Applied Economics and Finance; Vol. 13, No. 2; 2026
ISSN 2332-7294 E-ISSN 2332-7308
Published by Redfame Publishing

Bank Stability as a Proxy for Banking Sector Survival: Evidence from Local and Foreign Commercial Banks in Egypt

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Received: June 5, 2026 Revised: August 17, 2026 Accepted: September 3, 2026

Available online: November 24, 2026 URL: https://doi.org/10.11114/aef.v13i2.9549

Abstract

This study investigates the determinants of bank survival in Egypt over the period 2011–2022 and uses bank stability as a proxy for long-run bank survival, focusing on the role of internal bank-specific factors, macroeconomic conditions, and institutional variables. The study also examines whether the determinants of survival differ between local and foreign commercial banks operating in the Egyptian banking sector. The analysis uses an unbalanced panel dataset covering 35 commercial banks and employs a dynamic panel estimation using the Generalized Method of Moments (GMM). Bank stability is proxied by the Z-score.

The results indicate that credit risk variables exert a strong influence on bank stability across all ownership structures. Liquidity and profitability indicators appear to play a significant role as well. Macroeconomic and institutional factors—especially financial inclusion and regulatory quality—have a significant positive influence on banking resilience while inflation has a significant negative effect. The analysis shows that the survival of local banks is negatively affected by asset growth and bank size, but positively affected by diversification, whereas foreign banks are positively influenced by capital adequacy ratio, efficiency, and diversification.

The findings provide some important insights for policymakers and regulators seeking to strengthen financial resilience and enhance banking sector stability. This study provides a comprehensive empirical assessment of the determinants of bank stability in Egypt by jointly examining bank-specific, macroeconomic, and institutional factors while comparing local and foreign banks during a period characterized by significant economic and political changes.

Keywords: Bank survival, stability, Z-score, credit risk, financial inclusion, regulatory quality, foreign banks, GMM

1. Introduction

1.1 Conceptualizing Bank Survival through Financial Stability

Bank survival refers to the ability of a financial institution to continue operating over the long term while maintaining its financial soundness and avoiding insolvency, regulatory intervention, or market exit. Unlike non-financial firms, banks rarely fail suddenly. Instead, financial deterioration usually occurs gradually through declining profitability, weakening capital adequacy, increasing credit risk, and liquidity pressures before any actual failure takes place. Consequently, direct observation of bank survival is inherently difficult, particularly in highly regulated banking systems where supervisory authorities frequently intervene to prevent bank failures.

Because actual bank failures are relatively infrequent, empirical banking research increasingly relies on indirect measures that capture the probability of financial distress and insolvency rather than observed market exit. This approach allows researchers to evaluate banks' long-term viability even when failure events are scarce.

The theoretical foundation for this approach can be traced to Roy (1952), who introduced the concept of the *distance to default*, arguing that financial institutions seek to maximize safety by maintaining sufficient capital buffers against unexpected losses. Building upon this concept, Boyd and Runkle (1993) operationalized the idea through the banking Z-score, which measures the distance between a bank's current financial position and insolvency by combining profitability, capitalization, and earnings volatility.

Accordingly, higher Z-score values indicate that a bank can absorb larger adverse shocks before becoming insolvent, implying greater financial resilience and lower insolvency risk. Since insolvency risk represents one of the primary threats to a bank's continued operation, financial stability has become widely accepted in the banking literature as a practical proxy for long-term survival.

Subsequent empirical studies have reinforced this conceptual relationship by arguing that financial stability reflects banks' ability to withstand economic, financial, and institutional shocks without jeopardizing their solvency. Supervisory frameworks such as CAMELS similarly evaluate bank soundness through multiple dimensions, including capital adequacy, asset quality, liquidity, profitability, and sensitivity to market risk. More recently, researchers have proposed multidimensional stability indices and enhanced versions of the traditional Z-score to overcome some of its limitations (Gulati et al., 2023; Gulati et al., 2024; Dinh et al., 2026). Nevertheless, the traditional Z-score remains one of the most extensively validated and widely employed indicators of banking stability, allowing meaningful comparison with previous empirical studies.

In the present study, bank survival is therefore not measured directly. Instead, financial stability is adopted as a proxy for bank survival, while the Z-score is employed as the measure of financial stability. Thus, the Z-score is not interpreted as a direct measure of survival itself; rather, it measures financial stability, which in turn reflects banks' long-term survival prospects through its inverse relationship with insolvency risk.

This conceptual linkage is further supported by previous empirical evidence. Mpofu and Nikolaidou (2018) demonstrate that higher credit risk weakens banks' solvency by deteriorating asset quality, constraining lending activity, and increasing funding costs. Similarly, Badwan Nemer et al. (2024) report that credit risk significantly reduces banking stability through its impact on insolvency risk. These findings reinforce the view that improving financial stability enhances banks' ability to survive over the long run.

Previous studies have employed different approaches to measuring bank survival. For example, Gunsel (2010) investigated bank survival using discrete-time survival analysis, while Isshaq et al. (2012) linked operational efficiency and credit risk management to banks' ability to comply with regulatory requirements and sustain operations. Likewise, Asiama (2018) examined banking sector survival through financial stability indicators when analyzing the impact of non-performing loans on Ghana's banking sector.

Given the limited number of bank failures observed in Egypt during the study period, directly modeling survival would provide little variation for empirical estimation. Therefore, following Roy (1952) and Boyd and Runkle (1993), this study conceptualizes survival through financial stability and measures stability using the Z-score. This framework also aligns with Laeven and Levine (2009), who emphasize that governance structures and regulatory environments influence banks' risk-taking behavior, thereby shaping their financial stability and long-term survival.

Accordingly, throughout this study, bank survival is operationalized through financial stability, and financial stability is measured using the Z-score. This approach enables the study to identify the internal, macroeconomic, and institutional determinants of bank survival while maintaining consistency with the established international banking literature.

The importance of banking stability has significantly increased following the global financial crisis of 2007–2008, which exposed major weaknesses in financial institutions and regulatory frameworks worldwide. The crisis highlighted the need for stronger financial supervision and more effective risk management mechanisms (Saif-Alyousfi et al., 2020).

Previous studies have also highlighted the importance of bank size, efficiency, and profitability in influencing financial stability (Ali and Puah, 2018). Larger and more efficient banks often exhibit greater resilience to financial shocks due to economies of scale and better access to financial resources.

Despite the growing literature on banking stability, empirical research focusing specifically on the Egyptian banking sector remains limited. Most previous studies have primarily examined bank profitability, efficiency, and credit risk, with relatively little attention given to comprehensive stability analysis.

Moreover, few studies have simultaneously considered the interaction between internal bank-specific factors and external macroeconomic and institutional determinants of stability. In particular, the roles of financial inclusion, regulatory quality, and foreign bank presence in shaping bank stability in Egypt remain largely underexplored.

1.1.1 Conceptual Clarification of Bank Survival and Stability

In this study, bank survival is conceptualized in terms of a bank’s capacity to remain financially viable and resilient over time, rather than as the occurrence or timing of a specific failure event. Accordingly, the study does not attempt to measure survival through failure-based or duration-based measures, such as the time to bank failure or hazard rates estimated using survival models such as the Cox proportional hazards model. Instead, bank stability is employed as an observable proxy for the underlying capacity of a bank to survive and remain viable over time. The Z-score is therefore used to capture the degree of financial stability and the distance from insolvency, with greater stability indicating a stronger capacity to withstand adverse shocks and continue operating. Accordingly, the use of dynamic panel GMM in this study is intended to examine the determinants of bank stability as a proxy for banking-sector survival, rather than to estimate the probability or timing of an observed bank failure event.

1.2 Research Contribution

This study contributes to the banking stability and financial regulation literature in several important ways.

First, it provides new empirical evidence on the determinants of bank survival and stability in Egypt, an emerging banking system that has experienced significant economic and institutional changes over the past decade. While a large body of literature has examined bank stability in developed economies, empirical evidence from the Egyptian banking sector remains relatively limited.

Second, the study jointly examines the role of bank-specific, macroeconomic, and institutional factors in determining bank survival. In particular, it incorporates recently emphasized institutional variables such as financial inclusion and regulatory quality, which have received growing attention in the financial stability literature but remain relatively limited in the context of the Egyptian banking sector.

Third, the study provides a comparative analysis between local and foreign banks operating in Egypt, offering new insights into how ownership structure may influence the determinants of bank survival. By distinguishing between local and foreign banks, the study contributes to the ongoing debate regarding the role of foreign bank participation in shaping financial stability in emerging markets.

1.3 Literature Review

1.3.1 Concept of Risk and Risk Management

Risk generally refers to the variability of actual returns from their expected values associated with a given asset or investment. Awoke (2014) defines risk as the uncertainty surrounding financial returns, while Muriithi and Waweru (2017) describe banking risk as factors that generate volatility in reserves, operating expenses, and overall institutional value

1.3.2 Z-Score as a Measure of Bank Stability

A large body of empirical literature identifies the Z-score as one of the most widely used indicators of bank stability. The Z-score measures the distance from insolvency by combining profitability, capitalization, and earnings volatility into a single indicator. Higher values indicate stronger financial soundness and a lower probability of bank failure.

Several empirical studies confirm the reliability of this measure. Saif-Alyousfi et al. (2020) show that higher Z-scores based on return on assets (ROA) and return on equity (ROE) reflect improved financial soundness in GCC banking systems. Similarly, Ahamed and Mallick (2017) demonstrate that the Z-score provides a consistent measure of bank risk because it integrates profitability, leverage, and volatility within a single framework.

Other studies reach similar conclusions. Hassan et al. (2018) show that banks with higher profitability and stronger capital positions tend to exhibit higher Z-scores and therefore greater stability. Likewise, Phan et al. (2019) find that improved earnings performance and lower volatility significantly reduce the probability of bank insolvency.

Using a sample of banks from the MENA region, Albaity et al. (2019) confirm the robustness of the Z-score as an inverse indicator of insolvency risk. Their study incorporates additional variables such as non-performing loans and profitability indicators, but the Z-score remains the primary stability proxy. Similar approaches are adopted by Ghenimi et al. (2017), Korbi and Bougatef (2017), and Ali and Puah (2018), further reinforcing the widespread acceptance of this measure in banking research.

Alternative Measures of Bank Stability

Although the Z-score remains dominant in the literature, several studies incorporate alternative indicators to capture different dimensions of financial risk. For example, Hassan, Khan and Paltrinieri (2019) combine the Z-score with Merton's Distance-to-Default model to provide a market-based assessment of insolvency risk. In contrast, Ozili (2018) adopts a broader approach by incorporating variables such as non-performing loan ratios, credit-to-GDP indicators, and loan-loss provisions.

1.3.3 Credit Risk and Bank Stability

Credit risk represents one of the most important determinants of banking stability. It refers to the possibility that borrowers fail to meet their contractual obligations, resulting in financial losses for banks. Saeed and Zahid (2016) define credit risk as the likelihood that borrowers will default on their loans, thereby reducing banks' income and capital.

The theoretical relationship between credit risk and banking stability is often explained through financial intermediation theory and information asymmetry frameworks. According to Mpofu and Nikolaidou (2018), credit shocks can be amplified through balance-sheet effects and informational frictions between borrowers and lenders.

Empirical evidence supports this theoretical linkage. Badwan et al. (2024) find that credit risk significantly reduces banking stability in Palestinian banks, although adequate capitalization partially mitigates this effect. Similarly, Ben-Ammar (2023) reports that economic policy uncertainty combined with deteriorating credit conditions reduce banking stability in the Indian banking sector.

Institutional arrangements may also influence this relationship. Ben-Ammar (2023) demonstrates that deposit insurance schemes interact with banks' capital structures to shape stability outcomes. Furthermore, Kang et al. (2024) show that interest rate liberalization can strengthen banking stability by increasing deposit competition and encouraging financial innovation.

1.3.4 Profitability and Bank Stability

Bank profitability represents another important determinant of financial stability. Profitable banks are generally better positioned to absorb financial shocks and maintain adequate capital buffers. Öhman and Yazdanfar (2018) argue that internal organizational factors, including managerial efficiency and cost control, play a significant role in shaping bank profitability.

The relationship between profitability and stability is also influenced by banks' capital structures. Ali and Puah (2018) emphasize that well-capitalized banks are better able to withstand financial shocks and maintain depositor confidence.

Empirical studies generally confirm a positive relationship between profitability and stability. Rupeika-Apoga et al. (2020) show that profitability indicators such as return on assets and return on equity significantly enhance bank stability by strengthening internal capital generation. Similarly, Albaity et al. (2019) find that higher profitability improves financial resilience among banks operating in the MENA region.

1.3.5 Liquidity Risk and Bank Stability

Liquidity risk refers to the possibility that a bank becomes unable to meet its financial obligations when they fall due without incurring significant losses. According to banking theory, liquidity shortages may escalate into solvency crises when banks are forced to liquidate assets at unfavorable prices. The Basel Committee on Banking Supervision (2010) defines liquidity risk as the inability of a bank to meet short-term financial obligations due to funding constraints or maturity mismatches between assets and liabilities.

Because banks transform short-term deposits into long-term loans, they are inherently exposed to liquidity pressures. ElBadry (2018) emphasizes that adequate capital buffers and prudent liquidity management policies are essential for maintaining financial stability and preventing bank runs.

Empirical studies confirm the importance of liquidity management in determining bank stability. Hassan et al. (2018) document a negative relationship between liquidity risk and bank stability, indicating that banks with higher liquidity buffers tend to exhibit greater resilience during financial crises. Similarly, Rupeika-Apoga et al. (2020) find that banks holding higher proportions of liquid assets are better able to withstand financial shocks.

Other research highlights potential trade-offs between liquidity creation and profitability. Javid et al. (2023) demonstrate that increased liquidity creation strengthens banking stability but may simultaneously reduce profitability due to higher funding costs and reduced lending margins. Their findings suggest that while liquidity improves financial resilience, it may constrain banks' revenue-generating capacity.

1.3.6 Bank Size and Stability

Empirical findings reflect this theoretical ambiguity. Several studies report a negative relationship between bank size and stability. For example, Ghenimi et al. (2017) and Trad et al. (2017) find that larger banks may exhibit greater risk-taking behavior, increasing their vulnerability to financial distress. Similarly, Korbi and Bougatef (2017) report that bank size may weaken stability due to excessive leverage and moral hazard incentives.

In contrast, other studies find a positive relationship. Ozili (2018) shows that larger banks often benefit from diversification opportunities and improved operational efficiency, which may strengthen financial resilience. Similarly, Albaity et al. (2019) report that larger banks tend to achieve greater stability due to economies of scale and more diversified income sources.

Given these conflicting results, the relationship between bank size and stability appears to depend largely on institutional quality, regulatory supervision, and risk management practices.

1.3.7 Efficiency / Cost –to-Income Ratio (CIR) and Bank Stability

Efficiency represents another important determinant of financial stability. The Cost-to-Income Ratio (CIR) is commonly used to measure bank efficiency by comparing operating expenses to operating revenues. Lower CIR values indicate higher efficiency and better cost management.

Empirical evidence generally supports a positive relationship between efficiency and bank stability. Rupeika-Apoga et al. (2020) show that banks with lower CIR values are less likely to experience financial distress, suggesting that efficient cost management improves financial resilience.

Similarly, Ali and Puah (2018) find that efficiency significantly enhances bank stability by improving profitability and reducing operational risk. Additional evidence provided by Ozili (2018) and Albaity et al. (2019) also indicates that efficient banks are better able to withstand economic shocks due to stronger earnings performance.

1.3.8 Diversification and Bank Stability

Diversification refers to banks' expansion across different income sources, asset classes, and economic sectors in order to reduce reliance on a single revenue stream. In theory, diversification enhances financial stability by spreading risk and stabilizing income flows.

More recent research emphasizes the nonlinear nature of diversification effects. Seho et al. (2023) show that moderate diversification may increase risk exposure, while higher levels of diversification can improve financial resilience. Their results suggest that diversification benefits depend on banks' risk management capabilities and institutional environments.

1.3.9 Macroeconomic Determinants of Bank Stability

Economic Growth

Economic growth is commonly measured using the annual growth rate of gross domestic product (GDP). Higher economic growth generally improves borrowers' repayment capacity and reduces credit risk. Trad et al. (2017) show that GDP growth enhances bank profitability and financial performance, thereby strengthening banking stability.

Similarly, Korbi and Bougatef (2017) find that economic expansion significantly improves bank Z-scores for both conventional and Islamic banks. However, Rupeika-Apoga et al. (2020) report weaker effects in some economies, suggesting that institutional quality may moderate the relationship between economic growth and banking stability.

Inflation

Inflation affects bank stability through its impact on interest rates, operating costs, and borrowers' real income. When inflation is anticipated, banks may adjust lending rates accordingly. However, unexpected inflation may weaken borrowers' repayment capacity and increase credit risk.

Empirical studies generally report a negative relationship between inflation and banking stability. Trad et al. (2017) find that higher inflation significantly reduces bank performance. Similarly, Korbi and Bougatef (2017) show that inflation increases financial vulnerability within banking systems. Abuzayed et al. (2018) further demonstrate that stable macroeconomic conditions characterized by low inflation contribute to stronger banking stability.

Financial Inclusion and Bank Stability

Financial inclusion refers to the accessibility and usage of formal financial services by individuals and firms at affordable costs. Kumar et al. (2021) define financial inclusion as the ability of households and businesses to access banking services such as savings accounts, credit facilities, and payment systems.

Financial inclusion may enhance banking stability by increasing deposit mobilization and diversifying funding sources. Ahamed and Mallick (2017) find that inclusive financial systems improve institutional efficiency and reduce financing constraints for firms. Similarly, Feghali et al. (2021) demonstrate that higher deposit mobilization contributes positively to banking stability by reducing dependence on volatile external funding.

However, financial inclusion may also generate new risks. Rapid credit expansion to previously unbanked populations may weaken screening standards and increase default probabilities.

Regulatory Quality and Bank Stability

Institutional quality represents an important determinant of financial stability within banking systems. Regulatory quality reflects governments' ability to design and enforce sound financial policies that promote market efficiency and transparency.

Empirical evidence suggests that stronger regulatory frameworks enhance banking stability. Boulanouar et al. (2021) find that improved regulatory governance significantly strengthens bank stability in GCC countries by reducing excessive risk-taking behavior.

Similarly, Iqbal et al. (2024) emphasize the role of governance indicators such as rule of law and corruption control in strengthening banking resilience. Strong institutional frameworks improve supervisory effectiveness and reduce financial sector vulnerability.

1.3.10 Foreign Banks and Banking Sector Stability

Foreign banks are defined as banking institutions whose controlling ownership originates outside the host country and play an increasingly important role in emerging financial systems.

The theoretical foundations of foreign bank participation can be traced to financial liberalization frameworks introduced by El Menyari (2019), which emphasize the benefits of removing financial repression and encouraging international financial integration.

Foreign banks may contribute positively to banking stability by introducing advanced technologies, improved managerial practices, and enhanced competition. El Menyari (2019) argues that foreign bank presence may strengthen financial sector development and improve regulatory standards.

However, foreign bank participation may also introduce new vulnerabilities. Cross-border banking integration may increase exposure to global financial shocks and capital flow volatility. Bouzgarrou et al. (2018) show that foreign banks may withdraw liquidity from host countries during periods of financial crisis, thereby amplifying economic downturns.

Other studies highlight differences in lending behavior between local and foreign banks. Pelletier (2018) finds that foreign banks often focus on large corporations and multinational firms rather than small and medium-sized enterprises, potentially limiting financial inclusion.

Furthermore, Lee and Hsieh (2014) demonstrate that foreign ownership may influence banks' risk-taking behavior. Their findings suggest that moderate levels of foreign ownership may increase financial fragility, while stronger regulatory frameworks can mitigate these risks.

Given these mixed findings, the overall impact of foreign bank participation on banking stability remains context-dependent and influenced by institutional quality, regulatory frameworks, and macroeconomic conditions.

The literature provides mixed evidence regarding the impact of foreign bank participation on banking sector stability, suggesting that its effects depend on institutional quality, competition, and regulatory supervision (El Menyari, 2019; Bouzgarrou et al., 2018). Accordingly, the present study develops a set of hypotheses to empirically examine the impact of these bank-specific, macroeconomic, and institutional determinants on bank stability in the Egyptian banking sector.

2. Research Design and Methodology

Table 1. All variables and their calculations are summarized

Dependent Variables	**variable**	**Measure**	**Expected Relation**	**Source**
	Z-score	Z-score: (ROA+ Equity/Total Assets)/SD ROA		Bank Scope
Independent Variables	**Bank Specific Variables**			
	CAR	Capital / Total Asset	Positive	Bank Scope
	NPL Ratio	Impaired Loans/Gross Loans	Negative	Bank Scope
	Asset growth	(Loan t - loan t-1)/loan t-1	Negative	Bank Scope
	Liquidity Ratio	Liquid assets / Total Assets Ratio	Positive	Bank Scope
	Liquidity Gap	Logarithm of (Assets-Liabilities)	Positive	Bank Scope
	Loan to Assets Ratio	Net Loans / Total Assets	Positive	Bank Scope
	ROE: return on equity Ratio	Net Income / Equity	Positive	Bank Scope
	ROA: return on asset Ratio	Net Income / Total Assets	Positive	Bank Scope
	NIM Ratio	Net interest income / Earning Assets	Positive	Bank Scope
	NII Ratio	Non-interest income / Total Income	Negative	Bank Scope
	Size of the Bank	Logarithm of Total Assets	Negative	Bank Scope
	CIR (Efficiency) Ratio	Cost / Income Ratio	Positive	Bank Scope
	Diversification	$1 - [(NII/NOI)^2 + (NON/NOI)^2]$	Positive	Bank Scope
	Growth	Growth in Net Interest Income of bank	Positive	Bank Scope
	Leverage Ratio	Total Debt/Total Assets	Positive	Bank Scope
	Operating Risk	Net Income / Total Assets	Positive	Bank Scope

	Macro-Economic Variables			
	GDP	Annual Real GDP Growth Rate	Positive	World Bank
	Inflation rate	Consumer Price Index (CPI)	Negative	World Bank
	Financial Inclusion	Adults with Accounts at a Financial Institution / Total Adults	Positive	World Bank
	Regulatory Quality	World Bank Reports	Positive	World Bank

2.1 Model Specification and Hypotheses

This study examines the determinants of bank stability in Egypt using a comprehensive panel regression framework. The conceptual structure of the model is presented in Figure 1, while the definitions and measurements of all variables are reported in Table 1.

Furthermore, the relatively larger set of explanatory variables was intentionally retained because each variable captures a distinct dimension of bank stability identified in the literature. Excluding theoretically relevant variables without statistical justification could increase omitted-variable bias and weaken the explanatory capacity of the models.

Importantly, including this comprehensive set of theoretically justified variables enabled a more informative comparison across the three models

To capture potential differences between local and foreign banks, the empirical model is estimated for three subsamples. First, the model is applied to the full sample of banks. Second, it is estimated for locally owned banks. Third, it is estimated for foreign-owned banks, defined as institutions in which foreign shareholders hold controlling ownership and influence managerial decision-making.

The baseline empirical specification is e

$$ZSC_{it} = \alpha + \sum_{k=1}^{20} \beta_k X_{kit} + \varepsilon_{it}$$

Where ZSCit represents bank stability measured by the Z-score for bank *i* in year *t*, X_{kit} denotes the vector of explanatory variables, α is the intercept, and εit is the error term.

Specifically, the estimated models are given by:

Full Sample Model

ZSC-entire it= α + β1 CARit + β2 NPLRit + β3 AGit + β4 LRit + β5LGit+ β6 LTARit + β7ROEit + β8 ROAit + β9NIMit+ β10 NIIit +β11 SIZEit + β12 CIRit + β13DIVit + β14GRTHit + β15LVRGit + β16 ORit+ β17 GDPit+ β18INFit+ β19FIit + β20 RQit+ εit

Local Banks Model

ZSC-Local it= α + β1 CARit + β2 NPLRit + β3 AGit + β4 LRit + β5LGit+ β6 LTARit + β7ROEit + β8 ROAit + β9NIMit+ β10 NIIit +β11 SIZEit + β12 CIRit + β13DIVit + β14GRTHit + β15LVRGit + β16 ORit + β17GDPit+ β18 INFit+ β19 FIit + β20 RQit+ εit

Foreign Banks Model

ZSC-Foreign it= α + β1 CARit + β2 NPLRit + β3 AGit + β4 LRit + β5LGit+ β6 LTARit + β7ROEit + β8 ROAit + β9NIMit+ β10 NIIit +β11 SIZEit + β12 CIRit + β13DIVit + β14GRTHit + β15LVRGit + β16 ORit+ β17 GDPit+ β18 INFit+ β19FIit + β20 RQit+ εit

Variable Definitions

- **ZSC**: Z-score (bank stability)
- **CAR**: Capital adequacy ratio
- **NPLR**: Non-performing loans ratio
- **AG**: Asset growth
- **LR**: Liquidity ratio
- **LG**: Liquidity gap
- **LTAR**: Loan-to-asset ratio
- **ROE**: Return on equity
- **ROA**: Return on assets
- **NIM**: Net interest margin
- **NII**: Non-interest income

- **SIZE**: Bank size (log of total assets)
- **CIR**: Cost-to-income ratio
- **DIV**: Diversification index
- **GRTH**: Growth ratio
- **LVRG**: Leverage ratio
- **OR**: Operating risk
- **GDP**: GDP growth rate
- **INF**: Inflation rate
- **FI**: Financial inclusion indicator
- **RQ**: Regulatory quality

The subscript i denotes individual banks (i=1… 35i = 1, \dots, 35i=1… 35), while t represents the time period (2011–2022).

2.2 Estimation Method

Given the dynamic nature of bank stability and the potential endogeneity between stability and bank-specific characteristics, this study employs the Generalized Method of Moments (GMM) estimator. The GMM approach allows for controlling unobserved heterogeneity, simultaneity bias, and reverse causality by using appropriate internal instruments derived from lagged variables. This methodology is particularly suitable for panel data characterized by a large cross-sectional dimension and a moderate time span, as in the present study.

2.3 Research Hypotheses

Based on the theoretical framework and empirical literature, the following hypotheses are formulated:

H1: Individual Effects Hypothesis

Internal bank-specific variables (credit risk, liquidity risk, profitability, size, efficiency, diversification, growth, leverage, and operating risk) and external macroeconomic and institutional variables (GDP growth, inflation, financial inclusion, and regulatory quality) exert statistically significant individual effects on bank stability in Egypt.

H2: Joint Effects Hypothesis

Bank-specific, macroeconomic, and institutional variables jointly exert a statistically significant impact on bank stability.

The individual relationships are initially examined using correlation analysis, while the joint effects are evaluated using dynamic panel GMM regression models

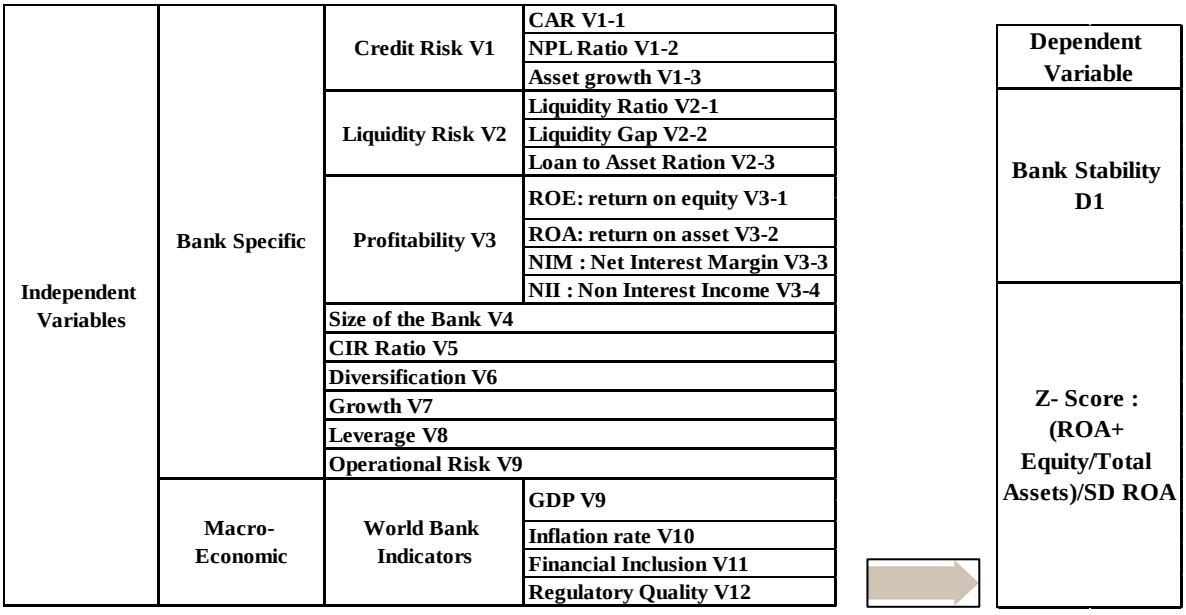

Figure 1. Theoretical Framework

3. Empirical Results

3.1 Model (1): All Banks Analysis

This section presents the empirical findings for the full sample of commercial banks operating in Egypt over the period 2011–2022.

Descriptive Statistics and Preliminary Analysis

The dataset consists of an unbalanced panel comprising 35 banks with a total of 420 observations. Correlation analysis reveals statistically significant associations between bank stability and most explanatory variables. Bank stability exhibits positive correlations with capital adequacy, liquidity indicators, profitability measures, diversification, growth, leverage, financial inclusion, and regulatory quality, while negative correlations are observed with non-performing loans, asset growth, bank size, operating risk, and inflation. These findings provide initial support for the existence of systematic relationships between stability and its determinants.

Also the data provided shows that there is a correlation between the independent variables and each other which create a multicollinearity problem, the severity of this multicollinearity problem can be examined using the VIF (Variance Inflation Factor) test, to examine whether the data and variables can hold or variables will need to be removed from the model.

After performing the VIF test to check the multicollinearity, we found there is a strong correlation between variables X8 (ROA), X11 (Size), X16 (Operating Risk) and X17 (GDP), where they are strongly correlated which means we have a multicollinearity problem, so as a remedy for this problem X8 (ROA), X11 (Size), X16 (Operating Risk) and X17 (GDP) have been removed from Model (1) regarding the test for All Banks

The exclusion of these variables does not imply that they are substantively irrelevant to banking stability. Rather, their exclusion reflects the model-specific multicollinearity diagnostics and the availability of alternative variables capturing related dimensions. Moreover, the existing literature on banking stability does not establish these variables as universally indispensable components of a stability specification; empirical specifications vary considerably across studies in terms of the bank-specific and macroeconomic determinants included.

Following the diagnostic tests conducted as part of the empirical analysis, the dynamic specification of the model was determined based on the statistical evidence. Accordingly, after conducting the Serial Correlation Test 2 lagged dependent variables were incorporated only into the model specifications for which the diagnostic results supported their inclusion. The resulting empirical equation after omitting the variables to remove multicollinearity and adding the Lag variables are presented below.

The lagged values of the Z-score are statistically significant at a level of < .001 for Z-score (-1) and 0.0076 forZ-score (-2), showing that stability is random andcumulative , where banks with previous strong position tend to remain stable which supports using dynamic GMM Model , indicating that bank stability exhibits persistence over time. This means that the previous stability conditions of banks significantly influence their current stability level. Concluding that current stability is partially determined by previous stability conditions, suggesting persistence and dynamic adjustment in banking performance.

$$\text{ZSC-entire}_{it} = \alpha + \text{ZSC-entire}_{it-1} + \text{ZSC-entire}_{it-2} + \beta_1 \text{CAR}_{it} + \beta_2 \text{NPLR}_{it} + \beta_3 \text{AG}_{it} + \beta_4 \text{LR}_{it} + \beta_5 \text{LG}_{it} + \beta_6 \text{LTAR}_{it} + \beta_7 \text{ROE}_{it} + \beta_9 \text{NIM}_{it} + \beta_{10} \text{NII}_{it} + \beta_{12} \text{CIR}_{it} + \beta_{13} \text{DIV}_{it} + \beta_{14} \text{GRTH}_{it} + \beta_{15} \text{LVRG}_{it} + \beta_{18} \text{INF}_{it} + \beta_{19} \text{FI}_{it} + \beta_{20} \text{RQ}_{it} + \varepsilon_{it}$$

Dynamic Panel GMM Results

As illustrated in Table 2, the factors affecting thestability of commercial banks in Egypt in Model (1) for all banks are evaluated using the GMM model in an attempt to decrease the difference between the observed point and its mean by adding a lag in order to reach better and more accurate beta coefficients.

Based on the literature review, theoretical background, and the results of the GMM estimation, the probability values of the t-statistics indicate that at a significance level of 0.05 most of the independent variables are significant in measuring commercial banks' stability (the dependent variable), except for X4 (Liquidity Ratio) which is significant at a level of 0.10. Variable X7 (ROE), which is one of the independent variables, has a positive significance level of 0.0395, which matches the findings of Mohamed Albaity et al. (2019), where ROE is considered an accounting-based risk measure of financial stability.

Variable X3 (Asset Growth), which is one of the variables used to measure credit risk, has a negative significance level of 0.0095, which matches the findings of Ghenimi et al. (2017). Therefore, it can be used to illustrate the ability of banks to attract new deposits, good managerial qualities, and a lower probability of default. From another perspective, loan growth represents an important channel through which banks manage their risk-taking behavior.

Variable X12 (Efficiency) also shows a positive significance level of 0.0233, which is consistent with the findings of Peterson K. Ozili (2018), M.K. Hassan et al. (2019), Muhammad Ali and Chin Hong Puah (2019), and M. Albaity et al. (2019), while contradicting the findings of Ghenimi et al. (2017).

Furthermore, X19 (Financial Inclusion) has a positive significant relationship with the dependent variable at a level of 0.0034, which is consistent with the findings of Feghali et al. (2021). Similarly, X20 (Regulatory Quality) has a positive significant relationship with the dependent variable at a level of 0.0028, which matches the findings of Boulanouar et al. (2021). This result is logical since strong regulatory quality plays an essential role in reducing the fragility of the banking sector and encouraging foreign direct investment.

For the remaining variables at a significance level of 0.05, X1 (CAR) shows a positive relationship with the dependent variable, X2 (NPL/Gross Loan) shows a negative relationship with the dependent variable, X4 (Liquidity Ratio) shows a positive relationship with the dependent variable, X5 (Liquidity Gap) shows a positive relationship with the dependent variable, X6 (Loan/Assets) shows a positive relationship with the dependent variable, X9 (NIM) shows a positive relationship with the dependent variable, X10 (NII) shows a negative relationship with the dependent variable, X13 (Diversification) shows a positive relationship with the dependent variable, X14 (Growth Ratio) shows a positive relationship with the dependent variable, X15 (Leverage) shows a positive relationship with the dependent variable, and X18 (Inflation) shows a negative relationship with the dependent variable.

Table 2. Dynamic GMM results – Full Sample

Constant added to instrument list				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
ZSCOREY(-1)	1.298401	0.106063	12.24182	0
ZSCOREY(-2)	-0.291424	0.102648	-2.83906	0.0076
CAR	0.072295	0.027341	2.644223	0.0123
NPLR	-0.229584	0.101318	-2.265974	0.0297
AG	-0.122644	0.044661	-2.74611	0.0095
LR	0.432548	0.213574	2.025284	0.0505
LG	0.375413	0.1236	3.037322	0.0045
LTAR	0.393813	0.14713	2.676633	0.0112
ROE	0.093975	0.043952	2.138128	0.0395
NIM	0.125271	0.031462	3.98166	0 .0003
NII	-0.092675	0.043348	-2.13793	0.0396
CIR	0.027448	0.011568	2.372752	0.0233
DIV	0.034002	0.014956	2.273469	0.0292
GRTH	0.762026	0.327783	2.324788	0.026
LVRG	0.066475	0.024408	2.723492	0.01
INF	-0.030511	0.009337	-3.267722	0.0025
FI	6.608049	2.095655	3.153214	0.0034
RQ	0.124568	0.038634	3.224307	0.0028
	Effects Specification			
Cross-section fixed (first differences)				
Root MSE	1.765384	**Mean dependent var**		-0.312536
S.D. dependent var	1.524547	**S.E. of regression**		1.818093
Sum squared resid	981.7225	**J-statistic**		20.46295
Instrument rank	35	**Prob(J-statistic)**		0.251237
R-squared	0.76212	**Durbin-Watson stat**		1.481346
		F Statistic		483.2790
Adjusted R-squared	0.751388	**Prob(F-statistic)**		0.000000

**** Correlation is Significant at 0.01 level (2-tailed)*

*** Correlation is Significant at 0.05 level (2-tailed)*

** Correlation is Significant at 0.1 level (2-tailed)*

The J-test for the regression model shows a high significance level for the whole model with a value of 0.251237, which increases the validity of the model and its variables in measuring bank stability. Since the significance value of the J-statistic (≥0.05) then we would not reject the null hypothesis that the overidentifying restrictions are satisfied or valid.

Since the value of "F test" is 483.2790 at a significant level less than (0.001), then we conclude that the independent variables were accepted in the model have been affected on the level of y. Since the significance value of the F-statistic is < 0.001, this supports the acceptance of the second hypothesis H2, which states that all research independent variables jointly have a statistically significant impact on banking sector Stability measured by the Z-score.

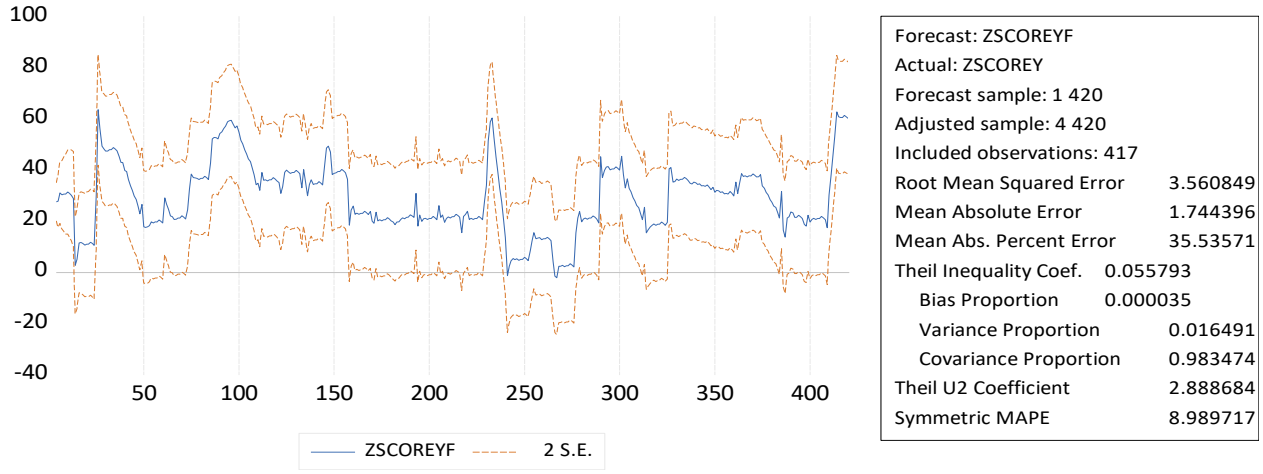

Figure 2. Forecasted against actual z-score for Model (1) – Full Sample

Model Diagnostics and Robustness

The coefficient of determination (R^2) shows a value of 76.212%, indicating that the independent variables explain a substantial portion of the variation in the dependent variable. The remaining percentage may be attributed to random error or other independent variables not included in the model. The adjusted R^2value is 75.1388%, which confirms the robustness of the explanatory power of the model. In terms of the standard error of regression, the model shows a relatively large value of 1.818093, which may reflect the inclusion of macroeconomic variables capturing the unstable economic conditions of the Middle East during the study period. Finally, the Durbin–Watson statistic shows a value of 1.481346, indicating that there is no evidence of serial autocorrelation in the residuals of the regression model.

3.2 Model (2): Local Banks Subsample Analysis

This section reports the empirical findings for locally owned commercial banks operating in Egypt during the period 2011–2022.

Descriptive Statistics and Dynamic Panel GMM Results

The Jarque–Bera normality test indicates that most variables are not normally distributed at a significance level greater than 0.05, except for X4 (Liquidity Ratio), X6 (Loan-to-Asset Ratio), X7 (ROE), and X8 (ROA), which are normally distributed.

The data used in Model (2) is based on 204 individual observations. The results indicate that the dependent variable is strongly correlated with several explanatory variables at a significance level of 0.01. These correlations between the dependent variable and the explanatory variables support the first hypothesis of the research, Therefore; the Pearson correlation matrix provides empirical support for accepting the first hypothesis.

After performing the VIF test to check the multicollinearity, we found there is a strong correlation between variables X5 (Liquidity Gap), X7 (ROE), X8 (ROA),X15 (Leverage) and X16 (Operating Risk), where they are strongly correlated which means we have a multicollinearity problem, so as a remedy for this problem Variables X5, X7, X8, X15 and X16 have been removed from Model (2) regarding the test for Local Banks. Following the diagnostic tests conducted as part of the empirical analysis, the dynamic specification of the model was determined based on the statistical evidence. Accordingly, after conducting the Serial Correlation Test one lagged dependent variable was incorporated only into the model specifications for which the diagnostic results supported their inclusion. The resulting empirical equation after omitting the variables to remove multicollinearity and adding the Lag variable are presented below.

The lagged values of the Z-score are statistically significant at a level of < .001 for Z-score (-1) showing that stability is random, cumulative, where banks with previous strong position tend to remain stable which supports using dynamic GMM Model , indicating that bank stability exhibits persistence over time. The significance of the lagged Z-score indicates a dynamic adjustment process, where past financial stability contributes positively to current bank stability

$$ZSC\text{-}Local_{it} = \alpha + ZSC\text{-}Local_{it-1} + \beta_1 CAR_{it} + \beta_2 NPLR_{it} + \beta_3 AG_{it} + \beta_4 LR_{it} + \beta_6 LTAR_{it} + \beta_9 NIM_{it} + \beta_{10} NII_{it} \beta_{11} SIZE_{it} + \beta_{12} CIR_{it} + \beta_{13} DIV_{it} + \beta_{14} GRTH_{it} + \beta_{17} GDP_{it} + \beta_{18} INF_{it} + \beta_{19} FI_{it} + \beta_{20} RQ_{it} + \varepsilon_{it}$$

Dynamic Panel GMM Results

Based on the literature review, theoretical framework, and the results obtained from the GMM estimation shown in Table 3, the probability values of the t-statistics indicate that, at a significance level of 0.05, most of the independent variables significantly affect commercial bank stability (the dependent variable). However, X6 (Loan-to-Asset Ratio), X9 (NIM), and X14 (Growth Ratio) are not statistically significant in explaining bank stability in the sample of local banks.

Variable X2 (NPL), which is one of the indicators used to measure credit risk, shows a negative relationship with bank stability with a significance level of 0.0141. This finding is consistent with the studies of Asif Khan et al. (2020), Abuzayed et al. (2018), and Saif-Alyousfi et al. (2020), which emphasize that credit risk, measured by non-performing loans, represents one of the primary sources of banking instability. An increase in NPLs indicates that banks are facing difficulties in managing credit risk, which may eventually lead to financial distress.

Similarly, X3 (Asset Growth), which is also used as an indicator of credit risk, exhibits a negative significance level of < .001. This result is consistent with the findings of Ghenimi et al. (2017). Loan growth can reflect banks' ability to attract deposits and expand lending activities; however, excessive loan growth may increase risk exposure and affect financial stability.

Variable X12 (Efficiency) shows a positive significance level of 0.0422. This result is consistent with the findings of Ozili (2018), Hassan et al. (2019), Ali and Puah (2018), and Albaity et al. (2019), while contradicting the findings of Ghenimi et al. (2017). Bank efficiency may influence the risk-taking behavior of banks. In less competitive markets, managers may enjoy monopoly rents rather than exerting greater effort to improve efficiency. Consequently, inefficiencies may increase when competition is limited.

Variable X13 (Diversification) also exhibits a positive significance level of < .001. This finding is consistent with the results of Ghenimi, Chaibi, and Omri (2017), Albaity, Mallek, and Noman (2019), and El Moussawi Chawki et al. (2024), which indicate that diversification strategies can enhance economic opportunities, promote economic growth, and ultimately improve financial stability.

In addition, X19 (Financial Inclusion) shows a positive and significant relationship with bank stability at a significance level of 0.0065, which is consistent with the findings of Feghali et al. (2021). Financial inclusion improves the allocation of financial resources in the economy and facilitates the financing of productive investments in both physical and human capital.

Similarly, X20 (Regulatory Quality) has a positive and statistically significant relationship with bank stability at a significance level of 0.0069, which matches the findings of Boulanouar et al. (2021). This result highlights the important role of strong regulatory frameworks in reducing banking sector fragility and encouraging higher levels of foreign direct investment.

Regarding the remaining variables at the 5% significance level, X1 (CAR) shows a positive relationship with bank stability, while X4 (Liquidity Ratio) also has a positive relationship with the dependent variable. In contrast, X10 (NII) and X11 (Size) exhibit negative relationships with bank stability. Additionally, X14 (Growth Ratio) shows a positive relationship with the dependent variable, while X17 (GDP) demonstrates a positive relationship with bank stability and X18 (Inflation) shows a negative relationship.

The J-test statistic for the regression model shows a significance value of 0.158013, which supports the validity of the model and the suitability of the instruments used in measuring bank stability. Since the significance value of the J-statistic ($\geq$0.05) then we would not reject the null hypothesis that the overidentifying restrictions are satisfied or valid.

Since the value of "F test" is 369.3815 at a significant level less than (0.001), then we conclude that the independent variables were accepted in the model have been affected on the level of y. Since the significance value of the F-statistic is < 0.001, this supports the acceptance of the second hypothesis H2, which states that all research independent variables jointly have a statistically significant impact on banking sector Stability measured by the Z-score.

Model Diagnostics and Robustness

The model exhibits strong explanatory power, the coefficient of determination (R^2) shows a value of 92.4995%, the adjusted R^2value is 90.491%, which confirms the strong explanatory power of the model. With an R^2exceeding 90%, suggesting that bank-specific, macroeconomic, and institutional variables effectively capture the determinants of stability in local banks.

Table 3. Dynamic GMM results – Local Banks

Dependent Variable: ZSCOREY				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
ZSCOREY(-1)	0.946312	0.032394	29.21268	0
CAR	0.43564	0.16946	2.570754	0.011
NPLR	-0.537985	0.216666	-2.48302	0.0141
AG	-0.836583	0.116242	-7.196908	0
LR	0.380421	0.146996	2.58797	0.0106
LTAR	0.208667	0.114401	1.824003	0.0701
NIM	1.408663	0.816608	1.725016	0.0865
NII	-0.058717	0.023286	-2.521515	0.0127
SIZE	-0.864743	0.148951	-5.805553	0
CIR	0.016792	0.008203	2.047055	0.0422
DIV	0.045846	0.00881	5.204101	0
GRTH	0.062454	0.012457	5.013567	0 .0000
GDP	0.023	0.010516	2.187143	0.0301
INF	-0.084724	0.009884	-8.571833	0
FI	21.08961	7.65029	2.756707	0.0065
RQ	0.488217	0.678993	2.727576	0.0069
Effects Specification				
Cross-section fixed (first differences)				
Root MSE	3.482423	**R-squared**		0.924995
Mean dependent var	24.56571	**Adjusted R-squared**		0.90941
S.D. dependent var	12.74972	**S.E. of regression**		3.837444
Sum squared resid	2267.8	**Durbin-Watson stat**		0.348123
J-statistic	1.993144	**Instrument rank**		34
Prob(J-statistic)	0.158013	**F- Statistic**		369.3815
		Prob (F-Statistic)		0.000

**** Correlation is Significant at 0.01 level (2-tailed)*

*** Correlation is Significant at 0.05 level (2-tailed)*

** Correlation is Significant at 0.1 level (2-tailed)*

The Durbin–Watson statistic, which is used to detect the presence of autocorrelation in the residuals, shows a value of 0.348123, indicating the presence of positive autocorrelation in the model. However, the use of dynamic GMM mitigates potential biases arising from residual autocorrelation, supporting the consistency of the estimated coefficients.

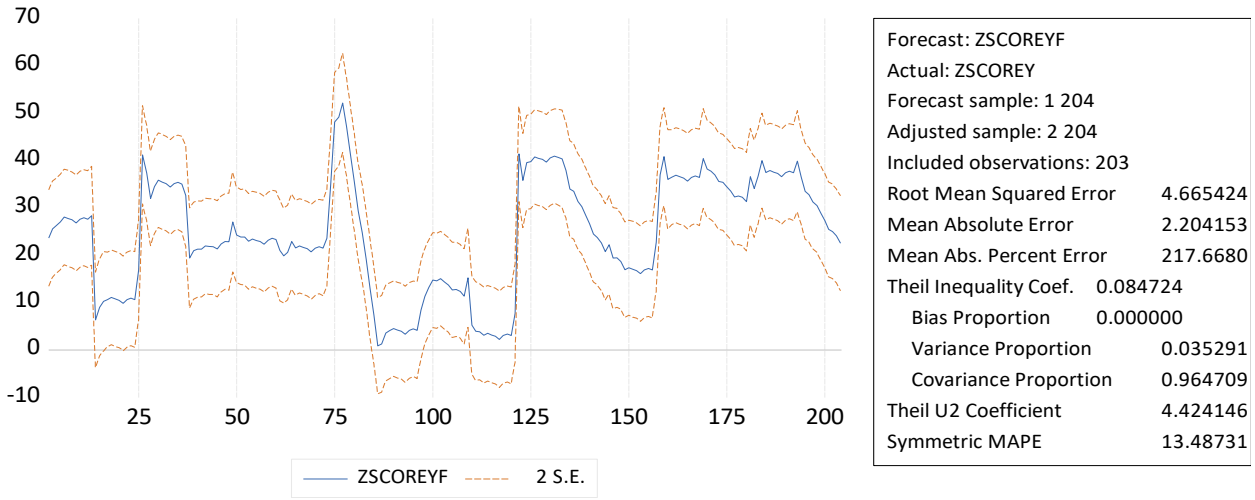

Figure 3. Forecasted against actual z-score for Model (2) – Local Banks

3.3 Model (3): Foreign Banks Subsample Analysis

This section presents the empirical findings for foreign-owned commercial banks operating in Egypt over the period 2011–2022.

Descriptive Statistics and Dynamic Panel GMM Results

The study relies on an unbalanced panel dataset. The Jarque–Bera test results indicate that most variables are normally distributed at a significance level less than 0.05, except for X1 (CAR), X4 (Liquidity Ratio), X8 (ROA), X9 (NIM), and X16 (Operating Risk), which are not normally distributed.

The Pearson correlation matrix for Model (3) indicates that the dependent variable is strongly correlated with most independent variables at the 0.01 significance level, except for X4 (Liquidity Ratio), X7 (ROE), and X10 (NII). These correlations between the dependent variable and the explanatory variables support the first research hypothesis, which states that there is a statistically significant relationship between the dependent variable and the independent variables. Therefore, the Pearson correlation matrix provides empirical support for accepting the first hypothesis.

After performing the VIF test to check the multicollinearity, we found there is a strong correlation between variables X5 (Liquidity Gap), X8 (ROA) and X16 (Operating Risk), where they are strongly correlated which means we have a multicollinearity problem, so as a remedy for this problem Variables X5, X8 and X16 have been removed from Model (3) regarding the test for Foreign Banks.

Following the diagnostic tests conducted as part of the empirical analysis, the dynamic specification of the model was determined based on the statistical evidence. The resulting empirical equation after omitting the variables to remove multicollinearity is presented below.

$$\text{ZSC-Foreign}_{it} = \alpha + \beta 1\ CAR_{it} + \beta 2\ NPLR_{it} + \beta 3\ AG_{it} + \beta 4\ LR_{it} + \beta 6\ LTAR_{it} + \beta 7 ROE_{it} + \beta 9 NIM_{it} + \beta 10\ NII_{it} + \beta 11\ SIZE_{it} + \beta 12\ CI_{it} + \beta 13 DIV_{it} + \beta 14 GRTH_{it} + \beta 15 LVRG_{it} + \beta 17\ GDP_{it} + \beta 18\ INF_{it} + \beta 19 FI_{it} + \beta 20\ RQ_{it} + \varepsilon_{it}$$

Dynamic Panel GMM Results

Based on the theoretical framework and the empirical results obtained from the GMM estimation shown in Table 4, the probability values of the t-statistics indicate that at a significance level of 0.05 most of the independent variables significantly affect commercial bankstability (the dependent variable). However, X4 (Liquidity Ratio), X7 (ROE), and X9 (NIM) are not statistically significant in explaining the dependent variable for the sample of foreign banks.

Variable X3 (Asset Growth), which is used as an indicator of credit risk, exhibits a negative relationship with bank stability with a significance level of 0.0022. This finding is consistent with the results reported by Ghenimi et al. (2017). Loan growth may reflect banks' ability to attract new deposits and expand lending activities; however, excessive loan growth may also increase risk exposure and affect financial stability. From another perspective, loan growth can represent an important mechanism through which banks manage risk-taking behavior.

Variable X12 (Efficiency) shows a positive significance level of < .001. This result is consistent with the findings of Ozili (2018), Hassan et al. (2019), Ali and Puah (2018), and Albaity et al. (2019), while contradicting the results of Ghenimi et al. (2017). Efficiency improvements may influence banks' risk-taking behavior and contribute to improved financial stability.

Similarly, X13 (Diversification) shows a positive significance level of < .0011, which is consistent with the findings of Ghenimi, Chaibi, and Omri (2017), Albaity, Mallek, and Noman (2019), and El Moussawi Chawki et al. (2024). Economic diversification may generate new opportunities, stimulate economic growth, and ultimately enhance financial stability.

Variable X19 (Financial Inclusion) exhibits a positive and statistically significant relationship with bank stability at a significance level of 0.0028. This finding is consistent with the findings of Feghali et al. (2021). Financial inclusion contributes to improving the efficiency of financial intermediation by mobilizing resources within the economy and enabling banks to fund productive investments.

In addition, X20 (Regulatory Quality) shows a positive and statistically significant relationship with bank stability at a significance level of 0.0249, which is consistent with the findings of Boulanouar et al. (2021). This result highlights the role of strong regulatory frameworks in reducing banking sector fragility and encouraging higher levels of foreign direct investment.

Regarding the remaining variables at the 5% significance level, X1 (CAR) has a positive relationship with the dependent variable, while X2 (NPL/Gross Loan) has a negative relationship with bank stability.X4 (Liquidity Ratio) and X6 (Loan-to-Assets) both show positive relationships with the dependent variable. Conversely, X10 (NII) and X11 (Size) exhibit negative relationships with bank stability.X14 (Growth Ratio) and X15 (Leverage) both show positive relationships with the dependent variable, while X17 (GDP) also has a positive relationship with bank stability. Finally, X18 (Inflation) shows a negative relationship with the dependent variable.

The J-test statistic for the regression model shows a significance value of 0.188604, indicating the validity of the model and confirming the suitability of the instruments used in estimating bank stability. Since the significance value of the J-statistic (≥0.05) then we would not reject the null hypothesis that the overidentifying restrictions are satisfied or valid.

Since the value of "F test" is 7.110249 at a significant level less than (0.001), then we conclude that the independent variables were accepted in the model have been affected on the level of y. Since the significance value of the F-statistic is < 0.001, this supports the acceptance of the second hypothesis H2, which states that all research independent variables jointly have a statistically significant impact on banking sector Stability measured by the Z-score.

Model Diagnostics and Robustness

The coefficient of determination (R^2) shows a value of 39.4029%. This indicates that the explanatory variables account for a moderate proportion of the variation in bank stability. The remaining percentage may be attributed either to random errors in the regression model or to other explanatory variables not included in the model. The adjusted R^2 value is 33.6798%, which may reflect the influence of macroeconomic conditions, particularly the unstable economic environment experienced in the Middle East during the study period. In measuring the standard error of regression, which reflects the deviation between the sample and the population, the value obtained is 2.73995, indicating that the sample adequately represents the population. Finally, the Durbin–Watson statistic shows a value of 1.456288, indicating that there is no evidence of serial autocorrelation in the regression residuals.

Explanation of SE of Regression

Table 4. Dynamic GMM results – Foreign Banks

Dependent Variable: ZSCOREY				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
CAR	1.937396	0.461007	4.20253	0
NPLR	-1.157656	0.292328	-3.96013	0 .0001
AG	-0.488656	0.157453	-3.103512	0.0022
LR	0.184431	0.193105	0.955083	0.3408
LTAR	0.428608	0.109754	3.905183	0 .0001
ROE	0.246855	0.230054	1.073031	0.2847
NIM	0.624249	0.914654	0.682497	0.4958
NII	-0.118328	0.04927	-2.401636	0.0173
SIZE	-11.41206	3.946487	-2.891702	0.0043
CIR	0.113262	0.01799	6.295974	0
DIV	0.097688	0.023759	4.111618	0 .0001

GRTH	0.598591	0.269385	2.222062	0.0275
LVRG	0.957331	0.349031	2.742822	0.0067
GDP	2.022376	0.600339	3.368723	0 .0009
INF	-1.062295	0.454465	-2.337463	0.0204
FI	112.4928	37.2117	3.023049	0.0028
RQ	2.889206	1.27878	2.259346	0.0249
C	-129.5544	70.90828	-1.82707	0.0693
			S.D.	**Rho**
Cross-section random			11.46779	0.569
Period random			9.596453	0.3984
Idiosyncratic random			2.74361	0.0326
	Weighted Statistics			
Root MSE	2.61244	**R-squared**		0.394029
Mean dependent var	1.617258	**Adjusted R-squared**		0.336798
S.D. dependent var	3.364494	**S.E. of regression**		2.73995
Sum squared resid	1351.319	**Durbin-Watson stat**		1.456288
J-statistic	3.336208	**Instrument rank**		20
		F- Statistic		7.110249
		Prob(F-Statistic)		0.0000
Prob(J-statistic)	0.188604			
	Unweighted Statistics			
R-squared	0.334578	**Mean dependent var**		32.88231
Sum squared resid	33893.18	**Durbin-Watson stat**		1.368505

**** Correlation is Significant at 0.01 level (2-tailed)*

*** Correlation is Significant at 0.05 level (2-tailed)*

** Correlation is Significant at 0.1 level (2-tailed)*

The relatively higher residual standard error observed in the local-bank specification was carefully considered. While the local-bank model reports a residual standard error of 3.80, this should be interpreted in relation to the dispersion of the dependent variable itself. The standard deviation of the Z-score for local banks is 12.85, making the residual standard error approximately 29.6% of the overall standard deviation of the dependent variable. By comparison, the corresponding ratios are approximately 13.1% for the all-banks model and 20.4% for the foreign-banks model.

The relatively greater residual variation in the local-bank specification may reflect the greater heterogeneity of domestic banks and their exposure to macroeconomic and institutional conditions during the study period which is clarified in the GMM model analysis. Importantly, the residual standard error should not be interpreted in isolation as evidence of an inadequate model, particularly without reference to the scale and dispersion of the dependent variable. Given the R2 of the Local Banks Model, which is the highest of the 3 models and which is illustrating the high explanatory power of the model? The model diagnostics and specification tests reported in the study provide the appropriate basis for assessing the adequacy and robustness of the estimated model.

Table 5 shows the standard deviation of the Z-score obtained from descriptive statistics analysis ,, the residual SE from Tables 2, 3, and 4 and the percentage Residual SE from the overall standard deviation of the dependent variable for the 3 Models .

Table 5. Percentage of Residual SE from the overall SD for the 3 Models

Model	SD of Z-score	Residual SE	RSE / SD
All banks	13.78	1.80	**13.1%**
Local banks	12.85	3.80	**29.6%**
Foreign banks	13.35	2.73	**20.4%**

4. Discussion

4.1 Evaluation of the Variables

The empirical findings provide several insights into the determinants of bank stability in Egypt

1- The positive coefficients of NIM across the three models suggest that traditional interest-based banking activities contribute positively to banking stability. In contrast, the negative and statistically significant coefficients of NII indicate that excessive reliance on non-interest income may increase risk and weaken stability, particularly in both local and foreign banks.

2- The positive significance of the Liquidity Gap (X5) in Model 1 for all banks suggests that effective management of asset–liability maturities enhances banking stability in the Egyptian banking sector by improving liquidity risk management.

3- The negative significance of both NPL (X2) and Asset Growth (X3) across the three models highlights the importance of prudent credit risk management. The findings suggest that excessive asset expansion may reflect relaxed lending standards and greater exposure to adverse selection, ultimately increasing both credit and liquidity risks In the Egyptian banking sector.

4- The negative significance of Bank Size (X11) in both the Local and Foreign Banks models suggests that excessive expansion may create managerial inefficiencies and increase operational complexity, thereby weakening banking stability.

5- The positive significance of the Efficiency Ratio (X12) across the three models indicates that operational efficiency enhances banking stability. This finding emphasizes the importance of managerial competence in reducing the likelihood of financial distress the Egyptian banking sector.

6- The statistical significance of the macroeconomic and institutional variables across the three models demonstrates that banking stability in Egypt is shaped not only by bank-specific characteristics but also by the broader macroeconomic environment and institutional reforms.

7- Despite employing a comprehensive set of bank-specific, macroeconomic, and institutional variables, the explanatory power of the Foreign Banks model remained considerably lower than that of the All Banks and Local Banks models. This suggests that foreign banks operating in Egypt are influenced by additional external factors beyond the domestic banking environment.

8- The Operating Risk variable was defined in accordance with the relevant literature as Net Income divided by Total Assets. Which is identical to the conventional Return on Assets (ROA) measure, it was adopted based on the definition used in the cited literature. However, following the multicollinearity assessment, this variable was excluded from all three model specifications.

4.2 Conclusion

Using stability in this study as a proxy for banking sector survival, the empirical results of the three estimated models provide important insights into the determinants of bank survival in Egypt and reveal notable differences between the full banking sample, local banks, and foreign banks. In Model (1), which includes all banks operating in Egypt, the results show that most bank-specific and macroeconomic variables significantly influence bank survival. The relatively high explanatory power of the model indicates that bank-specific financial indicators combined with macroeconomic factors provide a comprehensive explanation of banking sector Survival in Egypt.

When the analysis is restricted to local banks in Model (2), the results indicate an even stronger explanatory power of the determinants of Survival. Credit risk indicators such as non-performing loans and asset growth remain significant and negatively related to Survival, confirming that effective credit risk management is crucial for local banks. In addition, efficiency, diversification, financial inclusion, and regulatory quality continue to show positive and statistically significant relationships with bank survival. The results suggest that local banks are more sensitive to internal management factors and domestic economic conditions, particularly GDP growth and inflation. The very high R^2 value observed in this model indicates that the selected explanatory variables capture a substantial proportion of the variation in

survival among local banks.

In contrast, the results of Model (3), which focuses on foreign banks, show a relatively lower explanatory power compared with the other models. Although several determinants remain statistically significant—such as efficiency, diversification, financial inclusion, regulatory quality, credit risk indicators, and leverage—the overall R^2 value is lower, suggesting that foreign banks' survival may also be influenced by additional factors not fully captured in the model. This outcome may reflect the distinct operational characteristics of foreign banks, including access to international funding sources, stronger capital backing from parent institutions, and diversified global operations.

The models estimated for All Banks and Local Banks exhibited high explanatory power, suggesting that the selected variables capture a substantial proportion of the variation in bank survival within the Egyptian banking sector. In contrast, the Foreign Banks model demonstrated considerably lower explanatory power despite being estimated using the same comprehensive framework. This finding provides additional empirical evidence that the determinants of foreign bank survival are likely influenced by factors beyond those captured by domestic banking variables, including factors originating outside the Egyptian banking environment. This comparative insight constitutes one of the important contributions of the study and would not have been as evident had the explanatory variables been substantially reduced.

The comparison between the three models, shown in Table 6, highlights that while both internal bank-specific factors and macroeconomic variables play an important role in determiningbank survival in Egypt, their relative influence varies across ownership structures. Local banks appear to be more strongly affected by local financial and macroeconomic conditions, whereas foreign banks demonstrate greater resilience to these factors due to their international integration and diversified operational structures. These findings provide important policy implications, suggesting that regulatory authorities should consider ownership structure when designing survival-enhancing policies and supervisory frameworks within the Egyptian banking sector.

Table 6. Summary of the analysis of the three models

Independent Variables	**Full Sample Model (1)**		**Local Banks Model (2)**		**Foreign Banks Model (3)**	
	P Value	**Direction**	**P Value**	**Direction**	**P Value**	**Direction**
β1 CARit P-Value	0.0123	Positive	0.011	Positive	0	Positive
β2 NPLRit P-Value	0.0297	Negative	0.0141	Negative	0 .0001	Negative
β3 AGit P-Value	0.0095	Negative	0	Negative	0.0022	Negative
β4 LRit P-Value	0.0505	Positive	0.0106	Positive	0.3408	Positive
β5 LGit P-Value	0.0045	Positive	N/A	N/A	N/A	N/A
β6 LTARit P-Value	0.0112	Positive	0.0701	Positive	0.0001	Positive
β7 ROEit P-Value	0.0395	Positive	N/A	N/A	0.2847	Positive
β8 ROAit P-Value	N/A	N/A	N/A	N/A	N/A	N/A
β9 NIMit P-Value	0 .0003	Positive	0.0865	Positive	0.4958	Positive
β10 NIIit P-Value	0.0396	Negative	0.0127	Negative	0.0173	Negative
β11 SIZEit P-Value	N/A	N/A	0	Negative	0.0043	Negative
β12 CIRit P-Value	0.0233	Positive	0.0422	Positive	0	Positive
β13 DIVit P-Value	0.0292	Positive	0	Positive	0 .0001	Positive
β14GRTHit P-Value	0.026	Positive	0.7692	Positive	0.0275	Positive
β15 LVRGit P-Value	0.01	Positive	N/A	N/A	0.0067	Positive
β16 ORit P-Value	N/A	N/A	N/A	N/A	N/A	N/A
β 17GDPit P-Value	N/A	N/A	0.0301	Positive	0 .0009	Positive

β18INFit P-Value	0.0025	Negative	0	Negative	0.0204	Negative
β19FIit P-Value	0.0034	Positive	0.0065	Positive	0.0028	Positive
β 20RQit P-Value	0.0028	Positive	0.0069	Positive	0.0249	Positive
R2 of the model	0.76212		0.924995		0.394029	
J-Statistics (Prob)	0.251237		0.158013		0.188604	
Durbin Watson	1.481346		0.348123		1.456288	
F-Statistic	483.2790		369.3815		7.110249	
S.E. of Regression	1.818093		3.837444		2.73995	

Overall, the results demonstrate that bank survival in Egypt is shaped by a complex interaction between internal risk management practices, macroeconomic conditions, and institutional quality. The persistence of survival over time further indicates that past performance significantly affects current resilience, suggesting the presence of dynamic adjustment mechanisms and potential omitted structural factors.

4.3 Policy Implications and Recommendations

The findings of this study yield several policy implications for regulators, policymakers, and banking sector stakeholders. Importantly, the empirical results indicate that the determinants of banking stability vary across ownership structures. Accordingly, policy and supervisory measures should consider these differences rather than adopting a uniform approach across all banks operating in Egypt.

First, the findings highlight the importance of strengthening macroeconomic and institutional conditions that support banking stability. The statistically significant relationships observed for inflation, financial inclusion, and regulatory quality across the model specifications indicates that macroeconomic stability and institutional effectiveness are relevant to the resilience of the banking sector. Accordingly, the Central Bank of Egypt (CBE), within its monetary and supervisory mandate, should continue to strengthen its monitoring of macro-financial conditions and the transmission of macroeconomic shocks to banks, while maintaining an effective prudential and regulatory framework. Particular attention should be given to indicators that may signal emerging pressures on bank stability, especially during periods of heightened macroeconomic volatility.

Second, the results indicate that local banks are more sensitive to domestic financial and macroeconomic conditions. The findings therefore suggest that supervisory attention toward local banks should place particular emphasis on credit-risk management, asset-growth quality, income diversification, and exposure to domestic macroeconomic developments. The significant relationship between credit-risk indicators and bank stability highlights the importance of maintaining effective monitoring of asset quality and risk-management practices. Similarly, the significant role of diversification and asset growth suggests that sustainable expansion and diversified sources of income may contribute to greater resilience among domestic banks.

Third, the findings for foreign banks indicate a comparatively greater resilience to domestic conditions, which may reflect their international integration and access to resources and expertise from parent institutions. For these banks, supervisory attention should therefore continue to emphasize operational efficiency, governance, risk-management practices, and the potential transmission of external or parent-bank-related risks to their Egyptian operations. Greater attention to the diversification of ownership and funding structures may also help reduce concentration and region-specific risks.

Fourth, the significant positive association between regulatory quality and banking stability across the model specifications underscores the importance of maintaining an effective and predictable regulatory environment. The findings support continued efforts to strengthen supervisory effectiveness, regulatory transparency, and the consistency of prudential requirements. Such measures can contribute to a more resilient banking sector by reducing institutional vulnerabilities and supporting sound risk-management practices.

Fifth, the significant positive relationship between financial inclusion and banking stability provides a direct policy implication for the CBE. Policies that expand access to formal financial services can strengthen the banking sector by broadening the deposit base, increasing participation in the formal financial system, and reducing reliance on informal financial channels. Accordingly, continued development of digital payment infrastructure, mobile financial services, financial literacy, and access to formal banking services may contribute not only to broader financial inclusion but also to banking-sector resilience. In recent years, the Central Bank of Egypt (CBE) has launched several initiatives in line with Egypt Vision 2030 to promote financial inclusion and accelerate the transition toward a more digitally integrated financial system. These initiatives include expanding electronic payment systems, issuing millions of payment cards for government employees and pension recipients, increasing the number of ATMs and point-of-sale (POS) terminals,

promoting mobile wallets and digital payment services, supporting microfinance institutions, and encouraging cashless transactions. The CBE has also introduced regulatory reforms to facilitate mobile

Payments, remittances, and digital financial services while promoting financial literacy and broader access to banking services. Continuing these initiatives, together with further investment in digital financial infrastructure and financial education, is expected to strengthen bank survival, enhance financial resilience, and support the long-term sustainability of the Egyptian banking sector.

Sixth, the differences observed between local and foreign banks suggest that supervisory policies should incorporate ownership-specific risk considerations. While system-wide prudential standards remain necessary, the results indicate that the relative importance of individual determinants of stability differs across ownership structures. A more differentiated supervisory approach can therefore allow regulatory authorities to place greater emphasis on the risk factors that are empirically more relevant to each category of banks.

Finally, the results concerning income composition suggest that banks should strengthen the stability of their core intermediation activities while managing exposure to more volatile income sources. Maintaining a balanced and sustainable income structure may enhance earnings stability and strengthen banks' ability to absorb adverse shocks. From a supervisory perspective, monitoring the sustainability and quality of bank earnings can therefore complement traditional capital and credit-risk indicators in assessing overall banking resilience.

Overall, the empirical findings suggest that policies aimed at strengthening banking stability in Egypt should combine system-wide macro-financial and institutional measures with ownership-specific supervisory considerations. The evidence from the three model specifications indicates that banking stability is shaped by the interaction of bank-specific characteristics, macroeconomic conditions, financial inclusion, and institutional quality. Accordingly, policy interventions should be aligned with the specific determinants identified by the empirical results rather than relying solely on a uniform policy framework.

4.4 Limitations and Directions for Future Research

Despite its contributions, this study is subject to certain limitations. The analysis is confined to observable bank-specific and macroeconomic variables, while political risk, governance quality, and global financial spillovers are not explicitly modeled. In addition to the fact that no comparative analysis was made before and after the strategic decision of currency flotation in Egypt in 2016. Future research may extend this framework by incorporating political stability indicators, parent-bank characteristics, and stress-testing methodologies to provide deeper insights into systemic resilience. Where Currency flotation would require an event-based before-and-after framework with sufficiently long observation windows on both sides of the devaluation episode, followed by comparative analysis of bank stability. Political instability, by contrast, would require a different temporal framework based on the identification and comparison of relevant periods or waves of political unrest. These analytical requirements extend beyond the scope and research question of the present study, which examines the determinants of bank stability over the 2011–2022 period and compares local and foreign banks.

Acknowledgments

Not Applicable

Author contributions

The author was responsible for the conceptualization and design of the study, literature review, data preparation and analysis, econometric modeling, interpretation of the results, and drafting and revising the manuscript. The author read and approved the final version of the manuscript.

Funding

Not Applicable

Competing interests

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

Informed consent

Not Applicable

Ethics approval

Not Applicable

Provenance and peer review

Not commissioned; externally double-blind peer reviewed.

Data availability statement

Not Applicable

Data sharing statement

Not Applicable

Open access

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