856 | 0.858 | 0.863 |
| *F-test (p-value)* | 0.002 | 0.004 | 0.000 | 0.000 | 0.000 | 0.000 |

**Table 7. Panel B (local banks): The impact of capital on bank liquidity creation by ownership type.** This table reports regression results examining the relationship between bank capital and liquidity creation across ownership types. The key explanatory variable is the lagged equity-to-asset ratio (capital ratio), while the dependent variable is total liquidity creation (TLQC), derived from a modified version of Berger and Bouwman's (2009) "cat fat" measure. Interaction terms between the capital ratio and a local bank dummy (equal to 1 for locally-owned banks, and 0 otherwise) are included to capture ownership-specific effects. All variables, except ownership dummies, are Winsorized at the 1st and 99th percentiles. Variable definitions are provided in Table 1, with descriptive statistics in Table 2. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|---|---|---|---|---|---|---|
| **Dependent Variable:** | **TLQC** | **TLQC** | **TLQC** | **TLQC** | **TLQC** | **TLQC** |
| *CAR* | -0.782*** | -0.769*** | -0.749*** | -0.745*** | -0.773*** | -0.162 |
| | (-7.29) | (-5.28) | (-4.75) | (-4.82) | (-4.91) | (-1.10) |
| *CAR * Locally-owned banks* | | | | | | -0.697*** |
| | | | | | | (-4.41) |
| **CONTROLS:** | | | | | | |
| *Bank size* | | 0.008 | 0.015 | -0.012 | -0.024 | -0.034 |
| | | (0.15) | (0.36) | (-0.27) | (-0.53) | (-0.78) |
| *Bank risk (RWATA)* | | | 0.640*** | 0.626*** | 0.630*** | 0.634*** |
| | | | (4.16) | (4.26) | (4.32) | (4.51) |
| *Market share* | | | | 1.855** | 1.874** | 1.822** |
| | | | | (2.57) | (2.80) | (2.81) |
| *Profitability (ROE)* | | | | | 0.176 | 0.256 |
| | | | | | (1.19) | (1.51) |
| *Constant* | 0.356*** | 0.252 | -0.217 | 0.083 | 0.247 | 0.387 |
| | (20.23) | (0.35) | (-0.37) | (0.14) | (0.40) | (0.65) |
| *Bank Fixed Effects* | YES | YES | YES | YES | YES | YES |
| *Time Fixed Effects* | YES | YES | YES | YES | YES | YES |
| *Observations* | 1,180 | 1,180 | 1,180 | 1,180 | 1,180 | 1,180 |
| *Adj R-squared* | 0.551 | 0.551 | 0.703 | 0.712 | 0.714 | 0.726 |
| *F-test (p-value)* | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

**Table 8: Panel A (foreign-owned banks). The impact of capital on the components of bank liquidity creation by ownership type.**
This table reports regression results where the dependent variables represent distinct components of total liquidity creation (TLQC), including asset-side liquidity creation (ASLQC), liability-side liquidity creation (LSLQC), and off-balance sheet liquidity creation (OFFBSLQC), each scaled by gross total assets. The analysis also disaggregates these into sub-components: Illiquid assets (IA), Liquid assets (LA), Liquid liabilities (LL), Illiquid liabilities (IL), and Equity (EQ). For brevity, only the coefficients on the capital ratio are shown, though all regressions include the full set of control variables specified in Table 5. Bank and time fixed effects are included to control for unobserved heterogeneity, and all variables are Winsorized at the 1st and 99th percentiles. Statistical significance is denoted by *, **, and ***, corresponding to the 10%, 5%, and 1% levels, respectively.

| | Asset-side liquidity creation | | | Liability-side liquidity creation | | | | Off-balance sheet liquidity creation |
|---|---|---|---|---|---|---|---|---|
| **Dependent Variable:** | **ASLQC** | IA | LA | **LSLQC** | LL | IL | EQ | **OFFBSLQC** |
| Weight | | ½ | −½ | | ½ | −½ | −½ | |
| *Bank capital* | -0.263*** | -0.188** | 0.338*** | -0.627*** | -0.380* | 0.049 | 0.868*** | 0.192 |
| | (-3.98) | (-3.20) | (3.91) | (-5.86) | (-2.23) | (1.24) | (55.89) | (1.07) |
| *Controls included* | YES | YES | YES | YES | YES | YES | YES | YES |
| *Bank Fixed Effects* | YES | YES | YES | YES | YES | YES | YES | YES |
| *Time Fixed Effects* | YES | YES | YES | YES | YES | YES | YES | YES |
| *Observations* | 1,329 | 1,329 | 1,329 | 1,329 | 1,329 | 1,329 | 1,329 | 1,329 |
| *Adj R-squared* | 0.003 | 0.003 | 0.002 | 0.001 | 0.006 | 0.051 | 0.000 | 0.009 |
| *F-test (p-value)* | 0.914 | 0.918 | 0.903 | 0.822 | 0.800 | 0.625 | 0.940 | 0.679 |

**Table 8: Panel B (locally-owned banks). The impact of capital on the components of bank liquidity creation by ownership type.**
This table reports regression results where the dependent variables represent distinct components of total liquidity creation (TLQC), including asset-side liquidity creation (ASLQC), liability-side liquidity creation (LSLQC), and off-balance sheet liquidity creation (OFFBSLQC), each scaled by gross total assets. The analysis also disaggregates these into sub-components: Illiquid assets (IA), Liquid assets (LA), Liquid liabilities (LL), Illiquid liabilities (IL), and Equity (EQ). For brevity, only the coefficients on the capital ratio are shown, though all regressions include the full set of control variables specified in Table 5. Bank and time fixed effects are included to control for unobserved heterogeneity, and all variables are Winsorized at the 1st and 99th percentiles. Statistical significance is denoted by *, **, and ***, corresponding to the 10%, 5%, and 1% levels, respectively.

| | Asset-side liquidity creation | | | Liability-side liquidity creation | | | | Off-balance sheet liquidity creation |
|---|---|---|---|---|---|---|---|---|
| **Dependent Variable:** | **ASLQC** | IA | LA | **LSLQC** | LL | IL | EQ | **OFFBSLQC** |
| Weight | | ½ | −½ | | ½ | −½ | −½ | |
| *Bank capital* | -0.153 | -0.215 | 0.110 | -0.553*** | -0.469** | -0.253*** | 0.876*** | -0.123 |
| | (-0.85) | (-1.28) | (0.56) | (-7.59) | (-2.68) | (-3.76) | (24.57) | (-0.53) |
| *Controls included* | YES | YES | YES | YES | YES | YES | YES | YES |
| *Bank Fixed Effects* | YES | YES | YES | YES | YES | YES | YES | YES |
| *Time Fixed Effects* | YES | YES | YES | YES | YES | YES | YES | YES |
| *Observations* | 1,180 | 1,180 | 1,180 | 1,180 | 1,180 | 1,180 | 1,180 | 1,180 |
| *Adj R-squared* | 0.021 | 0.002 | 0.037 | 0.000 | 0.000 | 0.013 | 0.000 | 0.007 |
| *F-test (p-value)* | 0.717 | 0.694 | 0.715 | 0.736 | 0.671 | 0.567 | 0.947 | 0.448 |

**Table 9. Effect of elevated equity capital requirements on bank liquidity creation.**
This table presents results from a difference-in-differences (DID) regression estimating the impact of substantially higher equity capital thresholds on bank liquidity creation. The dependent variable is total liquidity creation (TLQC), calculated using a modified version of Berger and Bouwman's (2009) "cat fat" methodology. The key explanatory variable, NCFBank, is a binary indicator equal to 1 for foreign-owned banks subject to the heightened capital requirements introduced under Zambia's 2012 New Capital Adequacy Framework (NCF), and 0 otherwise. Post is a time dummy coded as 1 for all observations from February 2012 (following NCF implementation on January 30, 2012) through February 2019, and 0 for earlier periods. The interaction term NCFBank × Post represents the DID estimator, capturing the differential effect of the policy on foreign-owned (treated) banks relative to locally owned (control) banks in the post-reform period. All continuous variables are Winsorised at the 1st and 99th percentiles. Variable definitions are provided in Table 1 and summary statistics in Table 2. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|---|---|---|---|---|---|---|
| **Dependent Variable:** | **TLQC** | **TLQC** | **TLQC** | **TLQC** | **TLQC** | **TLQC** |
| NCFBank x Post | -0.132** | -0.089 | -0.097* | -0.053* | -0.047** | -0.047** |
| | (-2.32) | (-1.69) | (-1.83) | (-1.91) | (-2.13) | (-2.12) |
| **CONTROLS:** | | | | | | |
| *Bank capital* | | -0.881*** | -0.827*** | -0.695*** | -0.742*** | -0.748*** |
| | | (-9.08) | (-6.34) | (-7.63) | (-8.23) | (-8.08) |
| *Bank size* | | | 0.023 | 0.055** | -0.000 | -0.003 |
| | | | (0.63) | (2.40) | (-0.00) | (-0.13) |
| *Bank risk (RWATA)* | | | | 0.660*** | 0.657*** | 0.657*** |
| | | | | (8.06) | (8.23) | (8.21) |
| *Market share* | | | | | 1.564*** | 1.600*** |
| | | | | | (4.29) | (4.32) |
| *Profitability (ROE)* | | | | | | 0.055 |
| | | | | | | (0.49) |
| *Constant* | 0.249*** | 0.371*** | 0.046 | -0.786** | -0.116 | -0.070 |
| | (14.38) | (19.42) | (0.09) | (-2.36) | (-0.33) | (-0.18) |
| *Bank Fixed Effects* | YES | YES | YES | YES | YES | YES |
| *Time Fixed Effects* | YES | YES | YES | YES | YES | YES |
| *Observations* | 2,528 | 2,510 | 2,510 | 2,509 | 2,509 | 2,508 |
| *Adj R-squared* | 0.441 | 0.581 | 0.583 | 0.747 | 0.759 | 0.759 |
| *F-test (p-value)* | 0.033 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

.

**Table 10. Decomposed impact of elevated equity capital requirements on bank liquidity creation.**
This table reports results from a difference-in-differences (DID) regression analysis that evaluates how sharply increased equity capital requirements under Zambia's 2012 New Capital Adequacy Framework (NCF) affected different components of bank liquidity creation. The dependent variables are: ASLQC (asset-side liquidity creation), LSLQC (liability-side liquidity creation), and OFFBSLQC (off-balance-sheet liquidity creation), which respectively capture liquidity creation from bank assets, liabilities, and off-balance-sheet activities. NCFBank is a binary indicator equal to 1 for foreign-owned banks subject to the higher minimum capital thresholds imposed by the NCF, and 0 otherwise. Post is a time dummy coded as 1 from February 2012 (following the NCF's enforcement on January 30, 2012) through the end of the sample in February 2019, and 0 for earlier periods. The interaction term NCFBank × Post represents the DID estimator, isolating the differential effect of the policy on treated banks relative to the control group post-implementation. All continuous variables are Winsorised at the 1st and 99th percentiles. Full variable definitions are available in Table 1, and summary statistics in Table 2. Significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

| | Balance sheet decomposition of liquidity creation | | |
|---|---|---|---|
| | Asset side | Liability side | Off-balance sheet |
| **Dependent Variable:** | **ASLQC** | **LSLQC** | **OFFBLQC** |
| NCFBank x Post | -0.073* | -0.013 | 0.032 |
| | (-1.82) | (-0.55) | (1.16) |
| **CONTROLS:** | | | |
| *Bank capital* | -0.160 | -0.603*** | 0.019 |
| | (-1.37) | (-11.39) | (0.29) |
| *Bank size* | 0.003 | 0.010 | -0.010 |
| | (0.07) | (0.37) | (-0.33) |
| *Bank risk (RWATA)* | 0.488*** | -0.019 | 0.201*** |
| | (5.88) | (-0.63) | (5.94) |
| *Market share* | 0.526 | 0.874* | 0.139 |
| | (1.05) | (1.93) | (0.33) |
| *Profitability (ROE)* | -0.087 | -0.016 | 0.159* |
| | (-0.78) | (-0.29) | (1.93) |
| *Constant* | -0.287 | 0.065 | 0.075 |
| | (-0.55) | (0.19) | (0.19) |
| *Bank Fixed Effects* | YES | YES | YES |
| *Time Fixed Effects* | YES | YES | YES |
| *Observations* | 2,508 | 2,508 | 2,508 |
| *Adj R-squared* | 0.845 | 0.790 | 0.513 |
| *F-test (p-value)* | 0.000 | 0.000 | 0.000 |

**Table 11. Placebo tests for pre-treatment trends.**
This table presents the results of placebo regressions designed to detect any pre-existing differences between treated and control banks prior to Zambia's 2012 capital reform, within a difference-in-differences (DID) framework. The dependent variable is total liquidity creation (TLQC), based on a modified "cat fat" measure from Berger and Bouwman (2009). NCFBank is a binary variable equal to 1 for foreign-owned banks subject to higher minimum capital thresholds under the New Capital Adequacy Framework (NCF), and 0 for all others. The actual policy period ($Post_t$) runs from February 2012 to February 2019. In the placebo tests, this post-treatment period indicator is redefined as $Post_t$*, taking the value 1 for two alternative pre-policy periods, 2007-2009 and 2009-2011, and 0 otherwise. These simulations assume hypothetical policy interventions occurring three or five years prior to the NCF's true implementation date. The interaction term NCFBank × $Post^*_t$ represents the placebo DID estimator, measuring the simulated treatment effect in periods where no actual policy change occurred. A statistically insignificant coefficient would support the parallel trends assumption by confirming the absence of anticipatory or spurious effects prior to the reform. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

| | **Placebo Test 1** (Post: 2007-2009) | **Placebo Test 2** (Post: 2009-2011) |
|---|---|---|
| **Dependent Variable:** | **TLQC** | **TLQC** |
| NCFBank x Post* | -0.029 | -0.011 |
| | (-1.65) | (-0.93) |
| *Constant* | -0.117 | -0.145 |
| | (-0.93) | (-1.23) |
| *All Controls Included* | YES | YES |
| *Bank Fixed Effects* | YES | YES |
| *Time Fixed Effects* | YES | YES |
| *Observations* | 2508 | 2508 |
| *Adj R-squared* | 0.722 | 0.720 |
| *F-test (p-value)* | 0.000 | 0.000 |

**Table 12. Effect of the NCF on bank liquidity creation – Instrumental variables (2SLS) estimation.**
This table presents results from a two-stage least squares (2SLS) regression used to estimate the causal impact of Zambia's 2012 New Capital Adequacy Framework (NCF) on bank liquidity creation. The dependent variable is total liquidity creation (TLQC), calculated using a modified version of Berger and Bouwman's (2009) "cat fat" metric. The key explanatory variable is the interaction term NCFBank × Post, which captures the difference-in-differences (DID) treatment effect of the policy, comparing foreign-owned (treated) banks to locally owned (control) banks before and after the NCF implementation. A significantly negative coefficient indicates that heightened capital requirements under the NCF constrained liquidity creation, whereas a significantly positive estimate would suggest an expansionary effect. All continuous variables are Winsorised at the 1st and 99th percentiles to reduce the influence of extreme values. Variable definitions are provided in Table 1. Statistical significance is denoted by *, **, and ***, corresponding to the 10%, 5%, and 1% levels, respectively.

| **Test:** | **First Stage Instrumental Variable 2SLS** | **Final Stage Instrumental Variable 2SLS - Baseline** | **Final Stage Instrumental Variable 2SLS - DID** |
|---|---|---|---|
| **Dependent Variables:** | CAR | TLQC | TLQC |
| **Independent Variables:** | (1) | (2) | (3) |
| *L1_w_CAR* | 0.933*** | | |
| | (46.30) | | |
| *L2_w_CAR* | -0.101** | | |
| | (-2.27) | | |
| *L3_w_CAR* | 0.054 | | |
| | (1.69) | | |
| *w_CAR* | | -0.933*** | -0.898*** |
| | | (-11.61) | (-12.85) |
| *NCF Bank x Post* | | | -0.035 |
| | | | (-1.54) |
| *Bank Controls* | YES | YES | YES |
| *Bank Fixed Effects* | YES | YES | YES |
| *Time Fixed Effects* | YES | YES | YES |
| *Observations* | 2473 | 2473 | 2473 |
| *Underidentification test (p-value)* | | 0.0105 | 0.0098 |
| *Weak identification test (F-statistic)* | | 3533.236 | 2786.099 |
| *Hansen test (p-value)* | | 0.20 | 0.22 |
| *Adjusted R-squared* | 0.947 | | |
| *First Stage Wald F-test* | 896.13*** | | |

### 4.7 Policy implications and conclusion

#### 4.7.1 Policy implications and regulatory recommendations

The findings of this chapter carry important implications for the design and implementation of leverage-based capital regulation in low- and lower-middle-income Sub-Saharan African (SSA) banking systems. Taken together with the findings presented in Chapter 3, the evidence suggests that significantly higher equity capital requirements – when implemented through genuine equity recapitalisation rather than balance-sheet contraction – can materially strengthen bank resilience without causing disproportionately large reductions in liquidity creation. Against this backdrop, several important policy recommendations emerge.

First, regulators in SSA should place greater emphasis on leverage-based capital requirements anchored in high-quality common equity capital. The results show that materially stronger equity buffers improve solvency and financial resilience while only moderately reducing liquidity creation. This finding supports calls for stronger equity capital standards beyond current Basel III minima, particularly in structurally vulnerable and highly dollarised banking systems characterised by recurrent macro-financial shocks. For many SSA economies, a binding leverage ratio may therefore serve not merely as a passive backstop, but as an active macroprudential stabilisation tool. Second, the design of capital regulation matters critically. The Zambian experience demonstrates that mandatory equity recapitalisation can substantially reduce the likelihood that banks satisfy higher capital requirements through deleveraging or asset contraction alone. Unlike conventional ratio-based capital regulation, Zambia's NCF required banks to raise new equity capital in fixed monetary amounts. This reduced incentives for large-scale balance-sheet contraction and helped preserve intermediation activity despite the tightening of capital standards. Policymakers should therefore consider combining higher leverage ratio requirements with credible recapitalisation mechanisms that explicitly require new equity injections.

Third, although the estimated decline in liquidity creation was moderate, the findings highlight the importance of gradual and carefully sequenced implementation. Extremely sharp increases in minimum capital requirements may induce temporary adjustments in lending behaviour, portfolio allocation, or deposit mobilisation, particularly among smaller and foreign-owned banks. Regulators should therefore adopt phased implementation schedules, transitional arrangements, or staggered recapitalisation timelines to minimise abrupt disruptions to credit intermediation and financial deepening. Allowing banks to build capital progressively through retained earnings and phased equity issuance may help reduce adjustment costs while preserving financial stability gains. Fourth, policymakers should recognise that stronger capital requirements may induce compositional changes in bank balance sheets. The evidence suggests that higher capitalisation encourages a shift away from illiquid lending toward safer and more liquid assets, including government securities. While such adjustments improve resilience, excessive migration toward sovereign assets could weaken private-sector credit provision over time. Regulators should therefore complement leverage-based capital reforms with policies that support productive lending and financial intermediation, particularly in economies with shallow financial markets and limited non-bank financing alternatives.

Fifth, the results underscore the importance of tailoring Basel III implementation to the structural characteristics of SSA banking systems. Many SSA economies operate under conditions of high macroeconomic volatility, shallow financial markets, dollarisation, concentrated banking systems, and weak institutional environments. Under such conditions, reliance solely on risk-weighted capital regulation may prove insufficient to constrain excessive leverage and systemic vulnerabilities. A stronger leverage-based regulatory framework, calibrated to domestic structural risks, may therefore be more appropriate than the uniform adoption of Basel III minimum standards designed primarily for advanced economies.

Finally, the findings suggest that policymakers should evaluate bank capital regulation within a broader financial stability framework rather than focusing exclusively on short-run lending effects. While stronger capital requirements may moderately reduce liquidity creation, the associated gains in solvency, resilience, and crisis prevention may generate substantially larger long-run macroeconomic benefits. The experience of the Global Financial Crisis and the 2023 banking turmoil demonstrates that insufficient capitalisation can impose severe economic costs through financial instability, disorderly deleveraging, and banking crises. In this regard, the modest reduction in liquidity creation identified in this chapter may represent an acceptable trade-off for materially stronger banking-system resilience.

### 4.7.2 Chapter conclusion

This chapter examined the effects of significantly higher leverage-based equity capital requirements on bank liquidity creation using Zambia's 2012 New Capital Adequacy Framework (NCF) as a quasi-natural experiment. Motivated by ongoing debates surrounding the adequacy of Basel III capital standards and the broader relationship between bank capital and financial intermediation, the analysis investigated whether materially stronger equity capital requirements constrain banks' liquidity creation function.

The empirical findings provide strong evidence of a negative relationship between bank capitalisation and liquidity creation, consistent with the financial fragility–crowding-out hypothesis. Across the baseline fixed-effects specifications, higher lagged capital ratios were consistently associated with lower levels of liquidity creation. This negative relationship remained robust across alternative specifications, ownership structures, disaggregated balance-sheet components, and instrumental variable estimations addressing potential endogeneity concerns. Using a difference-in-differences framework, the chapter further identified the causal effects of Zambia's NCF on bank liquidity creation. Foreign-owned banks, which were subject to substantially larger recapitalisation requirements, experienced a statistically significant decline in liquidity creation relative to locally owned banks following implementation of the reform. However, the magnitude of the decline was moderate rather than destabilising. Importantly, the reduction in liquidity creation occurred alongside substantial increases in capitalisation and marked improvements in solvency and insolvency risk documented in Chapter 3.

The findings therefore point to a meaningful but manageable trade-off between stronger capitalisation and liquidity creation. While materially higher equity requirements may modestly constrain banks' liquidity transformation activities – particularly through reductions in illiquid lending and deposit-based funding – they also generate substantial financial stability benefits by strengthening loss-absorbing capacity and reducing insolvency risk. Crucially, the Zambian experience suggests that these stabilising benefits are more likely to emerge when higher leverage ratio requirements are implemented through genuine equity recapitalisation rather than through balance-sheet contraction alone. More broadly, the chapter contributes to the literature in three important ways. First, it provides rare causal evidence on the effects of significantly higher leverage-based equity requirements combined with mandatory equity recapitalisation. Second, it responds directly to longstanding concerns regarding endogeneity in the capital–liquidity creation literature by exploiting an exogenous regulatory capital shock. Third, it adapts established liquidity creation measures to reflect the structural characteristics of SSA banking systems, thereby improving the relevance of the analysis for developing and highly dollarised financial systems.

Overall, the evidence suggests that significantly stronger leverage-based equity capital requirements can enhance banking-system resilience without generating disproportionately large adverse effects on liquidity creation. For SSA regulators confronting persistent macro-financial vulnerabilities, shallow financial markets, and recurring systemic shocks, the results support the case for stronger leverage-based capital frameworks that go beyond existing Basel

III minimum standards. Nevertheless, the findings also emphasise the importance of careful calibration, gradual implementation, and credible recapitalisation mechanisms in order to preserve financial intermediation while strengthening financial stability.

# 5 THESIS CONCLUSION

## 5.1 Reassessing the leverage ratio in SSA LMICs: Motivation and summary of findings

This thesis was motivated by a central policy question confronting both microprudential and macroprudential authorities in low- and lower-middle-income Sub-Saharan African (SSA) economies: given the structural limitations of risk-weighted capital regulation – which has often encouraged the discretionary use of uniform fixed paid-up capital requirements irrespective of bank size or risk – can binding leverage ratio requirements, implemented alongside equity-based recapitalisation, provide a more effective and contextually appropriate framework for strengthening financial system resilience?

Although Basel III introduced the leverage ratio primarily as a non-risk-based "backstop" to complement risk-weighted capital requirements, this thesis reconceptualises the leverage ratio as a "frontstop" – a primary and proactive micro- and macroprudential policy instrument. The empirical evidence demonstrates that the distinctive macro-financial environment of SSA LMICs – characterised by high financial dollarisation, exchange-rate volatility, shallow financial markets, commodity dependence, and procyclical regulatory interventions arising from weaknesses in risk-weighted capital regulation – requires a departure from calibration frameworks designed for advanced economies. Across three empirical essays, the thesis evaluates the stabilising effects and trade-offs associated with significantly higher equity-to-assets (implicit leverage ratio) requirements implemented through binding leverage constraints and genuine equity recapitalisation.

**Essay 1** (**Chapter 2**) documents strong leverage procyclicality across 30 SSA LMICs. Importantly, the results show that leverage dynamics in these economies are driven less by domestic real economic activity, proxied by real GDP growth, and more by active balance-sheet management, accounting revaluation effects under IAS 21, and regulatory-induced portfolio shifts toward low-risk-weighted assets in highly dollarised and exchange-rate-sensitive environments. These findings suggest that conventional macroprudential tools such as the countercyclical capital buffer (CCyB), which rely heavily on credit-to-GDP gaps, may be poorly suited to SSA LMICs. Instead, the evidence supports repositioning the leverage ratio as a simpler, more transparent, and structurally relevant macroprudential instrument.

**Essay 2** (**Chapter 3**) exploits Zambia's 2012 New Capital Adequacy Framework (NCF) as a quasi-natural experiment within a difference-in-differences empirical framework to investigate whether significantly higher equity-to-assets (implicit leverage ratio) requirements – substantially above Basel III standards – encourage excessive bank risk-taking. The findings show that foreign-owned banks (treated), which faced capital increases of more than fortyfold compared with approximately ninefold increases for locally owned banks (controls), complied primarily through fresh equity injections, with no evidence that the substantially higher capital requirements induced risk-shifting behaviour. Moreover, insolvency risk declined significantly following the reform, providing strong support for the prudential benefits of equity-driven recapitalisation and challenging theoretical and empirical claims that binding leverage constraints necessarily create adverse risk-taking incentives.

**Essay 3** (**Chapter 4**) investigates the implications of such recapitalisation for bank liquidity creation. Using supervisory bank-level data from Zambia, the analysis identifies a statistically significant negative relationship between equity-to-assets ratios and liquidity creation, particularly among foreign-owned banks. While stronger equity capital materially improves solvency and resilience, the findings suggest that abrupt and undifferentiated recapitalisation requirements may constrain banks' intermediation capacity, especially through reductions in asset-side liquidity creation such as lending. These results underscore the importance of balancing financial stability objectives with the preservation of financial intermediation in SSA LMICs.

### 5.2 Policy relevance: Implications for SSA LMIC regulators

The findings from this thesis offer clear, actionable guidance for regulators in SSA LMICs seeking to enhance financial stability through more effective capital regulation:

1. **Elevate the leverage ratio from a simple backstop to a binding macroprudential frontstop.** Given the structural features of SSA banking systems, particularly high financial dollarisation and FX-induced balance sheet volatility, a binding leverage ratio should be treated not merely as a residual safeguard but as a central macroprudential instrument. Its simplicity, transparency, and immunity to model manipulation make it particularly suitable in jurisdictions with weaker regulatory capacities or exposure to regulatory arbitrage.
2. **Prioritise equity-based leverage recapitalisation over uniform fixed paid-up capital thresholds.** Although politically attractive, sharp increases in fixed paid-up capital requirements may encourage banks to reallocate portfolios toward low-risk assets while crowding out lending activity. Regulatory reforms should therefore place greater emphasis on dynamic, ratio-based leverage requirements supported by genuine equity injections. The Zambian experience demonstrates that abrupt equity-driven recapitalisation can materially strengthen solvency without inducing greater risk-taking, although it may reduce banks' liquidity creation capacity.
3. **Avoid procyclical implementation of capital requirements.** Uniform increases in fixed capital requirements during or immediately after crisis periods may intensify credit contraction and weaken financial intermediation. Policymakers should instead adopt countercyclical approaches that allow capital buffers to be accumulated during favourable periods and drawn down during downturns. This principle of "buffer usability" is particularly important in economies characterised by recurrent commodity-price shocks, macroeconomic volatility, and fiscal dominance.

4. **Tailor capital regulation to the structural characteristics of SSA economies.** Reliance on risk-weighted capital ratios may contribute to undercapitalisation and the accumulation of hidden vulnerabilities in highly dollarised banking systems characterised by strong sovereign–bank linkages, particularly because sovereign securities and foreign exchange reserve holdings often attract zero or very low risk weights. Regulatory frameworks should therefore incorporate structural vulnerabilities – such as financial dollarisation, foreign exchange mismatches, and sovereign–bank interconnectedness – more explicitly within macroprudential capital regulation.
5. **Reconsider the calibration of international capital standards.** The Basel III minimum leverage ratio of 3 percent may be inadequate for many SSA LMICs. The findings of this thesis support the case for substantially higher leverage ratio thresholds – potentially in the range of 10 to 15 percent – particularly in banking systems characterised by chronic undercapitalisation and recurrent exposure to macro-financial shocks. To strengthen both resilience and regulatory flexibility, the leverage ratio should be designed as a two-tier capital requirement comprising a fixed microprudential floor and a time-varying macroprudential buffer. The latter could be defined as the gap between a long-run target leverage ratio and the static microprudential minimum, thereby encouraging banks to accumulate additional capital buffers during expansionary phases of the financial cycle.
6. **Maintain the purity of Common Equity Tier 1 (CET1) capital.** In light of the vulnerabilities associated with hybrid capital instruments such as Additional Tier 1 (AT1) debt – highlighted during the collapse of Credit Suisse – SSA regulators should place greater emphasis on core equity capital, consistent with the region's existing reliance on paid-up capital requirements. Emphasising high-quality equity capital would strengthen both market confidence and banks' capacity to absorb shocks during periods of financial stress.

### 5.3 Caveats and constraints: Study limitations

While this thesis provides novel empirical and conceptual insights, several limitations merit acknowledgment:

1. **Data availability and granularity.** Panel data from the IMF FSIs and World Bank sources are annual and often unbalanced. Quarterly or monthly data could provide more granular analysis of financial cycles and policy timing, but such data are largely unavailable across SSA LMICs.
2. **Country sample bias.** Although the study includes 30 SSA economies, it excludes some LMICs due to data limitations. Moreover, upper-middle-income and high-income countries were retained to improve coverage, though they may not be fully representative of LMIC dynamics.
3. **Measurement challenges.** The thesis relies on book leverage and Tier 1 ratios as capital proxies. While this is consistent with regulatory definitions, it may not capture market perceptions of solvency or the full spectrum of off-balance sheet risks.
4. **Generalisation of Zambia's quasi-experiment.** While the Zambia NCF case offers a compelling test of capital policy under binding leverage constraints, institutional, regulatory, and political conditions may differ across other SSA LMIC countries. The external validity of these findings should thus be interpreted cautiously.
5. **Liquidity creation metrics.** Though the Berger and Bouwman (2009) measures were adapted to the SSA LMIC context, they were originally designed for advanced economies. Structural adjustments made for this thesis may still miss nuances in informal financial intermediation, especially in rural or microfinance-driven economies.

### 5.4 Scholarly relevance: Contributions and future research

This thesis contributes to academic literature in several key areas and offers pathways for further exploration:

1. **Reframing macroprudential capital tools for developing economies.** The thesis departs from conventional studies that centre credit cycles, instead linking leverage dynamics to exchange rate movements, accounting standards (IAS 21), and sovereign exposures. Future research should continue investigating how global standards (Basel III, IFRS) interact with idiosyncratic structural features in LMIC banking systems.
2. **Advancing empirical techniques in fragile settings.** By combining fixed-effects panel analysis with quasi-experimental methods (difference-in-differences), the study improves causal inference in data-scarce environments. Expanding these methodologies to other policy interventions, such as the interaction of Basel III liquidity requirements with the leverage ratio, would enrich SSA LMICs-focused financial stability research.
3. **Bridging capital regulation and liquidity creation.** This thesis adds to a limited body of empirical work on how leverage constraints affect financial intermediation. Future studies could explore cross-country comparisons using supervisory microdata, or investigate whether tiered capital requirements based on bank size or business model moderate these effects.
4. **Integrating climate and digital finance dimensions.** As SSA regulators incorporate climate-related financial risks and digitalisation into supervisory frameworks, there is scope to investigate how capital regulation interacts with these emerging vulnerabilities. For instance, could higher leverage ratios strengthen resilience to green swan events or mitigate instability from digital bank runs?
5. **Revisit existing capital structure theories.** The findings challenge conventional theoretical models that predict risk-shifting behaviour under flat leverage constraints.

Additional theoretical work is therefore needed to explain why significantly higher equity requirements may reduce insolvency risk without inducing adverse risk-taking behaviour, particularly in settings where banks are required to comply through genuine equity injections. Further research is also needed on the design of minimum capital requirements in highly dollarised banking systems. In particular, an important unresolved question concerns how regulators can maintain stable and credible capital requirements in environments characterised by persistent exchange-rate volatility and high balance-sheet dollarisation.

### 5.5 Conclusion

In summary, this thesis provides a robust and empirically grounded case for rethinking capital regulation in SSA LMICs. It reconceptualises the leverage ratio from a passive regulatory backstop into a proactive stabilisation instrument better suited to structurally fragile and highly dollarised banking systems. The findings demonstrate that significantly higher leverage-based equity capital requirements – when implemented through genuine equity recapitalisation and effectively enforced – can materially strengthen resilience and reduce insolvency risk. At the same time, the results highlight important trade-offs, particularly with respect to banks' liquidity creation capacity.

Overall, the evidence underscores the importance of carefully calibrated and context-sensitive regulatory frameworks capable of balancing financial stability objectives with credit intermediation and broader developmental priorities. By integrating theoretical insights, policy debates, and rigorous empirical analysis, the thesis contributes meaningfully to the literature on bank capital regulation and provides a foundation for more effective macroprudential governance in SSA LMICs and other structurally vulnerable developing economies.

## REFERENCES


Abor, J.Y. and Adjasi, C.K.D., 2022. Introduction: An Overview of Africa's Financial Systems. The Economics of Banking and Finance in Africa: Developments in Africa's Financial Systems, pp. 3-19. Cham: Springer International Publishing.

Acharya, V. and Naqvi, H., 2012. The seeds of a crisis: A theory of bank liquidity and risk taking over the business cycle. Journal of financial economics, 106(2), pp.349-366.

Acharya, V.V. and Ryan, S.G., 2016. Banks' financial reporting and financial system stability. Journal of Accounting Research, 54(2), pp.277-340.

Acosta-Smith, J., Grill, M. and Lang, J.H., 2024. The leverage ratio, risk-taking and bank stability. Journal of Financial Stability, 74, p.100833.

Adesina, K.S. and Mwamba, J.M., 2016. Do Basel III higher common equity capital requirements matter for bank risk-taking behaviour? Lessons from South Africa. African Development Review, 28(3), pp.319-331.

Admati, A. and Hellwig, M., 2013. The bankers' new clothes: What's wrong with banking and what to do about it. Princeton University Press.

Admati, A. and Hellwig, M., 2024. The bankers' new clothes: What's wrong with banking and what to do about it. New and Expanded Edition. Princeton University Press.

Admati, A.R., DeMarzo, P.M., Hellwig, M. and Pfleiderer, P., 2010. Fallacies, irrelevant facts, and myths in the discussion of capital regulation: Why bank equity is not expensive (No. 2010, 42). Preprints of the Max Planck Institute for Research on Collective Goods.

Admati, A.R., DeMarzo, P.M., Hellwig, M.F. and Pfleiderer, P., 2018. The leverage ratchet effect. The Journal of Finance, 73(1), pp.145-198.

Admati, A.R., DeMarzo, P.M., Hellwig, M.F. and Pfleiderer, P.C., 2012. Debt overhang and capital regulation. Rock Center for Corporate Governance at Stanford University Working Paper, (114).

Admati, A.R., DeMarzo, P.M., Hellwig, M.F. and Pfleiderer, P.C., 2013. Fallacies, irrelevant facts, and myths in the discussion of capital regulation: Why bank equity is not socially expensive. Max Planck Institute for Research on Collective Goods, 23, pp.13-7.

Adrian, M.T., Carvalho, A., Moretti, M.M., Chon, H.K., Seal, K., Melo, F. and Surti, J., 2023. Good supervision: lessons from the field. International Monetary Fund.

Adrian, T. and Shin, H.S., 2010. Liquidity and leverage. Journal of financial intermediation, 19(3), pp.418-437.

Adrian, T. and Shin, H.S., 2011. Financial intermediary balance sheet management. Annu. Rev. Financ. Econ., 3(1), pp.289-307.

Adrian, T. and Shin, H.S., 2014. Procyclical leverage and value-at-risk. The Review of Financial Studies, 27(2), pp.373-403.

Adrian, T., Covitz, D. and Liang, N., 2015. Financial stability monitoring. Annual Review of Financial Economics, 7(1), pp.357-395.

Afanasyeva, E., Jerow, S., Lee, S.J. and Modugno, M., 2024. Sowing the seeds of financial imbalances: The role of macroeconomic performance. Journal of Financial Stability, 74, p.100839.

Aggarwal, R. and Jacques, K.T., 2001. The impact of FDICIA and prompt corrective action on bank capital and risk: Estimates using a simultaneous equations model. Journal of Banking & Finance, 25(6), pp.1139-1160.

Aiyar, S., Calomiris, C.W. and Wieladek, T., 2015. Bank capital regulation: Theory, empirics, and policy. IMF Economic Review, 63(4), pp.955-983.

Ajide, K.B., Raheem, I.D. and Asongu, S.A., 2019. Dollarization and the "Unbundling" of Globalization in sub-Saharan Africa. Research in International Business and Finance, 47, pp.398-409.

Akerlof, G.A., 1978. The market for "lemons": Quality uncertainty and the market mechanism. In Uncertainty in economics (pp. 235-251). Academic Press.

Allen, B., Chan, K.K., Milne, A. and Thomas, S., 2012. Basel III: Is the cure worse than the disease?. International Review of Financial Analysis, 25, pp.159-166.

Allen, F. and Giovannetti, G., 2011. The effects of the financial crisis on Sub-Saharan Africa. Review of Development Finance, 1(1), pp.1-27.

Allen, F. and Santomero, A.M., 1997. The theory of financial intermediation. Journal of banking & finance, 21(11-12), pp.1461-1485.

Altunbas, Y., Carbo, S., Gardener, E.P. and Molyneux, P., 2007. Examining the relationships between capital, risk and efficiency in European banking. European financial management, 13(1), pp.49-70.

Ambrocio, G., Hasan, I., Jokivuolle, E. and Ristolainen, K., 2020. Are bank capital requirements optimally set? Evidence from researchers' views. Journal of Financial Stability, 50, p.100772.

Amel-Zadeh, A., Barth, M.E. and Landsman, W.R., 2017. The contribution of bank regulation and fair value accounting to procyclical leverage. Review of accounting studies, 22, pp.1423-1454.

Angelini, P., Clerc, L., Cúrdia, V., Gambacorta, L., Gerali, A., Locarno, A., Motto, R., Roeger, W., Van den Heuvel, S. and Vlček, J., 2015. B asel III: Long-term Impact on Economic Performance and Fluctuations. The Manchester School, 83(2), pp.217-251.

Anginer, D., Bertay, A.C., Cull, R., Demirgüç-Kunt, A. and Mare, D.S., 2024. Bank capital regulation and risk after the Global Financial Crisis. Journal of Financial Stability, 74, p.100891.

Angrist, J.D. and Pischke, J.S., 2009. Mostly harmless econometrics: An empiricist's companion. Princeton university press.

Anguren, R., Jiménez, G. and Peydró, J.L., 2024. Bank capital requirements and risk-taking: Evidence from Basel III. Journal of Financial Stability, 74, p.101292.

Arieff, A., 2010. Global economic crisis: Impact on sub-Saharan Africa and global policy responses. Diane Publishing.

Arnold, I.J., 2012. Sovereign debt exposures and banking risks in the current EU financial crisis. Journal of policy modeling, 34(6), pp.906-920.

Ashraf, B.N., Arshad, S. and Hu, Y., 2016. Capital regulation and bank risk-taking behavior: evidence from Pakistan. International Journal of Financial Studies, 4(3), p.16.

Asongu, S., Raheem, I. and Tchamyou, V., 2018. Information asymmetry and financial dollarization in sub-Saharan Africa. African Journal of Economic and Management Studies, 9(2), pp.231-249.

Athanasoglou, P.P., Daniilidis, I. and Delis, M.D., 2014. Bank procyclicality and output: Issues and policies. Journal of Economics and Business, 72, pp.58-83.

Athey, S. and Imbens, G.W., 2017. The state of applied econometrics: Causality and policy evaluation. Journal of Economic perspectives, 31(2), pp.3-32.

Avery, C. and Zemsky, P., 1998. Multidimensional uncertainty and herd behavior in financial markets. American Economic Review, pp.724-748.

Badarau, C. and Roussel, C., 2022. A theoretical foundation for prudential authorities decision making. International Economics, 172, pp.451-462.

Baker, M. and Wurgler, J., 2015. Do strict capital requirements raise the cost of capital? Bank regulation, capital structure, and the low-risk anomaly. American Economic Review, 105(5), pp.315-320.

Ballouk, H., Jabeur, S.B., Challita, S. and Chen, C., 2024. Financial stability: A scientometric analysis and research agenda. Research in International Business and Finance, 70, p.102294.

Banerjee, A.V., 1992. A simple model of herd behavior. The Quarterly Journal of Economics, 107(3), pp.797-817.

Bank of Ghana (BOG), 2007. Annual Report 2007. [online] Available at: https://www.bog.gov.gh/wp-content/uploads/2019/07/AnnRep-2007.pdf [Accessed 20 February 2025].

Bank of Ghana (BOG), 2008. Annual Report 2008. [online] Available at: https://www.bog.gov.gh/wp-content/uploads/2019/07/AnnRep-2008.pdf [Accessed 20 February 2025].

Bank of Ghana (BOG), 2009. Annual Report 2009. [online] Available at: https://www.bog.gov.gh/wp-content/uploads/2019/07/AnnRep-2009.pdf [Accessed 20 February 2025].

Bank of Ghana (BOG), 2010. Annual Report 2010. [online] Available at: https://www.bog.gov.gh/wp-content/uploads/2019/07/AnnRep-2010.pdf [Accessed 20 February 2025].

Bank of Ghana (BOG), 2012. Annual Report 2012. [online] Available at: https://www.bog.gov.gh/wp-content/uploads/2019/07/AnnRep-2012.pdf [Accessed 20 February 2025].

Bank of Ghana (BOG), 2017a. Annual Report 2017. [online] Available at: https://www.bog.gov.gh/wp-content/uploads/2019/07/AnnRep-2017.pdf [Accessed 20 February 2025].

Bank of Ghana (BoG), 2017b. Notice to the Banks and the General Public, Notice No. BG/GOV/SEC/2017/19, New Minimum Paid Up Capital, September. [online] Available at: https://www.bog.gov.gh/wp-content/uploads/2019/09/Notice-on-New-Minimum-Paid-Up-Capital.pdf [Accessed 20 February 2025].

Bank of Ghana (BOG), 2018a. Annual Report 2018. [online] Available at: https://www.bog.gov.gh/wp-content/uploads/2019/07/AnnRep-2018.pdf [Accessed 20 February 2025].

Bank of Ghana (BOG), 2018b. Capital Requirements Directive. [online] Available at: https://www.bog.gov.gh/wp-content/uploads/2022/05/Basel-II-BOG-CRD-Final-27-June-2018-Basel-Committee-BSD.pdf [Accessed 20 February 2025].

Bank of Ghana (BOG), 2019a. Update on Banking Sector Reforms – Press Release. [online] Available at: https://www.bog.gov.gh/wp-content/uploads/2024/05/Press-Release-Update-on-Banking-Sector-Reforms.pdf [Accessed 20 February 2025].

Bank of Ghana (BOG), 2019b. Annual Report 2019. [online] Available at: https://www.bog.gov.gh/wp-content/uploads/2020/06/Annual-Report-2019.pdf [Accessed 20 February 2025].

Bank of Ghana (BOG), 2019c. Restoring Confidence and Building a Resilient Banking System for Ghana. [online] Available at: https://www.bog.gov.gh/wp-content/uploads/2019/07/Restoring-Confidence-and-Building-a-Resilient-Banking-System-for-Ghana.pdf [Accessed 24 April 2025].

Bank of Ghana (BOG), 2020. Annual Report 2020. [online] Available at: https://www.bog.gov.gh/wp-content/uploads/2021/09/Annual-Report-2020_Electronic-Print-Version_BOG_NOV-2021.pdf [Accessed 20 February 2025].

Bank of Uganda (BOU), 2010a. The Financial Institutions (Revision of Minimum Capital Requirements) Instrument No. 43 of 2010. [online] Available at: https://bou.or.ug/bouwebsite/bouwebsitecontent/acts/other_acts_regulations/The_Financial_Institutions_xrevision_of_minimum_Capital_Requirementsx_Instrument_No._43_of_2010.pdf [Accessed 20 February 2025].

Bank of Uganda (BOU), 2010b. Annual Supervision Report 2010. [online] Available at: https://bou.or.ug/bouwebsite/bouwebsitecontent/Supervision/Annual_Supervision_Report/asr/ASR_Dec_2010.pdf [Accessed 20 February 2025].

Bank of Uganda (BOU), 2018a. Financial Institutions (Capital Adequacy Requirements) Regulations, 2018. [online] Available at: https://archive.bou.or.ug/bou/bou-downloads/supervision/Circulars_and_Guidance_Notes/2018/All/Capital-Adequacy-requirements.pdf [Accessed 20 February 2025].

Bank of Uganda (BOU), 2018b. Financial Stability Report – June 2018. [online] Available at: https://archive.bou.or.ug/bou/bou-downloads/financial_stability/Rpts/All/Financial_Stability_Report_June-2018_final.pdf [Accessed 20 February 2025].

Bank of Uganda (BOU), 2020. The Financial Institutions (Capital Buffers and Leverage Ratio) Regulations, 2020. [online] Available at: https://bou.or.ug/bouwebsite/bouwebsitecontent/Supervision/Supervision-Guidelines-and-Circulars/2021/The-Financial-Institutions-Capital-Buffers-and-Leverage-Ratio-Regulations-2020.pdf [Accessed 20 February 2025].

Bank of Uganda (BOU), 2021. Increase in Paid-Up Capital Requirement for Commercial Banks and Credit Institutions. [online] Available at: https://bou.or.ug/bouwebsite/bouwebsitecontent/Supervision/Supervision-Guidelines-and-Circulars/2021/Increase-paid-up-capital-requirement.pdf [Accessed 20 February 2025].

Bank of Uganda (BOU), 2022a. Countercyclical Capital Buffer (CCyB) Requirement. [online] Available at: https://bou.or.ug/bouwebsite/bouwebsitecontent/Supervision/Supervision-

Guidelines-and-Circulars/2022/Countercyclical-Capital-Buffer-CCyB-Requirement.pdf [Accessed 20 February 2025].

Bank of Uganda (BOU), 2022b. The Financial Institutions (Revision of Minimum Capital Requirements) Statutory Instrument, 2022 (No. 130). [online] Available at: https://bou.or.ug/bouwebsite/bouwebsitecontent/acts/Statutory-Instruments/The-Financial-Institutions-Revision-of-Minimum-Capital-Requirements-Instrument-2022.pdf [Accessed 20 February 2025].

Bank of Uganda (BOU), 2022c. Annual Supervision Report 2022. [online] Available at: https://bou.or.ug/bouwebsite/bouwebsitecontent/Supervision/Annual_Supervision_Report/asr/Annual-Supervision-Report-December-2022.pdf [Accessed 20 February 2025].

Bank of Zambia (BOZ), 1995. Statutory Instrument No. 184 of 1995: The Banking and Financial Services (Capital Adequacy) Regulations, 1995. [online] Available at: https://www.boz.zm/StatutoryInstrumentNo.184_CapitalAdequacy.pdf [Accessed 20 February 2025].

Bank of Zambia (BOZ), 2006. Gazette Notice No. 682 of 2006: The Banking and Financial Services (Capital Adequacy) Notice, 2006. [online] Available at: https://www.boz.zm/53_CapitalRevision.pdf [Accessed 20 February 2025].

Bank of Zambia (BOZ), 2007. Annual Report 2007. [online] Available at: https://www.boz.zm/BOZAnnualReport2007.pdf [Accessed 20 February 2025].

Bank of Zambia (BOZ), 2012a. CB Circular No. 02/2012: New Capital Adequacy Framework. [online] Available at: https://www.boz.zm/02-2012.pdf [Accessed 20 February 2025].

Bank of Zambia (BOZ), 2012b. CB Circular No. 17/2012: Issuance of the Technical Guidelines for the Currency Rebasing. [online] Available at: https://www.boz.zm/17-2012.pdf [Accessed 20 February 2025].

Bank of Zambia (BOZ), 2012c. Annual Report 2012. [online] Available at: https://www.boz.zm/BOZANNUALREPORT2012.pdf [Accessed 20 February 2025].

Bank of Zambia (BOZ), 2013. CB Circular No. 23/2013: New Capital Adequacy Framework. [online] Available at: https://www.boz.zm/232013CAPITAL.pdf [Accessed 20 February 2025].

Bank of Zambia (BOZ), 2017. The Banking and Financial Services Act No. 7 of 2017. [online] Available at: https://www.boz.zm/TheBankingandFinanceActNo7of2017.pdf [Accessed 20 February 2025].

Bank of Zambia (BOZ), 2020. The Banking and Financial Services (Amendment) Act No. 7 of 2020. [online] Available at: https://www.boz.zm/TheBankingandFinancialServicesAmendActNo.7of2020.pdf [Accessed 20 February 2025].

Bank of Zambia (BOZ), 2025a. Banking and Financial Services (Capital Adequacy) Regulations, 2025. [online] Available at: https://www.boz.zm/sites/default/files/migrated/financial-stability/S.I_Number_62_of_2025_The_Banking_and_Financial_Services_Act_Capital_Adequacy_Rules.pdf [Accessed 31 October 2025].

Bank of Zambia (BOZ), 2025b. Financial Stability Report. October [online] Available at: https://www.boz.zm/Financial-Stability-Report-October-2025.pdf [Accessed 14 February 2026].

Barth, J.R. and Miller, S.M., 2018. Benefits and costs of a higher bank "leverage ratio". Journal of Financial Stability, 38, pp.37-52.

Barth, J.R., Prabha, A. and Yun, G., 2012. The Eurozone financial crisis: Role of interdependencies between bank and sovereign risk. Journal of Financial Economic Policy, 4(1), pp.76-97.

Baudino, P., Guerra, R., Kre, M.D. and Songwe, V., 2024. The effectiveness of macroprudential policies during the Covid-19 pandemic in sub-Saharan Africa. FSI Insights on policy implementation No. 61. Basel: Bank for International Settlements, Financial Stability Institute. Available at: https://www.bis.org/fsi/publ/insights61.pdf.

Bawuah, I., 2024. Bank capital and liquidity creation in Sub-Saharan Africa: the role of quality institutions. African Journal of Economic and Management Studies.

BCBS 1987. Proposals for international convergence of capital measurement and capital standards (December). Basel: The Basel Committee on Banking Supervision (BCBS), Bank for International Settlements.

BCBS 1988. International Convergence of Capital Measurement and Capital Standards (July). Basel: The Basel Committee on Banking Supervision (BCBS), Bank for International Settlements.

BCBS 1996. Amendment to the Capital Accord to Incorporate Market Risks (January). Basel: The Basel Committee on Banking Supervision (BCBS), Bank for International Settlements.

BCBS 2004. International Convergence of Capital Measurement and Capital Standards: A Revised Framework (June). Basel: The Basel Committee on Banking Supervision (BCBS), Bank for International Settlements.

BCBS 2006. International Convergence of Capital Measurement and Capital Standards: A Revised Framework -Comprehensive Version (June). Basel: The Basel Committee on Banking Supervision (BCBS), Bank for International Settlements.

BCBS 2010a. Assessing the macroeconomic impact of the transition to stronger capital and liquidity requirements (December). Basel: The Financial Stability Board and The Basel Committee on Banking Supervision (BCBS), Bank for International Settlements.

BCBS 2010b. An assessment of the long-term economic impact of stronger capital and liquidity requirements (August). Basel The Basel Committee on Banking Supervision (BCBS), Bank for International Settlements.

BCBS 2010c. Basel III: A global regulatory framework for more resilient banks and banking systems (December). Basel: The Basel Committee on Banking Supervision (BCBS), Bank for International Settlements.

BCBS 2011. Basel III: A global regulatory framework for more resilient banks and banking systems (June). The Basel Committee on Banking Supervision (BCBS), Bank for International Settlements.

BCBS 2013. Basel III: The Liquidity Coverage Ratio and liquidity risk monitoring tools (January). Basel: The Basel Committee on Banking Supervision (BCBS), Bank for International Settlements.

BCBS 2014. Impact and implementation challenges of the Basel framework for emerging market, developing and small economies (November). Working Paper No. 27. Basel: The Basel Consultative Group, Basel Committee on Banking Supervision (BCBS), Bank for

International Settlements. Available at: https://www.bis.org/bcbs/publ/wp27.pdf (Accessed: 12 May 2025).

BCBS 2017. Basel III: Finalising post-crisis reforms (December). The Basel Committee on Banking Supervision (BCBS), Bank for International Settlements. [online] Available at: https://www.bis.org/bcbs/publ/d424.pdf [Accessed 12 May 2025].

BCBS 2019. Proportionality in bank regulation and supervision – a survey on current practices (March). Basel: The Basel Committee on Banking Supervision (BCBS), Bank for International Settlements.

BCBS 2020. Basel III: the implementation imperative. Basel: The Basel Committee on Banking Supervision (BCBS), Bank for International Settlements.

BCBS 2022. Evaluation of the Impact and Efficacy of the Basel III Reforms (December). Basel: The Basel Committee on Banking Supervision (BCBS), Bank for International Settlements.

BCBS 2023. Report on the 2023 banking turmoil (October). Basel: The Basel Committee on Banking Supervision (BCBS), Bank for International Settlements.

Beccalli, E., Frantz, P. and Lenoci, F., 2018. Hidden effects of bank recapitalizations. Journal of Banking & Finance, 94, pp.297-314.

Beck, T., Cull, R. and Valenzuela, P., 2019. Banking in Africa. In: A.N. Berger, P. Molyneux, and J.O. Wilson, eds. The Oxford handbook of banking. 3rd ed. Oxford: OUP Oxford, pp. 1076-1112.

Beck, T., Döttling, R., Lambert, T. and Van Dijk, M., 2023. Liquidity creation, investment, and growth. Journal of Economic Growth, 28(2), pp.297-336.

Beck, T., Jones, E. and Knaack, P., 2019b. Mind the gap: Making Basel standards work for developing countries. GEG Policy Brief. Oxford: Global Economic Governance Programme, University of Oxford.

Beck, T., Maimbo, S.M., Faye, I. and Triki, T., 2011. Financing Africa: Through the crisis and beyond. World Bank Publications.

Berger, A.N. and Bouwman, C.H., 2009. Bank liquidity creation. The review of financial studies, 22(9), pp.3779-3837.

Berger, A.N. and Bouwman, C.H., 2017. Bank liquidity creation, monetary policy, and financial crises. Journal of Financial Stability, 30, pp.139-155.

Berger, A.N. and Sedunov, J., 2017. Bank liquidity creation and real economic output. Journal of Banking & Finance, 81, pp.1-19.

Berger, A.N., Boubakri, N., Guedhami, O. and Li, X., 2019. Liquidity creation performance and financial stability consequences of Islamic banking: Evidence from a multinational study. Journal of Financial Stability, 44, p.100692.

Berger, A.N., Clarke, G.R., Cull, R., Klapper, L. and Udell, G.F., 2005. Corporate governance and bank performance: A joint analysis of the static, selection, and dynamic effects of domestic, foreign, and state ownership. Journal of banking & finance, 29(8-9), pp.2179-2221.

Berger, A.N., Herring, R.J. and Szegö, G.P., 1995. The role of capital in financial institutions. Journal of Banking & Finance, 19(3-4), pp.393-430.

Berger, A.N., Roman, R.A. and Sedunov, J., 2020. Did TARP reduce or increase systemic risk? The effects of government aid on financial system stability. Journal of Financial Intermediation, 43, p.100810.

Berrospide, J.M., 2011. Effects of Bank Capital on Lending: What Do We Know, and What Does It Mean?. DIANE Publishing.

Berrospide, J.M., 2015. Discussion of "Did the EBA Capital Exercise Cause a Credit Crunch in the Euro Area?". International Journal of Central Banking, 11(3), pp.119-126.

Betz, F., Oprică, S., Peltonen, T.A. and Sarlin, P., 2014. Predicting distress in European banks. Journal of Banking & Finance, 45, pp.225-241.

Beveridge, A.A., 1974. Economic independence, indigenization, and the African businessman: Some effects of Zambia's economic reforms. African Studies Review, 17(3), pp.477-490.

Bhattacharya, S. and Thakor, A.V., 1993. Contemporary banking theory. Journal of financial Intermediation, 3(1), pp.2-50.

Bhattacharya, S., Boot, A.W. and Thakor, A.V., 1998. The economics of bank regulation. Journal of money, credit and banking, pp.745-770.

Bikhchandani, S. and Sharma, S., 2000. Herd behavior in financial markets. IMF Staff papers, 47(3), pp.279-310.

Biljanovska, N., Chen, S., Gelos, M.R., Gelos, R., Igan, D., Igan, M.D.O., Peria, M.M., Peria, M.M.S.M., Nier, E. and Valencia, M.F., 2023. Macroprudential Policy Effects: Evidence and Open Questions. International Monetary Fund.

Bitar, M., Pukthuanthong, K. and Walker, T., 2018. The effect of capital ratios on the risk, efficiency and profitability of banks: Evidence from OECD countries. Journal of international financial Markets, Institutions and Money, 53, pp.227-262.

Blum, J.M., 2008. Why 'Basel II' may need a leverage ratio restriction. Journal of Banking & Finance, 32(8), pp.1699-1707.

Blundell-Wignall, A. and Atkinson, P., 2012. Deleveraging, traditional versus capital markets banking and the urgent need to separate and recapitalise G-SIFI banks. OECD Journal: Financial Market Trends, 2012(1), pp.7-44.

BOE, 2026. Financial Stability in Focus: The bank capital framework. Bank of England (BOE). The Financial Policy Committee's assessment of bank capital requirements, July.

Borio, C. and Shim, I., 2007. What can (macro-) prudential policy do to support monetary policy?", BIS Working Papers, No. 242, Basel, Bank for International Settlements.

Bostandzic, D., Irresberger, F., Juelsrud, R.E. and Weiß, G., 2022. Do capital requirements make banks safer? Evidence from a quasinatural experiment. Journal of Financial and Quantitative Analysis, 57(5), pp.1805-1833.

Bouwman, C.H., 2018. Creation and regulation of bank liquidity. Available at SSRN: (https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3266406).

Brambila-Macias, J. and Massa, I., 2010. The global financial crisis and Sub-Saharan Africa: the effects of slowing private capital inflows on growth. African Development Review, 22(3), pp.366-377.

Brautigam, D., 2022. China and Zambia: creating a sovereign debt crisis. International Affairs, 98(4), pp.1347-1365.

Brei, M. and Gambacorta, L., 2016. Are bank capital ratios pro-cyclical? New evidence and perspectives. Economic Policy, 31(86), pp.357-403.

Bridges, J., Gregory, D., Nielsen, M., Pezzini, S., Radia, A. and Spaltro, M., 2014. The impact of capital requirements on bank lending.

Brownbridge, M., 1996. Financial policies and the banking system in Zambia. United Nations Conference on Trade and Development (UNCTAD).

Brunnermeier, M., Crockett, A., Goodhart, C.A., Persaud, A. and Shin, H.S., 2009. The fundamental principles of financial regulation (Vol. 11). Geneva: ICMB, Internat. Center for Monetary and Banking Studies. https://web.actuaries.ie/sites/default/files/erm-resources/The_fundamental_principles_of_financial_regulation.pdf

Brunnermeier, M.K., 2021. The Resilient Society. Endeavor Literary Press.

Bryant, J., 1980. A model of reserves, bank runs, and deposit insurance. Journal of banking & finance, 4(4), pp.335-344.

Buckley, J. and Shang, Y., 2002. Estimating policy and program effects with observational data: the “differences-in-differences” estimator. Practical Assessment, Research, and Evaluation, 8(1).

Buser, S.A., Chen, A.H. and Kane, E.J., 1981. Federal deposit insurance, regulatory policy, and optimal bank capital. The journal of Finance, 36(1), pp.51-60.

Caggiano, G. and Calice, P., 2011. The macroeconomic impact of higher capital ratios on African economies (pp. 1-25). African Development Bank Group.

Calderon, C., Kabundi, A., Kubota, M., Korman, V., Goyal, A., Eliste, P. and Forget, V.D., 2022. Food System Opportunities in a Turbulent Time. Africa’s Pulse, 26. Washington, DC: The World Bank.

Callaway, B. and Sant’Anna, P.H., 2021. Difference-in-differences with multiple time periods. Journal of econometrics, 225(2), pp.200-230.

Callaway, B., Goodman-Bacon, A. and Sant'Anna, P.H., 2024. Difference-in-differences with a continuous treatment (No. w32117). National Bureau of Economic Research.

Calomiris, C.W. and Herring, R.J., 2013. How to design a contingent convertible debt requirement that helps solve our too-big-to-fail problem. Journal of Applied Corporate Finance, 25(2), pp.39-62.

Cameron, A.C. and Trivedi, P.K., 2022. Microeconometrics using Stata (Vol. II). Second edition, College Station, TX: Stata Press, pp 1338-1340.

Cameron, A.C., and Trivedi, P.K., 2022. Microeconometrics using Stata (Vol. 1). College Station, TX: Stata press.

Campbell, T.S., Chan, Y.S. and Marino, A.M., 1992. An incentive-based theory of bank regulation. Journal of Financial Intermediation, 2(3), pp.255-276.

Carney, M., 2021. Value(s): Building a better world for all. William Collins, London.

Casu, B., Di Pietro, F. and Trujillo-Ponce, A., 2019. Liquidity creation and bank capital. Journal of Financial Services Research, 56(3), pp.307-340.

Catarineu-Rabell, E., Jackson, P., & Tsomocos, D. P. (2005). Procyclicality and the new Basel Accord-banks’ choice of loan rating system. Economic Theory, 26(3), 537-557.

Central Bank of Kenya (CBK), 2008. Bank Supervision Annual Report 2008. [online] Available at: https://www.centralbank.go.ke/images/docs/Bank%20Supervision%20Reports/Annual%20Reports/bsd2008R.pdf [Accessed 20 February 2025].

Central Bank of Kenya (CBK), 2016. Prudential Guidelines for Institutions Licensed Under the Banking Act. [online] Available at: https://www.centralbank.go.ke/wp-content/uploads/2016/08/PRUDENTIAL-GUIDELINES.pdf [Accessed 20 February 2025].

Central Bank of Kenya (CBK), 2023. Bank Supervision Annual Report 2023. [online] Available at: https://www.centralbank.go.ke/uploads/banking_sector_annual_reports/69043552_2023%20Annual%20Report.pdf [Accessed 20 February 2025].

Central Bank of Kenya (CBK), 2025. Lifting of moratorium on licensing new commercial banks in Kenya. [online] Available at: https://www.centralbank.go.ke/uploads/press_releases/164519156_Press%20Release%20-%20Lifting%20of%20Moratorium%20on%20Licensing%20New%20Commercial%20Banks%20in%20Kenya.pdf [Accessed 8 May 2025].

Central Bank of Nigeria (CBN), 2004. CBN Briefs Series No. 2004-5/02. Abuja: Central Bank of Nigeria. [online] Available at: https://www.cbn.gov.ng/out/Publications/reports/rd/2007/CBN%20Briefs%202004-2005%20Edition.pdf [Accessed 18 February 2025].

Central Bank of Nigeria (CBN), 2010a. Financial Stability Report. [online] Available at: https://www.cbn.gov.ng/out/2010/publications/bsd/financial%20stability%20final%20to%20printer%20-%2015102010.pdf [Accessed 25 April 2025].

Central Bank of Nigeria (CBN), 2010b. Regulation on the scope of banking activities& ancillary matters, NO. 3, 2010. [online] Available at: https://www.cbn.gov.ng/OUT/2010/CIRCULARS/BSD/CBN%20REGULATION%20ON%20%20NEW%20BANKING%20MODEL%20%20CLEAN%20091110%20FINAL.PDF [Accessed 25 April 2025].

Central Bank of Nigeria (CBN), 2015. Consolidated Banking Supervision Annual Reports (2009-2014). [online] Available at: https://www.cbn.gov.ng/out/2015/bsd/consolidated%20bsar%202009%20-%202014.pdf [Accessed 25 April 2025].

Central Bank of Nigeria (CBN), 2021a. Guidelines on Regulatory Capital. [online] Available at: https://www.cbn.gov.ng/Out/2021/BSD/1.%20GUIDELINES%20ON%20REGULATORY%20CAPITAL.pdf [Accessed 20 February 2025].

Central Bank of Nigeria (CBN), 2021b. Guidelines on Leverage Ratio (LeR). [online] Available at: https://www.cbn.gov.ng/Out/2021/BSD/2.%20GUIDELINES%20ON%20LEVERAGE%20RATIO%20%28LeR%29.pdf [Accessed 20 February 2025].

Central Bank of Nigeria (CBN), 2024. Review of minimum capital requirements for commercial, merchant, and non-interest banks in Nigeria. FPR/DIR/PUB/CIR/002/009, March [online] Available at:

https://www.cbn.gov.ng/Out/2024/CCD/Recapitalization_MARCH_2024.pdf [Accessed 18 February 2025].

Cerutti, E., Claessens, S. and Laeven, L., 2017. The use and effectiveness of macroprudential policies: New evidence. Journal of financial stability, 28, pp.203-224.

CGFS 2009. The role of valuation and leverage in procyclicality. Committee on the Global Financial System (CGFS). April. CGFS Papers No 34. Bank for International Settlements. Basel. Available: https://www.bis.org/publ/cgfs34.pdf

CGFS 2010. The role of margin requirements and haircuts in procyclicality. Committee on the Global Financial System (CGFS), March. Bank for International Settlements. [online] Available at: https://www.bis.org/publ/cgfs36.htm [Accessed 21 May 2025].

CGFS 2012. Operationalising the selection and application of macroprudential instruments. Committee on the Global Financial System (CGFS). December. CGFS Papers No 48. Bank for International Settlements. Basel. Available: https://www.bis.org/publ/cgfs48.pdf

Chalermchatvichien, P., Jumreornvong, S. and Jiraporn, P., 2014. Basel III, capital stability, risk-taking, ownership: Evidence from Asia. Journal of Multinational Financial Management, 28, pp.28-46.

Chalermchatvichien, P., Jumreornvong, S., Jiraporn, P. and Singh, M., 2014. The effect of bank ownership concentration on capital adequacy, liquidity, and capital stability. Journal of Financial Services Research, 45(2), pp.219-240.

Chipili, J.M., 2016. Copper price and exchange rate dynamics in Zambia. Journal of International Development, 28(6), pp.876-886.

Choi, D.B., Holcomb, M.R. and Morgan, D.P., 2020. Bank Leverage Limits and Regulatory Arbitrage: Old Question-New Evidence. Journal of Money, Credit and Banking, 52(S1), pp.241-266.

Christensen, I., Meh, C. and Moran, K., 2011. Bank leverage regulation and macroeconomic dynamic. CIRANO-Scientific Publications 2011s-76.

Chuku, C. and Yenice, M.Y., 2022. Eurobonds, debt sustainability and macroeconomic performance in Africa: Synthetic control experiments. International Economics, 172, pp.368-388.

Cline, W.R., 2017. The right balance for banks: Theory and evidence on optimal capital requirements. Columbia University Press.

Coehlo, R., and Restoy, F., 2024. Capital buffers and the micro-macro nexus (FSI Briefs No. 24). Bank for International Settlements. https://www.bis.org/fsi/fsibriefs24.pdf

Cook, L.D., 2025. "A View on Financial Stability" Remarks at the Seventh Annual Women in Macro Conference. New York University and University of Chicago Becker Friedman Institute for Economics, New York, 23 May. Available at: https://www.bis.org/review/r250526w.pdf [Accessed 5 June 2025].

Cordell, L.R. and King, K.K., 1995. A market evaluation of the risk-based capital standards for the US financial system. Journal of Banking & Finance, 19(3-4), pp.531-562.

Corral, D. and Yang, M., 2024. An introduction to the difference-in-differences design in education policy research. Asia Pacific Education Review, pp.1-10.

Corrales, J.S., Imam, P.A., Weber, S. and Yehoue, E., 2016. Dollarisation in sub-saharan Africa. Journal of African Economies, 25(1), pp.28-54.

Cosimano, T.F. and Hakura, D., 2011. Bank behavior in response to Basel III: A cross-country analysis.

Coval, J. D., & Thakor, A. V., 2005. Financial intermediation as a beliefs-bridge between optimists and pessimists. Journal of Financial Economics, 75(3), 535–569. https://doi.org/10.1016/j.jfineco.2004.02.005.

CRS 2023. Belts and Suspenders: Analysis of Large Bank Capital Standards (July). Congressional Research Service (CRS) Report R47634. [online] Available at: https://crsreports.congress.gov/product/pdf/R/R47634 [Accessed 18 February 2025].

Cuoco, D. and Liu, H., 2006. An analysis of VaR-based capital requirements. Journal of Financial Intermediation, 15(3), pp.362-394.

D'Erasmo, P., 2018. Are higher capital requirements worth it. Economic Insights, 3(2), Federal Reserve Bank of Philadelphia, pp.1-8.

Da Rocha Lopes, S., Foos, D., Janowski, A., Schmitz, S. W., Tomova, M., and Yung, J., 2025. Bank capital and balance sheet management during times of distress: international evidence. Basel Committee on Banking Supervision. August. Working Paper 46. Bank for International Settlements. Basel. Available: https://www.bis.org/bcbs/publ/wp46.pdf

Dagher, J., Dell'Ariccia, G., Laeven, L., Ratnovski, M.L. and Tong, H., 2025. Bank capital: a seawall approach. 62nd issue (March 2020) of the International Journal of Central Banking.

Dahl, D. and Shrieves, R.E., 1990. The impact of regulation on bank equity infusions. Journal of Banking & Finance, 14(6), pp.1209-1228.

Dang, V.D., 2020. Do non-traditional banking activities reduce bank liquidity creation? Evidence from Vietnam. Research in International Business and Finance, 54, p.101257.

Dang, V.D., 2022. Bank liquidity creation under micro uncertainty: The conditioning role of income structure. Economic Modelling, 112, p.105852.

Darrough, M.N. and Stoughton, N.M., 1986. Moral hazard and adverse selection: The question of financial structure. The Journal of Finance, 41(2), pp.501-513.

Davydov, D., Fungáčová, Z. and Weill, L., 2018. Cyclicality of bank liquidity creation. Journal of International Financial Markets, Institutions and Money, 55, pp.81-93.

de Chaisemartin, C. and d'Haultfoeuille, X., 2020. Two-way fixed effects estimators with heterogeneous treatment effects. American economic review, 110(9), pp.2964-2996.

de Chaisemartin, C. and D'Haultfœuille, X., 2023. Credible answers to hard questions: differences-in-differences for natural experiments. Available at SSRN 4487202.

De Jonghe, O. and Öztekin, Ö., 2015. Bank capital management: International evidence. Journal of Financial Intermediation, 24(2), pp.154-177.

De Jonghe, O., Dewachter, H. and Ongena, S., 2020. Bank capital (requirements) and credit supply: Evidence from pillar 2 decisions. Journal of Corporate Finance, 60, p.101518.

De Nicolò, G., 2019. The costs and benefits of bank capital requirements. Global Finance Journal, 39, pp.21-25.

Deghi, A., Fendoglu, M.S., Iyer, T., Tabarraei, H., Tabarraei, M.H.R., Xu, Y. and Yenice, M., 2022. The sovereign-bank nexus in emerging markets in the wake of the COVID-19 pandemic. International Monetary Fund.

Dell'Ariccia, G., 2001. Asymmetric information and the structure of the banking industry. European economic review, 45(10), pp.1957-1980.

Dell'Ariccia, M.G., Ferreira, C., Jenkinson, N., Laeven, M.L., Martin, A., Minoiu, M.C. and Popov, A., 2018. Managing the sovereign-bank nexus. International Monetary Fund (IMF) No. 18/16. [online] Available at: https://www.imf.org/en/Publications/Departmental-Papers-Policy-Papers/Issues/2018/09/14/Managing-the-Sovereign-Bank-Nexus-45133 [Accessed 18 February 2025].

Demsetz, R.S., Saidenberg, M.R. and Strahan, P.E., 1996. Banks with something to lose: The disciplinary role of franchise value. Economic Policy Review, 2(2).

Dermine, J., 2015. Basel III leverage ratio requirement and the probability of bank runs. Journal of Banking & Finance, 53, pp.266-277.

Dewatripont, M. and Tirole, J., 1994. The prudential regulation of banks (Vol. 6). Cambridge, MA: MIT press.

D'Hulster, K., 2009. The leverage ratio: A new binding limit on banks. The World Bank Group, December. Washington, DC. [online] Available at: https://openknowledge.worldbank.org/server/api/core/bitstreams/b704fc7a-d454-554b-a210-a8dd66d130bb/content [Accessed 18 May 2025].

Diamond, D.W. and Dybvig, P.H., 1983. Bank runs, deposit insurance, and liquidity. Journal of political economy, 91(3), pp.401-419.

Diamond, D.W. and Dybvig, P.H., 1986. Banking theory, deposit insurance, and bank regulation. The journal of business, 59(1), pp.55-68.

Diamond, D.W. and Dybvig, P.H., 2000. Bank runs, deposit insurance, and liquidity. Federal Reserve Bank of Minneapolis Quarterly Review, 24(1), pp.14-23.

Diamond, D.W. and Rajan, R.G., 2000. A theory of bank capital. the Journal of Finance, 55(6), pp.2431-2465.

Diamond, D.W. and Rajan, R.G., 2001. Liquidity risk, liquidity creation, and financial fragility: A theory of banking. Journal of political Economy, 109(2), pp.287-327.

Diamond, D.W., 1984. Financial intermediation and delegated monitoring. The review of economic studies, 51(3), pp.393-414.

Diamond, D.W., 1991. Monitoring and reputation: The choice between bank loans and directly placed debt. Journal of political Economy, 99(4), pp.689-721.

Dias, R., 2021. Capital regulation and bank risk-taking–new global evidence. Accounting & Finance, 61(1), pp.847-884.

Díaz, V. and Huang, Y., 2017. The role of governance on bank liquidity creation. Journal of Banking & Finance, 77, pp.137-156.

Distinguin, I., Roulet, C. and Tarazi, A., 2013. Bank regulatory capital and liquidity: Evidence from US and European publicly traded banks. Journal of Banking & Finance, 37(9), pp.3295-3317.

Donaldson, J.R., Piacentino, G. and Thakor, A., 2018. Warehouse banking. Journal of Financial Economics, 129(2), pp.250-267.

Drechsler, I., Savov, A. and Schnabl, P., 2021. Banking on deposits: Maturity transformation without interest rate risk. The Journal of Finance, 76(3), pp.1091-1143.

Duan, Y. and Niu, J., 2020. Liquidity creation and bank profitability. The North American Journal of Economics and Finance, 54, p.101250.

Duchin, R. and Sosyura, D., 2014. Safer ratios, riskier portfolios: Banks′ response to government aid. Journal of Financial Economics, 113(1), pp.1-28.

Durand, P. and Le Quang, G., 2022. Banks to basics! Why banking regulation should focus on equity. European Journal of Operational Research, 301(1), pp.349-372.

ECB 2015. Financial Stability Review (November). Frankfurt am Main: European Central Bank (ECB). [online] Available at: https://www.ecb.europa.eu/pub/pdf/fsr/financialstabilityreview201511.en.pdf [Accessed 05 July 025].

ECB 2017. Economic Bulletin, Issue 1/2017. Frankfurt am Main: European Central Bank (ECB). Available at: https://www.ecb.europa.eu/pub/pdf/ecbu/eb201701.en.pdf (Accessed: 31 October 2025).

Edge, R. M., & Liang, J. N., 2022. Financial stability committees and the Basel III countercyclical capital buffer. International Journal of Central Banking, 18(5), 247-299.

Ediz, T., Michael, I., & Perraudin, W., 1998. The impact of capital requirements on UK bank behaviour. Economic Policy Review, 4(3).

EIB 2022. Finance in Africa: Navigating the financial landscape in turbulent times. Luxembourg: European Investment Bank.

Enoch, M.C., Mathieu, M.P.H., Mecagni, M.M. and Kriljenko, M.J.I.C., 2015. Pan-African Banks: Opportunities and challenges for cross-border oversight.

Evans, J.J. and Haq, M., 2022. Does bank capital reduce liquidity creation?. Global Finance Journal, 54, p.100640.

Eyraud, L., Bunda, I., Jack, J., Jardak, M.T., Ouedraogo, R., Wang, Z. and Wezel, T., 2021. Resolving nonperforming loans in Sub-Saharan Africa in the Aftermath of the COVID-19 Crisis. International Monetary Fund.

Fang, X., Jutrsa, D., Peria, S.M., Presbitero, A.F. and Ratnovski, L., 2022. Bank capital requirements and lending in emerging markets: The role of bank characteristics and economic conditions. Journal of Banking & Finance, 135, p.105806.

Fatouh, M., Giansante, S. and Ongena, S., 2024. Leverage ratio, risk-based capital requirements, and risk-taking in the United Kingdom. Financial Markets, Institutions & Instruments, 33(1), pp.31-60.

Faulkender, M. and Petersen, M.A., 2006. Does the source of capital affect capital structure?. The Review of Financial Studies, 19(1), pp.45-79.

Fazio, D.M., Silva, T.C., Tabak, B.M. and Cajueiro, D.O., 2018. Inflation targeting and financial stability: Does the quality of institutions matter?. Economic Modelling, 71, pp.1-15.

Fell, J. and Schinasi, G., 2005. Assessing financial stability: Exploring the boundaries of analysis. National Institute Economic Review, 192(1), pp.102-117.

Fender, I., and Lewrick, U., 2015. Calibrating the leverage ratio. BIS Quarterly Review (December), 43–58. Bank for International Settlements (BIS). Available at: https://www.bis.org/publ/qtrpdf/r_qt1512f.pdf (Accessed: 10.03.2025).

Feng, S., Ganguli, I., Lee, Y., Poe, J., Ryan, A. and Bilinski, A., 2024. Difference-in-Differences for Health Policy and Practice: A Review of Modern Methods. arXiv preprint arXiv:2408.04617. https://arxiv.org/abs/2408.04617

Ferreira, C., Jenkinson, N. and Wilson, C., 2019. From Basel I to Basel III: Sequencing implementation in developing economies. International Monetary Fund.

Feyen, E., Gispert, T.A., Kliatskova, T. and Mare, D.S., 2021. Financial sector policy response to COVID-19 in emerging markets and developing economies. Journal of Banking & Finance, 133, p.106184.

Feyen, E., Kibuuka, K. and Otker-Robe, I., 2012. Bank deleveraging: causes, channels, and consequences for emerging market and developing countries. World Bank Policy Research Working Paper, (6086).

Fidrmuc, J., Fungáčová, Z. and Weill, L., 2015. Does bank liquidity creation contribute to economic growth? Evidence from Russia. Open Economies Review, 26, pp.479-496.

Firestone, S., Lorenc, A. and Ranish, B., 2019. An empirical economic assessment of the costs and benefits of bank capital in the United States. Available at SSRN 3494164.

Flannery, M.J., 1995. Prudential regulation for banks. In: Financial stability in a changing environment. London: Palgrave Macmillan UK, pp. 281-328.

Fraisse, H., Lé, M. and Thesmar, D., 2020. The real effects of bank capital requirements. Management Science, 66(1), pp.5-23.

Frait, J. and TomŠÍk, V., 2014. Impact and implementation challenges of the Basel Framework for emerging, developing and small economies. Comparative Economic Studies, 56, pp.493-516.

Frait, J., Tomšík, V. , 2016. Impact and Implementation Challenges of the Basel Framework for Emerging, Developing and Small Economies. In: Brada, J.C., Wachtel, P. (eds) Global Banking Crises and Emerging Markets. Palgrave Macmillan, London. https://doi.org/10.1007/978-1-137-56905-9_13

Francis, W.B. and Osborne, M., 2012. Capital requirements and bank behavior in the UK: Are there lessons for international capital standards?. Journal of Banking & Finance, 36(3), pp.803-816.

Fratianni, M. and Pattison, J.C., 2015. Basel III in reality. Journal of Economic Integration, pp.1-28.

FSB 2008. Report of the Financial Stability Forum on Enhancing Market and Institutional Resilience. Financial Stability Board (FSB), April. Bank for International Settlements, Basel. [online] Available at: https://www.fsb.org/uploads/r_0804.pdf [Accessed 12 May 2025].

FSB 2009. Report of the Financial Stability Forum on addressing procyclicality in the financial system. Financial Stability Board (FSB), April. Bank for International Settlements, Basel. [online] Available at: https://www.fsb.org/uploads/r_0904a.pdf [Accessed 21 May 2025].

FSB 2013. Monitoring the effects of agreed regulatory reforms on emerging market and developing economies (EMDEs). Financial Stability Board (FSB), September. Bank for International Settlements, Basel. [online] Available at: https://www.fsb.org/uploads/r_130912.pdf [Accessed 12 May 2025].

FSB 2023. 2023 Bank Failures: Preliminary lessons learnt for resolution. Basel: The Financial Stability Board (FSB), Bank for International Settlements.

FSI 2023. Upside down: when AT1 instruments absorb losses before equity (September). Basel: Financial Stability Institute (FSI), Bank for International Settlements.

Ftiti, Z., Kablan, S. and Guesmi, K., 2016. What can we learn about commodity and credit cycles? Evidence from African commodity-exporting countries. Energy Economics, 60, pp.313-324.

Fu, X., Lin, Y. and Molyneux, P., 2016. Bank capital and liquidity creation in Asia Pacific. Economic Inquiry, 54(2), pp.966-993.

Fuchs, M., Losse-Mueller, T. and Witte, M., 2012. The reform agenda for financial regulation and supervision in Africa. Financial sector development in Africa: opportunities and challenges', World Bank, Washington, DC, pp.153-176.

Fungacova, Z., Turk, R. and Weill, L., 2021. High liquidity creation and bank failures. Journal of Financial Stability, 57, p.100937.

Funyina, T.K., 2023. Bank of Zambia Working Paper Series Dynamics of Sovereign Debt Securities Holdings by Commercial Banks in Zambia: Role of Balance Sheet and Macroeconomic Conditions.

Galati, G. and Moessner, R., 2013. Macroprudential policy–a literature review. Journal of Economic Surveys, 27(5), pp.846-878.

Gambacorta, L., and Karmakar, S., 2018. Leverage and Risk-Weighted Capital Requirements. International Journal of Central Banking, 14(5), 153-191.

Gjerde, Ø. and Semmen, K., 1995. Risk-based capital requirements and bank portfolio risk. Journal of Banking & Finance, 19(7), pp.1159-1173.

Goldstein, M., 2017. Banking's final exam: stress testing and bank-capital reform. Columbia University Press.

Goodhart, C. 2012. How Should We Regulate the Financial Sector. In: Goodhart, C. and Tsomocos, D. (eds.) Financial Stability in Practice: Towards an Uncertain Future. Cheltenham, UK: Edward Elgar Publishing, 90-113.

Goodhart, C., 2011. The Basel Committee on Banking Supervision: A History of the Early Years, 1974-1997. Cambridge University Press.

Gorton, G. and Winton, A., 2000. Liquidity Provision, Bank Capital, and the Macroeconomy.

Gorton, G. and Winton, A., 2017. Liquidity provision, bank capital, and the macroeconomy. Journal of Money, Credit and Banking, 49(1), pp.5-37.

Gottschalk, R., 2014. Institutional challenges for effective banking regulation and supervision in Sub-Saharan Africa. ODI.

Greenwood, R., Stein, J.C., Hanson, S.G. and Sunderam, A., 2017. Strengthening and streamlining bank capital regulation. Brookings Papers on Economic Activity, 2017(2), pp.479-565.

Gropp, R., Mosk, T., Ongena, S. and Wix, C., 2019. Banks response to higher capital requirements: Evidence from a quasi-natural experiment. The Review of Financial Studies, 32(1), pp.266-299.

Gross, M., Kok, C. and Żochowski, D., 2016. The impact of bank capital on economic activity-Evidence from a Mixed-Cross-Section GVAR model (No. 1888). ECB working paper. Available: https://www.econstor.eu/bitstream/10419/154321/1/ecbwp1888.pdf

Gruenberg, M. J., 2023. 'Basel III Endgame', Remarks by FDIC Chairman Martin J. Gruenberg on the Basel III Endgame at the Peterson Institute for International Economics, June 22. Available at: https://fdic.gov/news/speeches/2023/spjun2223.html?source=govdelivery&utm_medium=email&utm_source=govdelivery (Accessed: 05.07.2025).

Guesnerie, R., Picard, P. and Rey, P., 1989. Adverse selection and moral hazard with risk neutral agents. European Economic Review, 33(4), pp.807-823.

Guidara, A., Soumaré, I. and Tchana, F.T., 2013. Banks' capital buffer, risk and performance in the Canadian banking system: Impact of business cycles and regulatory changes. Journal of Banking & Finance, 37(9), pp.3373-3387.

Gujarati, D.N., and Dawn, C.P., 2009. Basic Econometrics. 5th ed. New York: McGraw-Hill/Irwin.

Hahm, J.H., Mishkin, F.S., Shin, H.S. and Shin, K., 2012. Macroprudential policies in open emerging economies (No. w17780). National Bureau of Economic Research.

Haldane, A.G. and Madouros, V., 2012. The Dog and the Frisbee. A paper presented at the Federal Reserve Bank of Kansas City's Economic Policy Symposium, "The Changing Policy Landscape," Jackson Hole, Wyoming, 31 August. Bank of England. Available at: https://www.bankofengland.co.uk/-/media/boe/files/paper/2012/the-dog-and-the-frisbee.pdf [Accessed 7 July 2025].

Hansen, B.E., 2022. Econometrics. Princeton University Press.

Hanson, S.G., Kashyap, A.K. and Stein, J.C., 2011. A macroprudential approach to financial regulation. Journal of economic Perspectives, 25(1), pp.3-28.

Hardouvelis, G.A. and Vayanos, D., 2023. The Greek economic crisis and the banks. GreeSE Papers: Hellenic Observatory Papers on Greece and Southeast Europe (180). Hellenic Observatory, London School of Economics and Political Science, London, UK. Available at: https://www.lse.ac.uk/hellenic-observatory/publications/greese-papers [Accessed on: 17.03.25]

Hardy, B. and Zhu, S., 2023. Covid, central banks and the bank-sovereign nexus. BIS Quarterly Review, (27). March, pp.15-31 [online] Available at: https://www.bis.org/publ/qtrpdf/r_qt2303h.pdf [Accessed 18 February 2025].

Harris, A.D., McGregor, J.C., Perencevich, E.N., Furuno, J.P., Zhu, J., Peterson, D.E. and Finkelstein, J., 2006. The use and interpretation of quasi-experimental studies in medical informatics. Journal of the American Medical Informatics Association, 13(1), pp.16-23.

Harvey, C., 1973. The control of credit in Zambia. The Journal of Modern African Studies, 11(3), pp.383-392.

Haxhiu, E. and Helgerman, T., 2024. Continuous Treatment Difference-in-Differences with Unknown Controls: A Data-Driven Approach [online]: https://elirdhaxhiu.github.io/elirdhaxhiu.com/haxhiu_JMP.pdf

He, Z. and Xiong, W., 2012. Rollover risk and credit risk. The Journal of Finance, 67(2), pp.391-430.

Hellmann, T.F., Murdock, K.C. and Stiglitz, J.E., 2000. Liberalization, moral hazard in banking, and prudential regulation: Are capital requirements enough?. American economic review, 91(1), pp.147-165.

Hernández de Cos, P. , 2020. 'Basel III: the implementation imperative', speech delivered at the 15th BCBS FSI High level Meeting for Africa, Cape Town, 30 January. Bank for International Settlements. Available at: https://www.bis.org/speeches/sp200130.htm

Herrera, L., Valerio, S., and Mara, P., 2024. The importance of being positive: costs and benefits of a positive neutral rate for the countercyclical capital buffer, Macroprudential Bulletin 24, ECB, Frankfurt am Main, June. Available at: https://www.ecb.europa.eu/press/financial-stability-publications/macroprudential-bulletin/html/ecb.mpbu202406_01~0ed53a85fa.en.html

Herz, B., & Keller, J., 2023. How Do Regulators Set the Countercyclical Capital Buffer?. International Journal of Central Banking, 19(3), 99-137.

Hessou, H., 2017. Basel III capital buffer requirements and credit union prudential regulation: Canadian evidence. Journal of Financial Stability, 30, pp.92-110.

Hettinger, G., Lee, Y. and Mitra, N., 2024. A Causal Framework for Evaluating Heterogeneous Policy Mechanisms Using Difference-in-Differences. https://arxiv.org/abs/2408.16670

Hirtle, B., Schuermann, T. and Stiroh, K., 2009. Macroprudential supervision of financial institutions: lessons from the SCAP. Federal Reserve Bank of New York Staff Reports, no. 409. https://elischolar.library.yale.edu/cgi/viewcontent.cgi?article=11633&context=ypfs-documents

Honohan, P. and Stiglitz, J.E., 2001. Robust financial restraint. Financial liberalization: How far, how fast, 31.

Hsieh, M.F., Lee, C.C. and Lin, Y.C., 2022. New evidence on liquidity creation and bank capital: The roles of liquidity and political risk. Economic Analysis and Policy, 73, pp.778-794.

Huizinga, H. and Laeven, L., 2019. The procyclicality of banking: evidence from the euro area. IMF Economic Review, 67(3), pp.496-527.

Igan, D., Mirzaei, A. and Moore, T., 2023. Does macroprudential policy alleviate the adverse impact of COVID-19 on the resilience of banks?. Journal of Banking & Finance, 147, p.106419.

Imbierowicz, B. and Rauch, C., 2014. The relationship between liquidity risk and credit risk in banks. Journal of Banking & Finance, 40, pp.242-256.

IMF 2009. Impact of the global financial crisis on Sub-Saharan Africa, International Monetary Fund.

IMF 2013. Nigeria: Financial sector stability assessment. IMF Country Report No. 13/140. International Monetary Fund (IMF), May. Washington, DC. [online] Available at: https://www.imf.org/external/pubs/ft/scr/2013/cr13140.pdf [Accessed 20 February 2025].

IMF 2022. Regional economic outlook. Sub-Saharan Africa : living on the edge (October). Washington, DC International Monetary Fund.

IMF 2024a. Regional economic outlook. Sub-Saharan Africa: a tepid and pricey recovery. International Monetary Fund (IMF), April. Washington, DC. https://www.imf.org/en/Publications/REO/SSA

IMF 2024b. Regional economic outlook. Sub-Saharan Africa : Reforms amid great expectations. International Monetary Fund (IMF), October. Washington, DC. https://www.imf.org/en/Publications/REO/SSA.

IMF 2024c. Uganda: Financial Sector Assessment Report. International Monetary Fund (IMF). [online] Available at: https://www.elibrary.imf.org/view/journals/002/2024/077/article-A001-en.xml [Accessed 20 February 2025].

IMF 2025a. Regional economic outlook. Sub-Saharan Africa: Recovery Interrupted. International Monetary Fund (IMF), April. Washington, DC. https://www.imf.org/en/Publications/REO/SSA/Issues/2025/04/25/regional-economic-outlook-for-sub-saharan-africa-april-2025.

IMF 2025b. Regional economic outlook. Sub-Saharan Africa: Holding Steady. International Monetary Fund (IMF), October. Washington, DC. https://www.imf.org/-/media/files/publications/reo/afr/2025/october/english/text.pdf.

IMF 2026. Regional economic outlook. Sub-Saharan Africa: Hard-Won Gains Under Pressure. International Monetary Fund (IMF), April. Washington, DC. https://www.imf.org/-/media/files/publications/reo/afr/2026/april/english/text.pdf.

Ingves, S., 2014. 'Banking on leverage', Keynote address to the 10th Asia-Pacific High-Level Meeting on Banking Supervision jointly organised by the Basel Committee on Banking Supervision (BCBS), the Financial Stability Institute (FSI), and the Executives' Meeting of East Asia-Pacific Central Banks Working Group on Banking Supervision (EMEAP WGBS), Auckland, New Zealand, February, 25–27. Available at: https://www.bis.org/speeches/sp140226.htm (Accessed: 11.03.2025).

Jacques, K. and Nigro, P., 1997. Risk-based capital, portfolio risk, and bank capital: A simultaneous equations approach. Journal of Economics and business, 49(6), pp.533-547.

Jeitschko, T.D. and Jeung, S.D., 2007. Do well-capitalised banks take more risk? Evidence from the Korean banking system. Journal of Banking Regulation, 8(4), pp.291-315.

Jiang, H., Zhang, J. and Sun, C., 2020. How does capital buffer affect bank risk-taking? New evidence from China using quantile regression. China Economic Review, 60, p.101300.

Jiang, L., Levine, R. and Lin, C., 2019. Competition and bank liquidity creation. Journal of Financial and Quantitative Analysis, 54(2), pp.513-538.

Jin, Y., 2024. The Differential Error Components Models under Treatment Effect Heterogeneity. Preprints 2024, 2024070569. https://doi.org/10.20944/preprints202407.0569.v1

Jokipii, T. and Milne, A., 2011. Bank capital buffer and risk adjustment decisions. Journal of Financial Stability, 7(3), pp.165-178.

Jokivuolle, E., Kiema, I. and Vesala, T., 2014. Why do we need countercyclical capital requirements?. Journal of Financial Services Research, 46, pp.55-76.

Jones, E. and Zeitz, A.O., 2017. The limits of globalizing Basel banking standards. Journal of Financial Regulation, 3(1), pp.89-124.

Jones, E., 2020. The puzzle: Peripheral developing countries implementing international banking standards. The Political Economy of Bank Regulation in Developing Countries: Risk and Reputation. Oxford University Press.

Jones, E., Beck, T. and Knaack, P., 2018. Room to manoeuvre: How developing countries can tailor Basel standards. GEG Policy Brief. Global Economic Governance Programme, University of Oxford. [online]

Juelsrud, R., 2018. Do Stricter Capital Requirements Reduce Systemic Risk? Evidence From a Quasi-Natural Experiment (March 13, 2018). Available at SSRN: https://ssrn.com/abstract=3139648 or http://dx.doi.org/10.2139/ssrn.3139648

Kablan, S., Ftiti, Z. and Guesmi, K., 2017. Commodity price cycles and financial pressures in African commodities exporters. Emerging Markets Review, 30, pp.215-231.

Kahane, Y., 1977. Capital adequacy and the regulation of financial intermediaries. Journal of Banking & Finance, 1(2), pp.207-218.

Kanga, D., Murinde, V. and Soumaré, I., 2020. Capital, risk and profitability of WAEMU banks: Does bank ownership matter?. Journal of Banking & Finance, 114, p.105814.

Kanga, D., Murinde, V. and Soumaré, I., 2021. How has the rise of Pan-African banks impacted bank stability in WAEMU?. Journal of International Financial Markets, Institutions and Money, 73, p.101364.

Kasekende, L., Bagyenda, J. and Brownbridge, M., 2012. Basel III and the global reform of financial regulation: How should Africa respond? A bank regulator's perspective. Bank of Uganda mimeo. Available at: https://www.researchgate.net/profile/Martin-Brownbridge/publication/265219010_Basel_III_and_the_global_reform_of_financial_regulation_How_should_Africa_respond_A_bank_regulator's_perspective/links/54b506280cf26833efd0570b/Basel-III-and-the-global-reform-of-financial-regulation-How-should-Africa-respond-A-bank-regulators-perspective.pdf

Kashyap, A.K. and Stein, J.C., 2004. Cyclical implications of the Basel II capital standards. Economic Perspectives-Federal Reserve Bank Of Chicago, 28(1), pp.18-33.

Kashyap, A.K., Stein, J.C. and Hanson, S., 2010. An analysis of the impact of 'substantially heightened' capital requirements on large financial institutions. Booth School of Business, University of Chicago, mimeo, 2, pp.1-47.

Kellermann, K. and Schlag, C., 2013. Occupy risk weighting: how the minimum leverage ratio dominates capital requirements: A Swiss example. Journal of Financial Regulation and Compliance, 21(4), pp.353-372.

Kennedy, P., 2008. A guide to econometrics. 6th ed. Blackwell Publishing.

Kennedy-Shaffer, L., 2024. A Generalized Difference-in-Differences Estimator for Unbiased Estimation of Desired Estimands from Staggered Adoption and Stepped-Wedge Settings. arXiv preprint arXiv:2405.08730. https://arxiv.org/pdf/2405.08730

Kiema, I. and Jokivuolle, E., 2014. Does a leverage ratio requirement increase bank stability?. Journal of Banking & Finance, 39, pp.240-254.

Kim, D. and Santomero, A.M., 1988. Risk in banking and capital regulation. The journal of finance, 43(5), pp.1219-1233.

Klein, P.O. and Turk-Ariss, R., 2022. Bank capital and economic activity. Journal of Financial Stability, 62, p.101068.

Klomp, J. and De Haan, J., 2012. Banking risk and regulation: Does one size fit all?. Journal of Banking & Finance, 36(12), pp.3197-3212.

Knell, M., 2015. Schumpeter, Minsky and the financial instability hypothesis. Journal of evolutionary Economics, 25(1), pp.293-310.

Koehn, M. and Santomero, A.M., 1980. Regulation of bank capital and portfolio risk. The journal of finance, 35(5), pp.1235-1244.

Korein, S., Abotalib, A., Trojak, M. and Abou-El-Sood, H., 2022. Is capital conservation buffer or regulatory leverage better at improving bank efficiency? The case of an emerging market. Journal of Humanities and Applied Social Sciences, 4(4), pp.292-309.

Kusi, B.A., Kriese, M., Nabieu, G.A.A. and Agbloyor, E.K., 2022. Bank ownership types and liquidity creation: evidence from Ghana. Journal of African Business, 23(3), pp.568-586.

Laeven, L., Ratnovski, L. and Tong, H., 2016. Bank size, capital, and systemic risk: Some international evidence. Journal of Banking & Finance, 69, pp.S25-S34.

Laffont, J.J. and Martimort, D., 2002. The theory of incentives: the principal-agent model. Princeton university press.

Lane, P.R., 2012. The European sovereign debt crisis. Journal of economic perspectives, 26(3), pp.49-68.

Laux, C. and Rauter, T., 2017. Procyclicality of US bank leverage. Journal of Accounting Research, 55(2), pp.237-273.

Le Quang, G. and Scialom, L., 2022. Better safe than sorry: Macroprudential policy, Covid 19 and climate change. International Economics, 172, pp.403-413.

Le, T., 2019. The interrelationship between liquidity creation and bank capital in Vietnamese banking. Managerial Finance, 45(2), pp.331-347.

Lee, C.C. and Hsieh, M.F., 2013. The impact of bank capital on profitability and risk in Asian banking. Journal of international money and finance, 32, pp.251-281.

Lee, K., Jeong, Y., Han, S., Joo, S., Park, J. and Qi, K., 2024. Difference-in-Differences with matching methods in leadership studies: A review and practical guide. The Leadership Quarterly, p.101813.

Lei, A.C. and Song, Z., 2013. Liquidity creation and bank capital structure in China. Global Finance Journal, 24(3), pp.188-202.

Levitt, S.D., 2002. Using electoral cycles in police hiring to estimate the effects of police on crime: Reply. American Economic Review, 92(4), pp.1244-1250.

Li, J., Jiang, H., Shen, J., Ding, H. and Yu, R., 2024. Using the difference-in-differences design with panel data in international business research: progress, potential issues, and practical suggestions. Journal of International Business Studies, pp.1-13.

Liao, D. and Valliant, R., 2012. Variance inflation factors in the analysis of complex survey data. Survey Methodology, 38(1), pp.53-62.

Lukas Pfeifer & Libor Holub & Zdenek Pikhart & Martin Hodula, 2016. "The Role of the Leverage Ratio in Capital Regulation of the Banking Sector," Occasional Publications - Chapters in Edited Volumes, in: CNB Financial Stability Report 2015/2016, chapter 0, pages 137-148, Czech National Bank, Research and Statistics Department.

Manu, S.A. and Qi, Y., 2023. CEO social connections and bank systemic risk: The “dark side” of social networks. Journal of Banking & Finance, 156, p.106988.

Marcus, A.J., 1984. Deregulation and bank financial policy. Journal of banking & finance, 8(4), pp.557-565.

Martynova, N., 2015. Effect of bank capital requirements on economic growth: a survey. DNB Working Paper. No. 467 / March 2015

Masera, R., 2020. Leverage and risk-weighted capital in banking regulation. Available at SSRN 3471119.

Masson, P.R., 2014. Macroprudential policies, commodity prices and capital inflows. Bank of International Settlements Papers, No. 76.

Mazioud Chaabouni, M., Zouaoui, H. and Ellouz, N.Z., 2018. Bank capital and liquidity creation: new evidence from a quantile regression approach. Managerial Finance, 44(12), pp.1382-1400.

Mecagni, M.M., Corrales, M.J.S., Dridi, M.J., Garcia-Verdu, M.R., Imam, P.A., Matz, M.J., Macario, M.C., Maino, M.R., Mu, M.Y., Moheeput, A. and Narita, M.F., 2015. Dollarization in Sub-Saharan Africa: Experiences and Lessons. Washington: International Monetary Fund (April). Available: https://www.imf.org/external/pubs/ft/dp/2015/afr1504.pdf

Mehran, H. and Thakor, A., 2011. Bank capital and value in the cross-section. The Review of Financial Studies, 24(4), pp.1019-1067.

Merton, R.C., 1972. An analytic derivation of the efficient portfolio frontier. Journal of financial and quantitative analysis, 7(4), pp.1851-1872.

Merton, R.C., 1977. An analytic derivation of the cost of deposit insurance and loan guarantees an application of modern option pricing theory. Journal of banking & finance, 1(1), pp.3-11.

Merton, R.C., 1978. On the cost of deposit insurance when there are surveillance costs. Journal of Business, pp.439-452.

Mésonnier, J.S. and Monks, A., 2014. Did the EBA capital exercise cause a credit crunch in the euro area?. Banque de France.

Meyer, B.D., 1995. Natural and quasi-experiments in economics. Journal of business & economic statistics, 13(2), pp.151-161.

Miles, D., Yang, J. and Marcheggiano, G., 2013. Optimal bank capital. The Economic Journal, 123(567), pp.1-37.

Milne, A. and Whalley, A.E., 2001. Bank capital and incentives for risk-taking. Cass Business School Research Paper, WBS Finance Group Research Paper, (15).

Milne, A., 2002. Bank capital regulation as an incentive mechanism: Implications for portfolio choice. Journal of banking & finance, 26(1), pp.1-23.

Minsky, H.P. and Kaufman, H., 1986, 2008. Stabilizing an unstable economy. New York: McGraw-Hill.

Minsky, H.P., 1977. The financial instability hypothesis: An interpretation of Keynes and an alternative to "standard" theory. Challenge, 20(1), pp.20-27.

Minsky, H.P., 1978. The financial instability hypothesis: A Restatement. Hyman P. Minsky Archive. 180.

Minsky, H.P., 1979. The financial instability hypothesis: Capitalist processes and the behavior of the economy. Hyman P. Minsky Archive. 471.

Minsky, H.P., 1982a, 2016. Can "it" happen again?: Essays on instability and finance. London: Routledge.

Minsky, H.P., 1982b. Can "it" happen again? A reprise. Challenge, 25(3), pp.5-13.

Minsky, H.P., 1992. The financial instability hypothesis. Working paper, No. 74. Levy Economics Institute of Bard College, Annandale-on-Hudson, New York.

Mlachila, M.M. and Yabara, M.M., 2013. Banking in sub-Saharan Africa: the macroeconomic context. International Monetary Fund.

Modigliani, F. and Miller, M.H., 1958. The cost of capital, corporation finance and the theory of investment. The American economic review, 48(3), pp.261-297.

Moreno, R., 2011. Policymaking from a "macroprudential" perspective in emerging market economies. BIS Working Papers, No. 336. Basel: Bank for International Settlements Available: https://www.bis.org/publ/work336.htm

Morrison, A.D. and White, L., 2005. Crises and capital requirements in banking. American Economic Review, 95(5), pp.1548-1572.

Murphy, D., Vasios, M. and Vause, N., 2014. An investigation into the procyclicality of risk-based initial margin models. Bank of England Financial Stability Paper, (29). [online] Available at: https://www.bankofengland.co.uk/-/media/boe/files/financial-stability-paper/2014/an-investigation-into-the-procyclicality-of-risk-based-initial-margin-models.pdf [Accessed 18 May 2025].

Myers, S.C. and Majluf, N.S., 1984. Corporate financing and investment decisions when firms have information that investors do not have. Journal of financial economics, 13(2), pp.187-221.

Myers, S.C., 1984. Capital structure puzzle. National Bureau of Economic Research Cambridge, Mass., USA.

Myers, S.C., 2001. Capital structure. Journal of Economic perspectives, 15(2), pp.81-102.

Naceur, S.B., Marton, K. and Roulet, C., 2018. Basel III and bank-lending: Evidence from the United States and Europe. Journal of Financial Stability, 39, pp.1-27.

Nguyen, Q. T., Nguyen, S. T., & Nguyen, Q. V., 2019. Can higher capital discipline bank risk: Evidence from a meta-analysis. Journal of Risk and Financial Management, 12(3), 134.

Nguyen, Q.T.T., Anh, D.L.T. and Gan, C., 2023. Bank capital and risk relationship during COVID-19: a cross-country evidence. Studies in Economics and Finance, 40(5), pp.878-900.

Nguyen, Q.T.T., Gan, C. and Li, Z., 2019. Bank capital regulation: How do Asian banks respond?. Pacific-Basin Finance Journal, 57, p.101196.

Nistor, S. and Ongena, S., 2023. The impact of policy interventions on systemic risk across banks. Journal of Financial Services Research, 64(2), pp.155-206.

Nuno, G. and Thomas, C., 2017. Bank leverage cycles. American Economic Journal: Macroeconomics, 9(2), pp.32-72.

Obadire, A.M., Moyo, V. and Munzhelele, N.F., 2022. Basel III capital regulations and bank efficiency: Evidence from selected African Countries. International Journal of Financial Studies, 10(3), p.57.

Oduor, J., Ngoka, K. and Odongo, M., 2017. Capital requirement, bank competition and stability in Africa. Review of development finance, 7(1), pp.45-51.

OECD 2010. Risk and Regulatory Policy.

Paroush, J. and Schreiber, B.Z., 2019. Profitability, capital, and risk in US commercial and savings banks: Re-examination of estimation methods. The Quarterly Review of Economics and Finance, 74, pp.148-162.

Paulus, M., 2014. The financial instability hypothesis of Hyman P. Minsky: Application to the current financial crisis. LAP Lambert Academic Publishing, Saarbrücken.

Pfeifer, L. and Pikhart, Z., 2019. Leverage ratio and its potential for enhancing the effectiveness of capital regulation. Journal of Central Banking Theory and Practice, 8(2), pp.129-146.

Pfeifer, L., Holub, L., Pikhart, Z. and Hodula, M., 2016. The role of the leverage ratio in capital regulation of the banking sector. CNB Financial Stability Report 2015, 2016, pp.137-148.

Pham, H.S.T., Le, T. and Nguyen, L.Q.T., 2021. Monetary policy and bank liquidity creation: does bank size matter?. International Economic Journal, 35(2), pp.205-222.

Prescott, E.S., 2004. Auditing and bank capital regulation. FRB Richmond Economic Quarterly, 90(4), pp.47-63.

Raheem, I.D. and Asongu, S.A., 2018. Extending the determinants of dollarization in sub-Saharan Africa: The role of easy access to foreign exchange earnings. Research in International Business and Finance, 45, pp.106-120.

Rahman, M.M., Zheng, C., Ashraf, B.N. and Rahman, M.M., 2018. Capital requirements, the cost of financial intermediation and bank risk-taking: Empirical evidence from Bangladesh. Research in International Business and Finance, 44, pp.488-503.

Randall, A., 1983. The problem of market failure. Natural Resources Journal, 23(1), pp.131-148.

Reddy, D.R.K., 2012. Financial inclusion: Road Ahead. the Journal of Indian institute of Banking & Finance, pp.40-45.

Rees, R., 1985. 'The Theory of Principal and Agent: Part 2', Bulletin of Economic Research, 37(2), p. 75. doi:10.1111/j.1467-8586.1985.tb00185.x.

Reis, R., 2020. The fiscal footprint of macroprudential policy. Deutsche Bundesbank Discussion Paper (No. 31/2020). [online] Available at: https://www.econstor.eu/bitstream/10419/219020/1/1699808902.pdf [Accessed 20 February 2025]

Repullo, R., 2004. Capital requirements, market power, and risk-taking in banking. Journal of financial Intermediation, 13(2), pp.156-182.

Rime, B., 2001. Capital requirements and bank behaviour: Empirical evidence for Switzerland. Journal of banking & finance, 25(4), pp.789-805.

Rochet, J.C., 1992. Capital requirements and the behaviour of commercial banks. European economic review, 36(5), pp.1137-1170.

Rook, L., 2006. An economic psychological approach to herd behavior. Journal of Economic Issues, 40(1), pp.75-95.

Rosengren, E.S., 2010. Dividend Policy and Capital Retention: A Systemic 'First Response'. In Speech given at "Rethinking Central Banking" Conference (October), Washington, DC. https://www.bostonfed.org/news-and-events/speeches/dividend-policy-and-capital-retention-a-systemic-first-response.aspx [Accessed 02.07.25]

Roth, J., Sant'Anna, P.H., Bilinski, A. and Poe, J., 2023. What's trending in difference-in-differences? A synthesis of the recent econometrics literature. Journal of Econometrics, 235(2), pp.2218-2244.

Saeed, S., Moodie, E.E., Strumpf, E.C. and Klein, M.B., 2019. Evaluating the impact of health policies: using a difference-in-differences approach. International journal of public health, 64, pp.637-642.

Sahyouni, A. and Wang, M., 2019. Liquidity creation and bank performance: evidence from MENA. ISRA International Journal of Islamic Finance, 11(1), pp.27-45.

Saidane, D., Sène, B. and Kanga, K.D., 2021. Pan-African banks, banking interconnectivity: A new systemic risk measure in the WAEMU. Journal of International Financial Markets, Institutions and Money, 74, p.101405.

Santos, J.A., 1999. Bank capital and equity investment regulations. Journal of Banking & Finance, 23(7), pp.1095-1120.

Santos, J.A., 2001. Bank capital regulation in contemporary banking theory: A review of the literature. Financial Markets, Institutions & Instruments, 10(2), pp.41-84.

Schinasi, G.J., 2004. Defining Financial Stability (SSRN Scholarly Paper No. ID 879012). Social Science Research Network, Rochester, NY. https://doi. org/10.2139/ssrn. 879012.

Shrieves, R.E. and Dahl, D., 1992. The relationship between risk and capital in commercial banks. Journal of banking & finance, 16(2), pp.439-457.

Simon, L., 2021. Capital requirements in a model of bank runs: The 2008 run on repo. Latin American Journal of Central Banking, 2(3), p.100038.

Sivec, V., & Volk, M., 2023. Empirical evidence on the effectiveness of capital buffer release. International Journal of Central Banking, 19(3), 139-173.

Slovik, P. and Cournède, B., 2011. Macroeconomic impact of Basel III.

Smaga, P., 2024. Potential impact of introducing a neutral positive countercyclical capital buffer in EU countries. Central Bank Review, 24(4), p.100180.

Sobiech, A.L., Kgari, L., Nguyen, L. and Wilson, J.O., 2025. Implicit guarantees and bank stability: Evidence from a quasi-natural experiment. Journal of International Economics, p.104094.

Sosa, M. S., & Garcia-Escribano, M. M., 2011. What is Driving Financial De-dollarization in Latin America?. International Monetary Fund.

Stojkov, K., 2020. Different Approaches to Implementing a Countercyclical Capital Buffer| Bulletin–September 2020. Rerserve Bank of Australia. Available: https://www.rba.gov.au/publications/bulletin/2020/sep/different-approaches-to-implementing-a-countercyclical-capital-buffer.html

Stolz, S., 2002. The relationship between bank capital, risk-taking, and capital regulation: A review of the literature.

Tang, Y., Li, Z., Chen, J. and Deng, C., 2021. Liquidity creation cyclicality, capital regulation and interbank credit: Evidence from Chinese commercial banks. Pacific-Basin Finance Journal, 67, p.101523.

Tang, Y., Li, Z., Chen, J. and Deng, C., 2021. Liquidity creation cyclicality, capital regulation and interbank credit: Evidence from Chinese commercial banks. Pacific-Basin Finance Journal, 67, p.101523.

Tarullo, D., 2023. Capital Regulation and the Treasury Market, Harvard Law School & The Brookings Institution (March 2023). [online] Available at: https://www.brookings.edu/wp-content/uploads/2023/03/Brookings-Tarullo-Capital-Regulation-and-Treasuries_3.17.23.pdf [Accessed 18 February 2025].

Thakor, A.V., 1996. Capital requirements, monetary policy, and aggregate bank lending: theory and empirical evidence. The Journal of Finance, 51(1), pp.279-324.

Thakor, A.V., 2014. Bank capital and financial stability: An economic trade-off or a Faustian bargain?. Annu. Rev. Financ. Econ., 6(1), pp.185-223.

Toh, M.Y., 2019. Effects of bank capital on liquidity creation and business diversification: Evidence from Malaysia. Journal of Asian Economics, 61, pp.1-19.

Tran, V.T., Lin, C.T. and Nguyen, H., 2016. Liquidity creation, regulatory capital, and bank profitability. International Review of Financial Analysis, 48, pp.98-109.

Tyson, J., 2021. Financial-sector development and inclusive and sustainable economic growth in sub-Saharan Africa. Joint FSDA and ODI working paper. London: Overseas Development Institute. Available at: https://cdn-odi-production.s3.amazonaws.com/media/documents/ODI_Working_Paper_1_Financial_sector_development_FINAL.pdf [Accessed 20 February 2025]

Umar, M., Sun, G., Shahzad, K. and Rao, Z.U.R., 2018. Bank regulatory capital and liquidity creation: evidence from BRICS countries. International Journal of Emerging Markets, 13(1), pp.218-230.

Upadhyaya, R., 2017. The Political Economy of Basel Adoption in Kenya: A Case of Alignment of Donor, Government, and Banking Sector Interests. [online] Available at: https://www.econstor.eu/bitstream/10419/196387/1/GEG-WP-131.pdf [Accessed 20 February 2025].

Van Der Weide, M.E., Zhang, J.Y., 2019. Bank capital requirements after the financial crisis. In: Berger, A.N., Molyneux,P., Wilson, J.O.S. (Eds.), The Oxford Handbook of Banking. Oxford University Press, Oxford, UK, pp. 706–735.

Van Zeebroeck, T. and Pircalabelu, E., 2024. Flexible estimation of causal effects with observational data. Faculté des sciences, Université catholique de Louvain. https://thesis.dial.uclouvain.be/entities/masterthesis/c8dfd7ad-68c6-481b-8371-db28cd4e6370.

VanHoose, D., 2007. Theories of bank behavior under capital regulation. Journal of Banking & Finance, 31(12), pp.3680-3697.

Von Thadden, E., 2004. Bank capital adequacy regulation under the new Basel Accord. Journal of Financial Intermediation, 13(2), 90–95. https://doi.org/10.1016/j.jfi.2003.04.002.

Wagster, J.D., 1996. Impact of the 1988 Basle Accord on international banks. The Journal of Finance, 51(4), pp.1321-1346.

Wall, L.D. and Peterson, P., 1996. Banks' responses to binding regulatory capital requirements. Economic Review, 81(2), pp.1-17.

Wang, G., Hamad, R. and White, J.S., 2024. Advances in difference-in-differences methods for policy evaluation research. Epidemiology, 35(5), pp.628-637.

Wang, G., White, J.S. and Hamad, R., 2024. The end of court-ordered desegregation and US children's health: Quasi-experimental evidence. American Journal of Epidemiology, p.kwae082.

Wang, J. and Guo, Y., 2024. Semiparametric estimation of average treatment effects in observational studies. Statistical Analysis and Data Mining: The ASA Data Science Journal, 17(3), p.e11688.

Wehinger, G., 2012. Bank deleveraging, the move from bank to market-based financing, and SME financing. OECD Journal-Financial Market Trends, 102, p.65.

Wezel, T., Barrail, Z., and Dehmej, S., 2026. The Sovereign-Bank Nexus in Emerging Markets and Developing Economies: Trends, Determinants, and Macrofinancial Implications. IMF Working Paper, Washington, DC.

White, W.R., 2005. Procyclicality in the financial system: do we need a new macrofinancial stabilization framework? (No. 2). Kiel Economic Policy Papers.

Wooldridge, J.M., 2016. Introductory econometrics: a modern approach, 6th ed. Boston: Cengage Learning

Wooldridge, J.M., 2025. Two-way fixed effects, the two-way mundlak regression, and difference-in-differences estimators: JM Wooldridre. Empirical Economics, pp.1-43.

World Bank, 2020. Global financial development report 2019/2020: Bank regulation and supervision a decade after the global financial crisis. The World Bank. Available: https://openknowledge.worldbank.org/entities/publication/71ec90e9-08f3-52be-b0be-63f136719243

Yan, M., Hall, M.J. and Turner, P., 2012. A cost–benefit analysis of Basel III: Some evidence from the UK. International Review of Financial Analysis, 25, pp.73-82.

Yeddou, N. and Pourroy, M., 2020. Bank liquidity creation: does ownership structure matter?. The Quarterly Review of Economics and Finance, 78, pp.116-131.

Zhao, P. and Cui, Y., 2023. A Semiparametric Instrumented Difference-in-Differences Approach to Policy Learning. https://arxiv.org/abs/2310.09545

Zheng, C. , Cheung, A. and Cronje, T., 2019. The moderating role of capital on the relationship between bank liquidity creation and failure risk. Journal of Banking & Finance, 108, p.105651.

Zimmert, F. and Zimmert, M., 2024. Part-time subsidies and maternal reemployment: Evidence from a difference-in-differences analysis. Journal of Applied Econometrics.

**APPENDICES**

**APPENDIX A1: Comparative case studies of regulatory-driven equity recapitalisation in SSA LMICs**

This appendix reviews five country case studies (Ghana, Kenya, Nigeria, Uganda, and Zambia) to examine how regulatory-mandated equity recapitalisation has been used across the SSA LMICs to strengthen banking sector solvency, enhance financial resilience, and mitigate systemic risk (e.g., BOG, 2017a, p. 19; BOG, 2019c, pp. 4–5; BOU, 2021; CBN, 2024; CBK, 2024, 2025). Collectively, these experiences demonstrate that recapitalisation has become a common prudential policy response to macro-financial instability, regulatory weaknesses, and structural vulnerabilities. Although primarily intended to strengthen individual bank solvency, these reforms have increasingly pursued broader macroprudential objectives by improving the resilience of banking systems to systemic shocks. This has been particularly important in highly dollarised financial systems, where large holdings of government securities and foreign-currency assets (typically assigned zero or low regulatory risk weights) can weaken the effectiveness of Basel's risk-weighted capital framework.

Ghana implemented three major recapitalisation exercises, increasing the minimum paid-up capital requirement from GH¢7 million (US$6 million) in 2007 to GH¢400 million (US$89 million) by 2017 to strengthen bank solvency and support the country's structural economic transformation (BOG, 2007, p. 28; BOG, 2017a, p. 19; BOG, 2019c, pp. 4–5). These reforms coincided with the phased implementation of Basel II/III through the Capital Requirements Directive (CRD), introducing an 8% Tier 1 ratio, 6.5% CET1 ratio, 10% total capital adequacy ratio, a 3% capital conservation buffer, a countercyclical capital buffer, and a 6% leverage ratio (BOG, 2018a, 2018b, 2019b).

Kenya similarly adopted a phased recapitalisation strategy. Minimum capital requirements increased from KSh 250 million (US$3.2 million) to KSh 1 billion (US$12.8 million) following the Finance Act 2008, before being raised further to KSh 10 billion (US$77.3 million) under reforms announced in 2024, with full compliance expected by 2029 (CBK, 2008, p. 31; CBK, 2024, p. 64). While Kenya's prudential framework remains largely aligned with Basel II, it has progressively incorporated key Basel III elements, including a revised definition of Tier 1 capital, a 2.5% capital conservation buffer, and plans to introduce a 4% leverage ratio (CBK, 2016; CBK, 2023, p. 41; CBK, 2024, pp. 66, 81–82).

Nigeria has undertaken three major recapitalisation programmes. The landmark 2004–2005 reform increased minimum capital from ₦2 billion to ₦25 billion (US$17 million to US$210 million), triggering extensive mergers and acquisitions that reduced the number of commercial banks from 89 to 24 (CBN, 2004; CBN, 2010a, p. 40; BIS, 2014, pp. 84–85). Following the banking crisis of 2009, the Central Bank of Nigeria (CBN) introduced a differentiated licensing framework with minimum capital requirements of ₦15 billion for regional banks, ₦25 billion for national banks, and ₦100 billion for international banks (CBN, 2010a, pp. 69–70; CBN, 2010b, pp. 3–4; CBN, 2015, p. 37). In response to renewed macroeconomic instability and exchange-rate depreciation, these thresholds were increased substantially in 2024 to ₦50 billion, ₦200 billion, and ₦500 billion, respectively (CBN, 2024, pp. 67–68; KPMG, 2024; African Business, 2024). Nigeria has complemented these reforms with Basel III capital standards, including a 15% capital adequacy ratio (CAR) for international banks and domestic systemically important banks (D-SIBs), a 10% CAR for other banks, and leverage ratios of 4% (or 5% for D-SIBs) (CBN, 2021a, 2021b).

Uganda has likewise pursued a phased recapitalisation strategy. Minimum paid-up capital increased from UGX 4 billion (US$2 million) to UGX 25 billion (US$11 million) in 2010 and subsequently to UGX 150 billion (US$40 million) under reforms introduced in 2022, with full implementation required by 2024 (BOU, 2010a; BOU, 2010b, p. 10; BOU, 2021; BOU, 2022a, 2022b). Alongside these reforms, Uganda adopted several Basel III capital requirements, including a 10% CET1 ratio, 12% total capital adequacy ratio, a 2.5% capital conservation buffer, a 0–2.5% countercyclical capital buffer, a 0–3.5% systemic risk buffer, and a 6% leverage ratio (BOU, 2018a, 2018b; BOU, 2020; IMF, 2024c).

Zambia implemented its most significant recapitalisation through the 2012 New Capital Adequacy Framework (NCF). Minimum paid-up capital increased from K12 million (US$2.3 million) to K520 million (US$100 million) for foreign-owned banks and K104 million (US$20 million) for locally owned banks (BOZ, 2006; BOZ, 2007, p. 43; BOZ, 2012a, 2012c, p. 50). Unlike earlier reforms, the NCF also strengthened the quality of regulatory capital by requiring Tier 1 nominal capital to comprise entirely common equity, consisting of 80% paid-up ordinary share capital and 20% retained earnings. More recently, the 2025 Capital Adequacy Rules further aligned Zambia's prudential framework with Basel III by introducing an 8% Tier 1 ratio, 6% CET1 ratio, a 6% leverage ratio, together with both the capital conservation buffer (CCB) of 3% and a 0–2.5% countercyclical capital buffer (BOZ, 2025).

Taken together, these case studies demonstrate that regulatory-driven equity recapitalisation has become a prominent macroprudential policy instrument across SSA LMICs. While the specific design and calibration of recapitalisation programmes differ across jurisdictions, they share a common objective of strengthening banking sector resilience in environments characterised by macroeconomic volatility, financial dollarisation, and structural weaknesses. At the same time, the diversity of these approaches highlights the need for recapitalisation frameworks that are proportionate, risk-sensitive, and complemented by broader Basel III instruments – particularly binding leverage requirements – to address the limitations of relying solely on risk-weighted capital measures.

## APPENDIX A2: Conceptual Framework: Leverage Procyclicality in SSA LMICS

This conceptual framework illustrates how commodity price cycles propagate through exchange rate movements, financial dollarisation, and IAS 21 accounting valuation effects to generate procyclical leverage in banking systems across Sub-Saharan African low- and lower-middle-income countries (SSA LMICs). During commodity booms, favourable terms of trade, capital inflows, and credit expansion are accompanied by currency appreciation, which reduces the domestic-currency value of foreign-currency-denominated assets and liabilities, thereby mechanically improving reported leverage and capital ratios. Conversely, during downturns, exchange rate depreciation inflates the domestic-currency value of foreign-currency exposures, increasing reported leverage as bank equity, largely denominated in local currency, adjusts more slowly. These valuation effects, reinforced by widespread financial dollarisation and shallow financial markets, produce asymmetric leverage dynamics – moderate during expansions but substantially amplified during contractions. The framework therefore highlights the need for macroprudential policies that combine countercyclical capital buffers, leverage ratio requirements, limits on foreign exchange exposures, and valuation-adjusted capital measures to mitigate systemic risk arising from commodity-driven financial cycles.

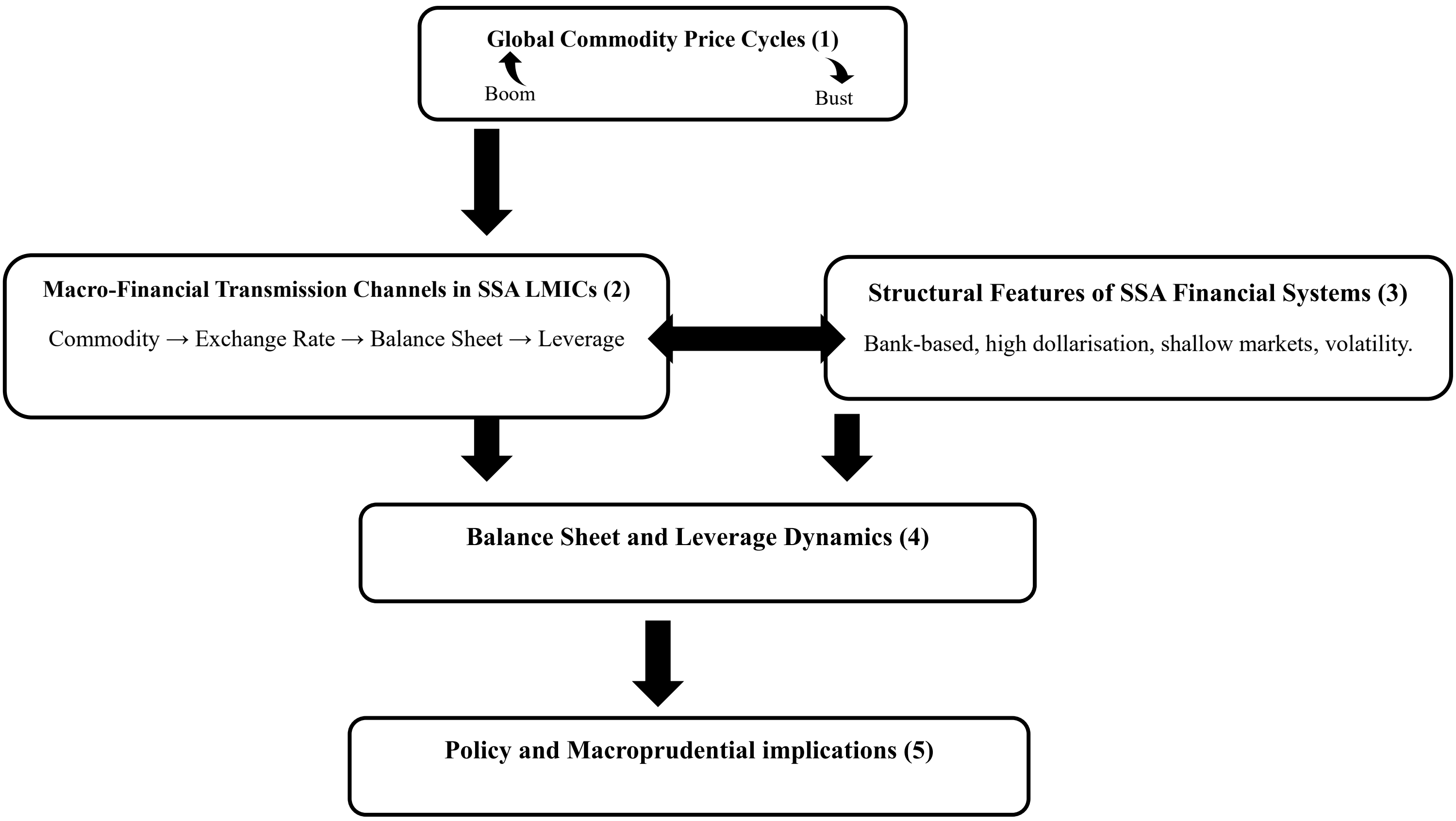



**Figure A1: Conceptual Framework: Leverage Procyclicality in Dollarised SSA LMICs**

## Explanatory Notes for Figure A1: Conceptual Framework of Leverage Procyclicality in Dollarised SSA LMICs

### 1 & 2. MACRO-FINANCIAL TRANSMISSION CHANNELS IN SSA LMICs

**A. Commodity Boom Phase:**

- ↑ Export revenues & capital inflows
- ↑ Liquidity → credit expansion and build-up of FX reserves
- ↑ Currency appreciation (commodity-linked FX)
- ↓ Local currency value of FX assets/liabilities
- → Apparent fall in leverage (accounting valuation-driven)

**B. Commodity Bust Phase:**

- ↓ Export revenues, ↓ capital inflows
- ↓ Liquidity → credit contraction
- ↑ Currency depreciation
- ↑ Local currency value of FX assets/liabilities
- → Sharp ↑ in book leverage (mechanical revaluation)

### 3. STRUCTURAL FEATURES OF SSA FINANCIAL SYSTEMS

- High financial dollarisation (FX deposits & loans >30%)
- Exchange rate volatility amplifies valuation effects
- Shallow domestic financial and capital markets with limited market-based hedging instruments
- Weak prudential buffers & risk management (under provisioning and overstated capital buffers)
- IAS 21 accounting effects - periodic FX revaluation
- Commodity-linked currencies (e.g., ZMW ↔ copper prices)

### 4. BALANCE SHEET AND LEVERAGE DYNAMICS

**A. During Booms:**

- Asset growth ↑ funded by FX inflows
- Leverage may appear stable/declining (valuation effect)
- Banks expand credit and other risk exposures (FX reserves and government securities)

**B. During Busts:**

- FX depreciation → ↑domestic-currency value of foreign-currency-denominated exposures
- Sticky equity → higher reported leverage
- ↑ NPLs & credit losses → further erosion of bank capital
- ↑ Regulatory-driven recapitalisation → banks raise equity to restore capital adequacy
- → Procyclical leverage dynamics intensify → reduced private-sector credit, weaker financial intermediation, and the accumulation of systemic financial imbalances (FX reserves and government securities)

### 5. POLICY AND MACROPRUDENTIAL IMPLICATIONS

- Commodity price cycles generate pronounced leverage and financial procyclicality

- Reported improvements in capital adequacy may be driven by exchange-rate valuation effects rather than genuine increases in resilience
- Macroprudential policy should:
    - Elevate the Basel III leverage ratio from a backstop to a binding frontstop.
    - Combine countercyclical capital buffers with FX exposure limits and valuation-adjusted capital measures.
    - Tailor capital regulation to the structural characteristics of commodity-dependent, highly dollarised banking systems.
- Enhance supervisory data, stress testing, and early-warning systems to detect valuation-driven leverage accumulation and emerging systemic vulnerabilities

**APPENDIX A3: Conceptual Framework: Leverage Procyclicality and the Basel III Leverage Ratio in Highly Dollarised SSA LMICs**

This conceptual framework illustrates how a macroprudential capital framework can be calibrated to the structural characteristics and macro-financial conditions of commodity-dependent, highly dollarised banking systems. It highlights the complementary roles of risk-weighted capital requirements, the Basel III leverage ratio, and fixed minimum capital requirements in containing leverage procyclicality and strengthening financial stability.

**Figure A2. Panel A: Macro-Financial Mechanism**

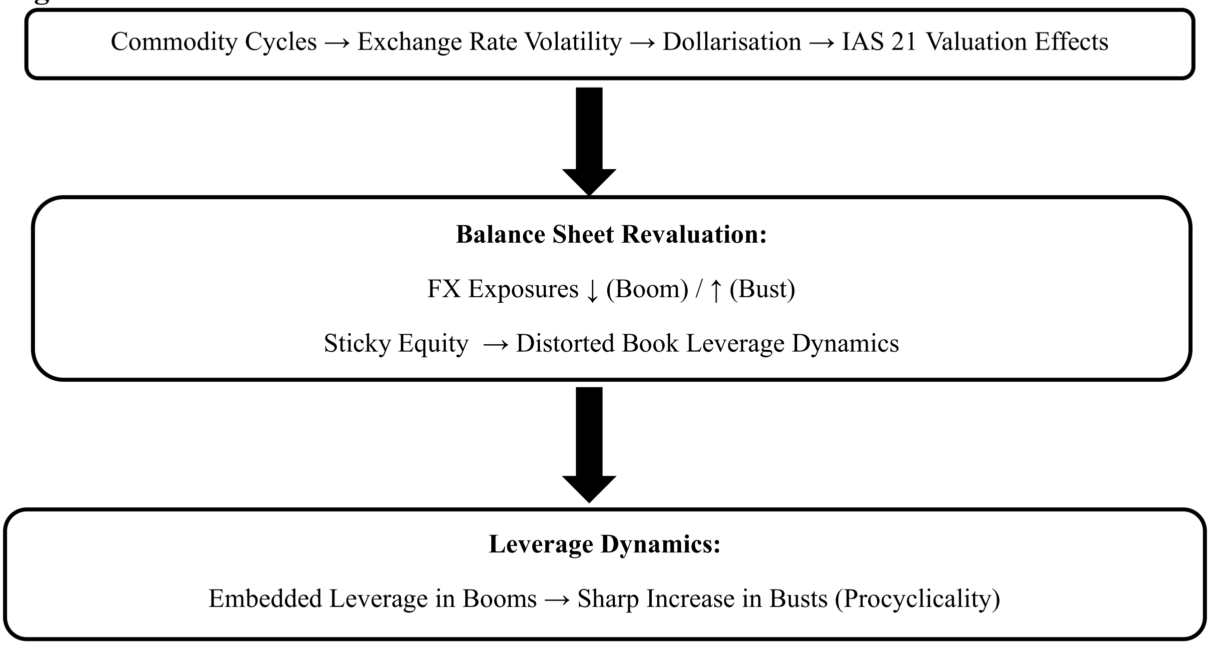


**Figure A2. Panel B: Macroprudential Capital Framework**

**Capital Requirement:**

$K \geq \max\{K_{RWR}, K_{LRC}\}$, subject to $K \geq K_{FAC}$

↓

**Macroprudential Tools:**

Leverage Ratio (LR), LR Buffer, CCyB (Positive Neutral Rate), Stress Capital Buffer

↓

**Outcomes:**

Reduced Procyclicality • Enhanced Resilience • Stable Credit Supply • Improved Intermediation

**Figure A2: Leverage Procyclicality and Basel III-Style Leverage Ratio in SSA LMICs**

**Explanatory Notes for Figure A2: Conceptual Framework of Leverage Procyclicality and the Implementation of a Basel III-Style Framework in SSA LMIC**

**(A) Structural Drivers of Leverage Procyclicality**

Commodity Cycles (Boom – Bust)
⬇
Exchange Rate Movements (Appreciation / Depreciation)
⬇
Financial Dollarisation (FX Assets & Liabilities)
⬇
IAS 21 Accounting Valuation Effects
⬇
Balance Sheet Revaluation

- FX assets ↓ (boom) / ↑ (bust)
- Equity (sticky, local currency)

⬇
Distorted Book Leverage Dynamics

- Understated leverage in booms
- Overstated leverage in busts

**(B) Limitations of Risk-Weighted Capital Framework**

High Concentration in Low/Zero RW Assets

- Government securities
- FX reserves

⬇
Declining RWAs Relative to Total Exposure
⬇
RWR Distortions

- Apparent capital strength
- Embedded leverage accumulation
- Weak CCyB effectiveness

**(C) Core Regulatory Architecture (Basel III-Style Hybrid Framework)**

$$K \geq \max\{K_{RWR}, K_{LR}\} \text{ subject to } K \geq K_{FAC}$$

**Three Complementary Pillars:**

1. **Risk-Weighted Capital (RWR)** → Risk sensitivity
2. **Leverage Ratio (LR)** → Non-risk-based constraint (Total exposure)
3. **Fixed Capital Floor (FAC)** → Absolute safeguard

**➞ Mutual Backstop Structure**

**(D) Leverage Ratio as Macroprudential "Frontstop"**

Key Functions:

- Captures total exposure (including off-balance sheet)
- Not distorted by risk weights
- Limits balance-sheet expansion

↓

Macroprudential Role:

- Constraint in booms (limits leverage build-up)
- Buffer in busts (prevents disorderly deleveraging)
- Surveillance trigger for systemic leverage

**(E) Countercyclical Capital Design**

Time-Varying Instruments:

- Leverage Ratio Buffer
- Countercyclical Capital Buffer (CCyB)
- Stress Capital Buffer (FX-sensitive)

↓

Positive Neutral CCyB Rate

- Gradual buffer build-up in normal times
- Pre-emptive capital accumulation
- Reduced reliance on crisis recapitalisations

**(F) Recapitalisation Mechanism (Hybrid Approach)**

Traditional Approach (Weak):

- Fixed amount, delayed recapitalisation
- Procyclical
- Difficult equity raising by banks

↓

Proposed Approach (LR-Based):

- Capital linked to total exposures
- Scales with bank size
- Incentivises equity issuance (not asset shrinkage)
- Supports countercyclical adjustment

### (G) Final Outcomes

**Enhanced Financial Stability**

- Reduced leverage procyclicality
- Lower systemic risk

**Resilient Banking System**

- Stronger capital buffers
- Improved shock absorption
- Banks sustain financial intermediation following the shock

## APPENDIX A4: Constructing the IAS21Effect (FX Revaluation Residual)

### A4.1: Setup and notation

Let

- $TA_t$ = total assets at end of period $t$, i.e., in local currency units (LCU)
- $AD_t$ = domestic-currency assets at end of $t$ in LCU
- $AF_t$ = foreign-currency-denominated assets translated at closing rate at end of $t$ (i.e., in LCU)
- $F_t$ = foreign-currency amount of the FX-denominated asset stock at end of $t$ (i.e., in foreign currency units (FCU), e.g., the US$)
- $f_t$ = closing exchange rate at end of $t$ (local currency per unit of foreign currency, i.e., LCU per US$1)
- $f_{avg}$ = average exchange rate over the period $t$ to $t$+1(i.e., LCU per US$1)

The bank's total balance sheet size at the end of period $t$ is given by:

$$TA_t = AD_t + AF_t, \text{ where } AF_t = F_t \times f_t. \quad \textbf{(1)}$$

Balance sheet size at the end of period $t$+1:

$$TA_{t+1} = AD_{t+1} + AF_{t+1}, \text{ where } AF_{t+1} = F_{t+1} \times f_{t+1}. \quad \textbf{(2)}$$

### A4.2: Observed and unobserved quantities

**Observed from banks' financial statements and accompanying notes:**

$TA_t$, $TA_{t+1}$, $AF_t$, $AF_{t+1}$, $f_t$, $f_{t+1}$, and $f_{avg}$.

**Unobserved:**

$F_t$ and $F_{t+1}$ (foreign-currency-denominated amounts).

**Implied foreign-currency exposures derived from observable variables:**

$$F'_t = AF_t \div f_t \quad \textbf{(3)}$$

$$F'_{t+1} = AF_{t+1} \div f_{t+1} \quad \textbf{(4)}$$

$$\Delta F'_{t+1} = F'_{t+1} - F'_t = [AF_{t+1} \div f_{t+1}] - [AF_t \div f_t] \quad \textbf{(5)}$$

## A4.3: Accounting Treatment and Decomposition of Foreign-Currency Balance Sheets

**Change in the domestic-currency value of translated foreign-currency assets (LCU):**

$$\Delta AF_{t+1} = AF_{t+1} - AF_t = [F_{t+1} \times f_{t+1}] - [F_t \times f_t] \quad \textbf{(6)}$$

Conceptually, the total change can be decomposed into two components:

- a flow component, capturing the actual change in the foreign-currency position, valued at the average transaction exchange rate; and
- a revaluation component, capturing changes arising solely from exchange rate movements.

Consistent with **IAS 21 – The Effects of Changes in Foreign Exchange Rates**, which permits the use of an average exchange rate ($f_{avg}$) as a practical approximation when individual transaction rates are unavailable, the flow component expressed in local currency is defined as:

$$\Delta F''_{t+1} = (F'_{t+1} - F'_t) \times f_{avg} \quad \textbf{(7)}$$

**Deriving the IAS 21 translation (revaluation) effect**

Replacing the unobserved foreign-currency positions in Equation (7) with their implied values from Equations (3) and (4) gives:

$$\Delta F''_{t+1} = \Delta F'_{t+1} \times f_{avg} = [(AF_{t+1} \div f_{t+1}) - (AF_t \div f_t)] \times f_{avg} \quad \textbf{(8)}$$

The **IAS 21 translation (revaluation) effect** is then defined as the residual between the total change in the domestic-currency value of foreign-currency assets and the underlying transaction (flow) component:

$$IAS21Effect_{t+1} = \Delta AF_{t+1} - \Delta F''_{t+1} \quad \textbf{(9)}$$

Substituting Equations (6) and (8) yields

$$IAS21Effect_{t+1} = (AF_{t+1} - AF_t) - [f_{avg} \times \{(AF_{t+1} \div f_{t+1}) - (AF_t \div f_t)\}]$$
**(10)**

**Equivalent representations**

Equation (10) can be rewritten as

$$\text{IAS21Effect}_{t+1} = \text{AF}_{t+1} \times [1 - (f_{avg} \div f_{t+1})] - \text{AF}_t \times [1 - (f_{avg} \div f_t)] \quad \textbf{(11a)}$$

Using $\text{AF}_t = \text{F}_t \times f_t$ and $\text{AF}_{t+1} = \text{F}_{t+1} \times f_{t+1}$, Equation (11a) can alternatively be expressed as

$$\text{IAS21Effect}_{t+1} = [\text{F}_{t+1} \times (f_{t+1} - f_{avg})] - [\text{AF}_t \times (f_t - f_{avg})] \quad \textbf{(11b)}$$

or, equivalently,

$$\text{IAS21Effect}_{t+1} = [\text{F}_t \times (f_{t+1} - f_t)] + [(\text{F}_{t+1} - \text{F}_t) \times (f_{t+1} - f_{avg})] \quad \textbf{(11c)}$$

**Interpretation**

- $\text{F}_t \times (f_{t+1} - f_t)$: the IAS 21 translation gain or loss arising from revaluing the opening foreign-currency position at the closing exchange rate.
- $(\text{F}_{t+1} - \text{F}_t) \times (f_{t+1} - f_{avg})$: the translation adjustment on the net foreign-currency transactions during the period, reflecting the difference between valuing those transactions at the average exchange rate ($f_{avg}$) and the closing exchange rate ($f_{t+1}$).

**APPENDIX A5: List of Sub-Saharan African Countries Included in the Sample**

| Country Name | Classification |
|---|---|
| Angola | Lower Middle Income |
| Botswana | Upper Middle Income |
| Burundi | Low Income |
| Cameroon | Lower Middle Income |
| Central African Republic | Low Income |
| Chad | Low Income |
| Comoros | Lower Middle Income |
| Congo - DR | Low Income |
| Congo | Lower Middle Income |
| Equatorial Guinea | Upper Middle Income |
| Eswatini | Lower Middle Income |
| Ethiopia | Low Income |
| Gabon | Upper Middle Income |
| Gambia | Low Income |
| Ghana | Lower Middle Income |
| Guinea | Low Income |
| Kenya | Lower Middle Income |
| Lesotho | Lower Middle Income |
| Madagascar | Low Income |
| Malawi | Low Income |
| Mauritius | Upper Middle Income |
| Mozambique | Low Income |
| Namibia | Upper Middle Income |
| Nigeria | Lower Middle Income |
| Rwanda | Low Income |
| Seychelles | High Income |
| South Africa | Upper Middle Income |
| Tanzania | Lower Middle Income |
| Uganda | Low Income |
| Zambia | Lower Middle Income |

**Source:** World Bank

**A6: CAP Variables (Country-specific recapitalisation dummies)**

**CAP_Ghana**
A binary variable equal to 1 for observations in Ghana during years when major regulatory-driven bank recapitalisation initiatives occurred (2009–2012, 2014–2015, 2018–2019), and 0 otherwise.

**CAP_Kenya**
A binary variable equal to 1 for observations in Kenya during the period of regulatory-driven bank recapitalisation (2009–2012), and 0 otherwise.

**CAP_Nigeria**
A binary variable equal to 1 for observations in Nigeria during the period of regulatory-driven bank recapitalisation (2011–2012), and 0 otherwise.

**CAP_Uganda**
A binary variable equal to 1 for observations in Uganda during episodes of regulatory-driven bank recapitalisation (2011–2013 and 2022–2023), and 0 otherwise.

**CAP_Zambia**
A binary variable equal to 1 for observations in Zambia during regulatory-driven bank recapitalisation periods (2007–2008 and 2012–2013), and 0 otherwise.

## APPENDIX A7: Liquidity Classification of Bank Activities

### Table A1: Liquidity classification of bank activities

This table outlines the classification of activities from Step 1, the weights applied in Step 2, and their corresponding alignment with Berger and Bouwman's (2009) "cat fat" and "cat nonfat" categories.

**PANEL A: ASSETS, LIABILITIES AND EQUITY**

| Berger and Bouwman (2009) by category "cat" | Corresponding Bank of Zambia category |
|---|---|
| **ASSETS** | |
| ***Illiquid assets (weight = ½)*** | ***Illiquid assets (weight = ½)*** |
| Commercial real estate loans (CRE) | Gross loans and advances |
| Loans to finance agricultural production | Fixed assets |
| Commercial and industrial loans (C & I) | Other assets |
| Other loans and lease finance receivables | |
| All other assets | |
| ***Semiliquid assets (weight = 0)*** | ***Semiliquid assets (weight = 0)*** |
| Residential real estate loans (RRE) | Statutory bonds |
| Consumer loans | Other bonds |
| Loans to depository institutions | Other securities |
| Loans to state and local governments | Bills of exchange |
| Loans to foreign governments | Interbranch |
| ***Liquid assets (weight = -½)*** | ***Liquid assets (weight = -½)*** |
| Cash and due from other institutions | Cash and balances with Bank of Zambia |
| All securities (regardless of maturity) | Balances with domestic banks |
| Trading assets | Balances with foreign banks |
| Fed funds sold | Treasury bills |
| | Government bonds |
| **LIABILITIES PLUS EQUITY** | |
| ***Liquid liabilities (weight = ½)*** | ***Liquid liabilities (weight = ½)*** |
| Transactions deposits | Demand deposits |
| Savings deposits | Savings deposits |
| Overnight federal funds purchased | Bank of Zambia – current account |
| Trading liabilities | Bank of Zambia – OMO |
| | Balances due to domestic banks |
| | Balances due to foreign banks |
| ***Semiliquid liabilities (weight = 0)*** | ***Semiliquid liabilities (weight = 0)*** |
| Time deposits | Time deposits |
| Other borrowed money | Bills of exchange + interbranch |
| ***Illiquid liabilities + equity (weight = -½)*** | ***Illiquid liabilities + equity (weight = -½)*** |
| Banks' liability on bankers' acceptance | Subordinated debt |
| Subordinated debt | Other liabilities |
| Other liabilities | Bank of Zambia – refinance credit |
| Equity | Bank of Zambia – other |
| | Shareholders' equity |

**Table A1. Liquidity classification of bank activities**

This table outlines the classification of activities from Step 1, the weights applied in Step 2, and their corresponding alignment with Berger and Bouwman's (2009) "cat fat" and "cat nonfat" categories.

**PANEL B: OFF-BALANCE SHEET GUARANTEES (NOTIONAL VALUES)**

| Berger and Bouwman (2009) by category "cat" | Corresponding Bank of Zambia category |
|---|---|
| ***Illiquid guarantees (weight = ½)*** | ***Illiquid guarantees (weight = ½)*** |
| Unused commitments | Guarantees |
| Net standby letters of credit | Letters of credit |
| Commercial and similar letters of credit | Commitments |
| All other off-balance sheet liabilities | Other |
| ***Semiliquid guarantees (weight = 0)*** | ***Semiliquid guarantees (weight = 0)*** |
| Net credit derivatives | N/A |
| Net securities lent | |
| Off-balance sheet derivatives (gross fair value) | |
| ***Liquid guarantees (weight = -½)*** | ***Liquid guarantees (weight = -½)*** |
| Net participations acquired | N/A |
| ***Liquid derivatives (weight = -½)*** | ***Liquid derivatives (weight = -½)*** |
| Interest rate derivatives | Foreign exchange contracts |
| Foreign exchange derivatives | Interest rate related contracts |
| Equity and commodity derivatives | |