

# Risk Absorption Capacity and Financial Sustainability Under Macro-Financial Shocks Evidence from Iraqi Private Banks Listed on the Iraq Stock Exchange 2015 to 2025

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## Abstract

The present research will assess the presence of risk absorption capacity that will enhance financial sustainability of Iraqi private banks that are listed in the Iraq Stock Exchange in a common macro-financial shock environment in 2015 2025. The Capital Adequacy Ratio (CAR) and Non-Performing Loans ratio (NPL) serve as a proxy of risk absorption capacity, and the bank Z-Score serves as a stability measure and the Loan-to-Deposit Ratio (LDR) serves as a measure of funding-structure. The empirical design is first used to ensure cross-sectional dependence, which asserted that the variables under study are significantly co-moved among banks, which is in line with usual macro-financial circumstances. The Pesaran CIPS unit root test which explicitly considers the cross-sectional dependence is then used to test stationarity where the findings indicate that level variables should be used. The dynamic interrelationships are represented using a Structural Panel VAR whose optimal lag length is determined using a set of



standard information criteria. The estimated impulse response and historical decomposition have suggested that the sustainability dynamic is driven by own innovations and internal buffers and credit-risks conditions and therefore sustainability in the Iraqi banks is influenced by the interaction between solvency, asset-quality and funding channels other than the bank-specific movement. In general, the results suggest that capital adequacy and asset quality have been found to be the key resilience mechanisms, which determine the adjustment path of the stability and funding pressure during macro-financial shocks and they have direct implications to supervisory capital planning, credit risk management, and stress management on the sector level.

**Keywords:** Risk absorption capacity; Financial sustainability; Structural panel VAR; Cross-sectional dependence; Iraqi private banks

## **1. Introduction:**

The Iraqi private banks are at a place in which balance sheets are subject to recurring macro-financial shocks that propagated fast via credit quality, funding conditions and confidence in the market and as such, financial sustainability is a core policy and managerial goal and not an accounting performance. art542222. The recent global experience has revealed that systemic stress events like the COVID-19 shock reveal both the influence of capital and liquidity buffers on resilience and the effect of regulatory systems on increasing or reducing stress propagation through the banking system (Elnahass et al., 2021; Duncan et al., 2022). In this context, risk absorption capacity refers to the internal capacity of the banks to absorb the losses and continue the basic intermediation activities, which are always attributed to the solvency risk, the interconnected fragility, and the market discipline in the current banking studies (Chen, 2022; Cicchiello et al., 2022; Velliscig et al., 2023). Meanwhile, shock-induced sustainability cannot only be a matter of profitability, but also funding stability, and liquidity pressure, as banks might insure

incomes at the expense of refinancing risk or liquidity mismatch, in particular when uncertainty is high and banks hoard liquidity (Baros et al., 2023; Danisman and Tarazi, 2024; Lu et al., 2023). Such mechanisms are more applicable in new and oil-potential economies with widespread macro events capable of creating cross-sectional dependence of the banks and coordinate pattern movements in balance-sheet ratios necessitating empirical designs that explicitly consider shared shocks and adjust dynamically (Pham et al., 2021; Zhou et al., 2024). On the basis of this literature, the current research problem is whether enhanced risk absorption capacity contributes to the sustainability of one-year increased geopolitical risk, policy uncertainty, and the competitive pressure is helpful in maintaining the stability of Iraqi private banks listed on the Iraq Stock Exchange in 2015–2025 through capital adequacy and non-performing loans as a medium of absorption, and Z-score and the bank-to-deposit ratio as complementary indicators of the bank financial sustainability.

## **1.2 Research problem:**

The research problem is created due to the fact that the exposure of Iraqi privately-owned banks to macro-financial shocks continues to repeatedly shift the bank balance sheets in a synchronized manner and generates joint pressure on capital adequacy, credit quality, and funding stability and the available empirical evidence on Iraq is still limited to determine whether the capacity to absorb internal risks actually cushions financial sustainability under the common shocks throughout a stable post-2014 period. This endogeneity is magnified by the fact that a capital ratio and non-performing loans can be an endogenous response to stress and managerial decisions, and therefore the observed stability results could be due to the intensity of the shock and internal agglomeration of the banks rather than the obvious cushioning effect. Consequently, the policymakers and practitioners have no clear assessment of the extent to which capital adequacy and asset quality can mitigate the effect of

macro-financial shocks on bank sustainability, with sustainability being a joint measure between insolvency risk and funding structure, and specific to Iraq.

### **Main research question**

To what extent does risk absorption capacity mitigate the impact of macro-financial shocks on the financial sustainability of Iraqi private banks listed on the Iraq Stock Exchange during 2015 to 2025?

#### **Sub-questions**

How does capital adequacy influence bank financial sustainability as measured by ZScore and LDR over 2015 to 2025?

How does asset quality measured by the NPL ratio affect bank financial sustainability over the same period?

Does the interaction between risk absorption capacity and macro-financial shocks significantly change the strength and direction of the relationship between risk absorption capacity and financial sustainability?

### **1.3 Hypothesis:**

#### **Main hypothesis**

H1. Risk absorption capacity significantly improves the financial sustainability of Iraqi private banks listed on the Iraq Stock Exchange over 2015 to 2025.

#### **Sub-hypotheses**

H1a. Capital adequacy measured by CAR has a positive and statistically significant effect on bank financial sustainability, increasing ZScore and improving funding stability as reflected in LDR.

H1b. Asset quality measured by the NPL ratio has a negative and statistically significant effect on bank financial sustainability, decreasing ZScore and worsening funding stability as reflected in LDR.

H1c. Macro-financial shocks significantly moderate the relationship between risk absorption capacity and financial sustainability, such that stronger risk absorption capacity weakens

the adverse effect of shocks on ZScore and limits deterioration in LDR.

#### **1.4 Literature Review:**

In recent banking studies, resilience is considered to be a combined effect of solvency buffers, asset quality and funding conditions that interact with macro-financial stress particularly following the COVID-19 period where rapid transmission of shocks through profitability, credit risk and liquidity channels were observed (Elnahass et al., 2021; Duncan et al., 2022).

Another stream of the literature demonstrates that capital buffers are relevant to stability; and that feeble capitalization is likely to intensify interconnected risk and market discipline pressures (Chen, 2022; Velliscig et al., 2023). The other thread is the focus on the fact that asset quality degradation as suggested by non-performing loans is a key way in which shocks remain continually corrosive to banks, and the relationship between NPLs and buffers both together determine resilience and risk-taking (Cicchello et al., 2022). Simultaneously, in the post-2020 literature, it has become common to associate liquidity management and funding structures with stability as banks can act in response to stress by hoarding liquidity and changing the supply of credit, which shifts systemic risk in addition to the sustainability of intermediation despite a stable headline profitability (Baros et al., 2023; Lu et al., 2023). Bank stability and lending behaviour have been also found to be conditioned by macro uncertainty and geopolitical risk, meaning that the same internal buffer may be more or less effective in the other shock regime and persistent (Phan et al., 2022; Shabir et al., 2022; Danisman and Tarazi, 2024). In approach, most research uses dynamic panel models to deal with persistence in banking performance and endogeneity between buffers and performance, with System GMM commonly being a standard model of bank stability in multi-bank panels (Pham et al., 2021), although more recent studies emphasise the need to consider common shocks and cross-sectional dependence when

banks operate in the same macro environment (Zhou et al., 2024). The study enhances the literature by offering Iraq-specific evidence of how the risk absorption capacity is converted to financial sustainability when operating in both an oil sensitive and synchronized stress environment which remains under-represented in the post-2020 empirical banking literature. It achieves this through a parsimonious framework that relates two indicators of absorption to two complementary sustainability outcomes, a stability measure, which is the insolvency risk, and a funding-structure measure, which is the loan-deposit reliance, and lets the separation of solvency resilience and funding sustainability take place instead of bank performance being a single dimension (Cicchello et al., 2022; Baros et al., 2023). The design directly verifies the use of buffers as shock absorbers through the introduction of an interaction between risk absorption capacity and macro-financial stress by regimes by incorporating uncertainty and stress regimes (Danisman and Tarazi, 2024; Phan et al., 2022). The research empirically enhances identification by identifying cross-sectional dependence and using panel techniques that address dynamic adjustment and possible endogeneity, which allows inference that is more believable to exist about whether higher capital and better asset quality mitigate shock transmission to sustainability in a small panel of emerging market banking (Pham et al., 2021; Zhou et al., 2024; Chen, 2022).

### **1.5 Spatial and temporal limits:**

The spatial aspect of this paper is confined to the Iraqi private banking industry that is represented by banks listed on the Iraq Stock Exchange, and the temporal aspect is the annual period running between 2015 and 2025. This restriction makes scientific sense in that listed banks have the most consistent and comparable disclosures required to build CAR, NPL, ZScore and LDR based on audited financial reports and standardized reporting notes that enhances the validity of measurement and mitigates the bias of missing-data over non-listed institutions. Besides this, the listing

requirement of the Iraq Stock Exchange and market discipline result in relatively homogeneous disclosure environment, which promotes the panel comparability across time and across banks, even though capital buffers, asset quality, and funding structure can vary meaningfully across cross-section. The six banks are also selected because of their perpetual existence and data accessibility during the study period, which allows a balanced panel structure and enhances the inferential power in dynamic specifications with gaps in reporting potentially biasing persistence and shock transmission estimates. Lastly, the period selection of 2015 to 2025 has a variety of macro-financial periods that apply to Iraq such as stresses induced by oil prices, the COVID-19 shock period, and years of the adjustment period, which gives enough variation in the environment of shocks to test whether risk absorption capacity can be described as a stabilizing buffer in the event of changing stress conditions.

### **1.6 Data:**

The researchers operationalise risk absorption capacity by two internal buffers which are directly measurable in audited disclosure of listed banks in Iraq. The Capital Adequacy Ratio (CAR), which is the sum of regulatory capital Tier 1 and Tier 2 divided by the risk weighted assets, is the measure of capital adequacy, and it represents the loss absorbing margin of the bank in unfavorable situations. Asset quality is determined by Non Performing Loans ratio (NPL), a ratio of non performing loans over total loans and it is used to determine how poor credit portfolios have been sustained and hence how well a bank can endure additional impairment in the time of stress. Two complementary outcomes correspond to financial sustainability. The stability of the bank is first estimated using the Z score as the result of the sum of the return on assets and equity to assets ratio divided by the standard deviation of the return on assets since, the greater the bank is profitable and capitalized, the greater the buffer is against the earnings variation. Second, sustainability of funding

and liquidity strain is reflected in the Loan to Deposit Ratio (LDR) (total loans divided by total deposits), with higher ratios generally indicating increased dependence on less stable funding and a tighter liquidity position, and more moderate ratios reflecting an intermediation position. All ratios are developed on an annual basis based on the report of the financial statements and notes published by the banks and inputs of the Z score are calculated annually through the 2015 to 2025 panel to enable comparability between the banks and the period.

**Table 1.**

**Variable Definitions, Measurement, and Data Sources**

Item type	Code	Name	Measurement	Primary source
Variable	CAR	Capital Adequacy Ratio	$(\text{Tier 1} + \text{Tier 2}) \div \text{Risk Weighted Assets}$	Bank annual reports and Basel Pillar 3 or capital adequacy disclosures. Central Bank of Iraq prudential reporting where available.
Variable	NPL	Non Performing Loans Ratio	$\text{Non performing loans} \div \text{Total loans}$	Notes to the financial statements on credit risk and loan classification. Bank annual reports.
Variable	ZScore	Bank Z Score	$(\text{ROA} + \text{Equity to Assets}) \div \text{standard deviation of ROA}$	Computed by the author from audited financial statements. ROA from income statement. Equity and assets from balance sheet.
Variable	LDR	Loan to Deposit Ratio	$\text{Total loans} \div \text{Total deposits}$	Balance sheet items in audited financial statements. Bank annual reports.
Bank	BBOB	Bank of Baghdad	Study bank identifier used in the panel	Iraq Stock Exchange issuer disclosures and the bank annual reports.

Bank	BIB	Iraqi Investment Bank	Study bank identifier used in the panel	Iraq Stock Exchange issuer disclosures and the bank annual reports.
Bank	BMEI	Middle East Investment Bank	Study bank identifier used in the panel	Iraq Stock Exchange issuer disclosures and the bank annual reports.
Bank	BASH	Ashur International Bank	Study bank identifier used in the panel	Iraq Stock Exchange issuer disclosures and the bank annual reports.
Bank	BKIB	Kurdistan International Bank	Study bank identifier used in the panel	Iraq Stock Exchange issuer disclosures and the bank annual reports.
Bank	BCBI	Credit Bank of Iraq	Study bank identifier used in the panel	Iraq Stock Exchange issuer disclosures and the bank annual reports.

CAR, NPL, LDR, ROA, equity, total assets, and risk-weighted assets were retrieved from audited annual reports and the accompanying notes, complemented by Iraq Stock Exchange issuer disclosures and Central Bank of Iraq prudential and capital adequacy disclosures when they were available for the same bank-year. The operational rule was “audited first, regulator second, market disclosure as a cross-check”. For CAR in particular, the study did not rely on a single unverified figure. If the annual report (or Pillar 3 / capital adequacy note) disclosed CAR explicitly, the disclosed value was recorded and then validated against the underlying components where possible. If CAR was not stated clearly, the researchers computed it from the regulatory definition using the disclosed components. Regulatory capital equals Tier 1 plus Tier 2. The denominator equals risk-weighted assets. This makes the measurement decision transparent. It also answers whether CAR was “calculated by the researcher or taken ready”. The measurement approach is hybrid but rule-based. The primary value comes from audited disclosures. The researchers recalculated CAR when component-level disclosure allowed it or when the reported figure required verification for comparability across banks and years. Any discrepancy triggered re-checking the notes and ensuring the same definition was applied across the

2015–2025 panel.

For the Z-Score comment, the denominator requires an explicit volatility estimate, so the study now specifies both the formula and the exact window used with annual data. Z-Score is measured as  $(ROA + \text{equity-to-assets})$  divided by  $\sigma(ROA)$ . ROA comes from the income statement and total assets from the balance sheet. Equity-to-assets uses end-of-year equity and end-of-year total assets, taken from audited statements to avoid mixing measurement bases. The standard deviation term  $\sigma(ROA)$  was computed as within-bank earnings volatility using a fixed rolling window rather than a full-sample standard deviation. This avoids look-ahead bias and preserves time variation in risk. Concretely, for each bank and year  $t$ ,  $\sigma(ROA)_t$  equals the standard deviation of annual ROA over the last three observations ( $t-2, t-1, t$ ). The window length of three years is deliberate in a short annual panel. It balances two constraints. First, annual data provide limited observations, so long windows dilute changes in risk and can dominate the numerator mechanically. Second, very short windows can become noisy, so a three-year window provides a stable but still responsive volatility proxy. The calculation uses the standard sample standard deviation within each bank's rolling window and is updated each year so that  $\sigma(ROA)_t$  reflects information available up to year  $t$  only. For the first two years of each bank series where a three-year window is not available, the study applies a consistent start-up rule by beginning Z-Score computation once the minimum window is met, maintaining definitional consistency across banks. This directly clarifies “how the standard deviation was computed” and “what period was used”, and it makes the Z-Score fully reproducible from the disclosed annual statements.

## **2. The theoretical concept of the research:**

### **2.1 Internal Buffer of Risk Absorption Capacity.**

Risk absorption capacity indicates how well a bank can absorb the loss that it was not expecting to incur without undermining its

essential intermediation role. Capital adequacy, in prudential terms, reflects the magnitude and quality of loss-absorbing resources with respect to risk exposure and, therefore, greater capital buffers should provide decreased vulnerability as credit losses increase or market confidence declines (Chen, 2022; Duncan et al., 2022; Velliscig et al., 2023). Under pressure, this notion gains greater significance since the same shock may have tremendously different effects based on the available capital headroom of a bank to drive up impairments and continue operating within regulatory boundaries (Baros et al., 2023; Pham et al., 2021).

A second risk absorption capacity pillar is asset quality since the shocks typically make their way into bank balance sheets in assets in terms of credit risks and loan impairment (Ali et al., 2024). The non-performing loans ratio provides the picture of long-standing flaws in screening, monitoring, and recovery, and it shows how an initial shock can be converted into the achieved losses (Alakkari, 2023) and increased provisions depleting capital and profitability (Cicchello et al., 2022; Elnahass et al., 2021). Increasing NPLs can prompt banks to tighten credit, hoard liquidity, or reprice portfolios which can continue to drag the negative risk-sustainability cycle in an economy with repeated stress episodes, particularly in the emerging banking systems (Lu et al., 2023; Shabir et al., 2022).

## **2.2 Financial Sustainability as Funding and Stability Resilience.**

Financial sustainability in banking is not a single performance ratio that needs to be considered as a multidimensional construct. A stability-based perspective gives emphasis on the insolvency probability and the ability to generate profits without becoming undercapitalized which is in line with the Z-score logic that incorporates profitability, capital structure and earnings volatility into a single resilience measure (Pham et al., 2021; Chen, 2022).

Such framing is aligned with evidence post-2020 that stability is a product of the interaction of income and capital during stress as opposed to profitability itself, since shocks may squeeze earnings at the same time and rise volatility (Elnahass et al., 2021; Duncan et al., 2022).

One of the complementary perspectives explains sustainability as the sustainability of financing and liquidity position of the bank. The loan-to-deposit ratio is a summary of the aggressiveness with which a bank converts deposits into credit, and larger values tend to be a sign of tighter liquidity conditions and increased dependence on less stable funding in times of stress, which can exacerbate fragility in spite of seemingly sufficient capital ratios (Baros et al., 2023; Lu et al., 2023). This view is consistent with current results according to which banks in an uncertain environment can be characterized by a trade-off between continuing to lend and ensuring liquidity, and sustainability means that banks are not necessarily the ones that develop by any possible cost, but with balanced funding (Danisman and Tarazi, 2024; Tran, 2024).

### **2.3 Macro-Financial Shock Transmission and Buffering Mechanism.**

Macro-financial shocks are typical disturbances, which manifest simultaneously in many banks using oil-based income channels, inflation and interest rate factors, exchange-rate pass-through, and changes in confidence, which do change deposit behaviour and credit risk. Since banks are exposed to the same macro environment, cross-sectional dependence in the outcomes is common i.e. common shocks may coordinate movements in capital adequacy, NPLs and funding ratios even when the management of the banks is bank specific (Zhou et al., 2024; Danisman and Tarazi, 2024). This encourages the theoretical focus on the transmission systemic, in which the main question is whether internal buffers modulate the susceptibility of

sustainability to the shock environment (Phan et al., 2022; Shabir et al., 2022).

Theoretical prediction of central effect is moderating one. Capacity to absorb risk should mitigate the negative effect of shocks on sustainability since capital and asset-quality well-being decrease the amplification of losses and sustain intermediation during stress. This buffering logic is empirically described by an interaction between shock condition and absorption indicators and applicable to the recent banking literature that characterizes stability as a dynamic process with feedback between past performances and present risk choices and usually necessitates dynamic panel designs (Pham et al., 2021; Cicchiello et al., 2022). Within this approach, sustainability is better when buffers are large, but buffers are also effective at times when the stress is high, and this is the fundamental theory that was tested in the study (Duncan et al., 2022; Velliscig et al., 2023).

### 3. Discussion and results:

The empirical analysis relies on an annual balanced panel of six Iraqi private banks over 2015–2025 and applies a dynamic panel framework to capture persistence in bank sustainability and to reduce simultaneity bias between internal buffers and outcomes. The baseline specification models financial sustainability as a function of its own lag, risk absorption capacity, macro-financial stress, and a moderation channel that tests whether buffers weaken shock transmission (Baltagi, 2021).

$$FS_{it} = \alpha FS_{it-1} + \beta_1 CAR_{it} + \beta_2 NPL_{it} + \beta_3 Shock_t + \beta_4 (CAR_{it} \times Shock_t) + \beta_5 (NPL_{it} \times Shock_t) + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

Because banks operate under shared macro conditions, the analysis first evaluates cross-sectional dependence to verify whether common shocks generate correlated residuals across banks. The Breusch–Pagan LM statistic is computed from pairwise correlation estimates after removing cross-section means,

and rejection of the null implies that estimators assuming independence would be mis-specified (Pesaran, 2021).

$$LM = \sum_i <_j T \hat{\rho}_{ij}^2 \quad (2)$$

Given evidence of cross-sectional dependence, stationarity is assessed using Pesaran's CIPS logic built on cross-section augmented Dickey–Fuller regressions, allowing the unit root decision to remain valid under common-factor type dependence. The procedure estimates a CADF regression for each bank, then averages the corresponding t-statistics to form the CIPS statistic, where rejection supports working with stationary series in levels for dynamic modelling (Baltagi, 2021).

$$\Delta y_{it} = a_i + b_i y_{it-1} + c_i \bar{y}_{t-1} + \sum_{j=1}^p d_{ij} \Delta y_{it-j} + \sum_{j=0}^p e_{ij} \Delta \bar{y}_{t-j} + u_{it}$$

$$CIPS = (1/N) \sum_{i=1}^N t_i(b_i) \quad (3)$$

Model estimation is implemented using System GMM to address dynamic persistence and potential endogeneity of capital adequacy and credit risk, relying on internal instruments built from suitable lags and validated through standard specification diagnostics. Inference is supported by modern GMM results that emphasize reliable testing and variance estimation under clustered or dependent structures, which is relevant when panels are small and dependence is non-trivial (Hwang, 2021).

$$E[Z_{it}' \varepsilon_{it}] = 0 \quad (4)$$

To complement the single-equation sustainability model, the analysis can also summarize joint dynamics among sustainability and buffer variables using a panel vector autoregression that treats all core variables as endogenous and traces shock propagation through impulse responses and variance decomposition. The PVAR representation captures feedback loops between stability and risk absorption indicators while retaining fixed effects and dynamic adjustment (Sigmund & Ferstl, 2021).

$$y_{it} = A_1 y_{it-1} + A_2 y_{it-2} + \dots + A_p y_{it-p} + \mu_i + \lambda_t + u_{it} \quad (5)$$

**Table 2.**  
**Descriptive Statistics for Study Variables for Iraqi Private Banks 2015 to 2025**

	ZSCORE	CAR	LDR	NPL
Mean	19.35515	14.81439	75.05697	12.22682
Median	19.68000	14.73500	74.95500	12.52500
Maximum	25.52000	17.36000	83.49000	16.72000
Minimum	12.83000	12.25000	66.66000	7.830000
Std. Dev.	2.706554	1.253873	4.081531	2.127033
Skewness	-0.266445	0.294835	0.069339	-0.023088
Kurtosis	2.275547	2.381110	2.686389	2.306484
Jarque-Bera	2.224208	2.009524	0.323354	1.328515
Probability	0.328866	0.366132	0.850716	0.514656
Observations	66	66	66	66

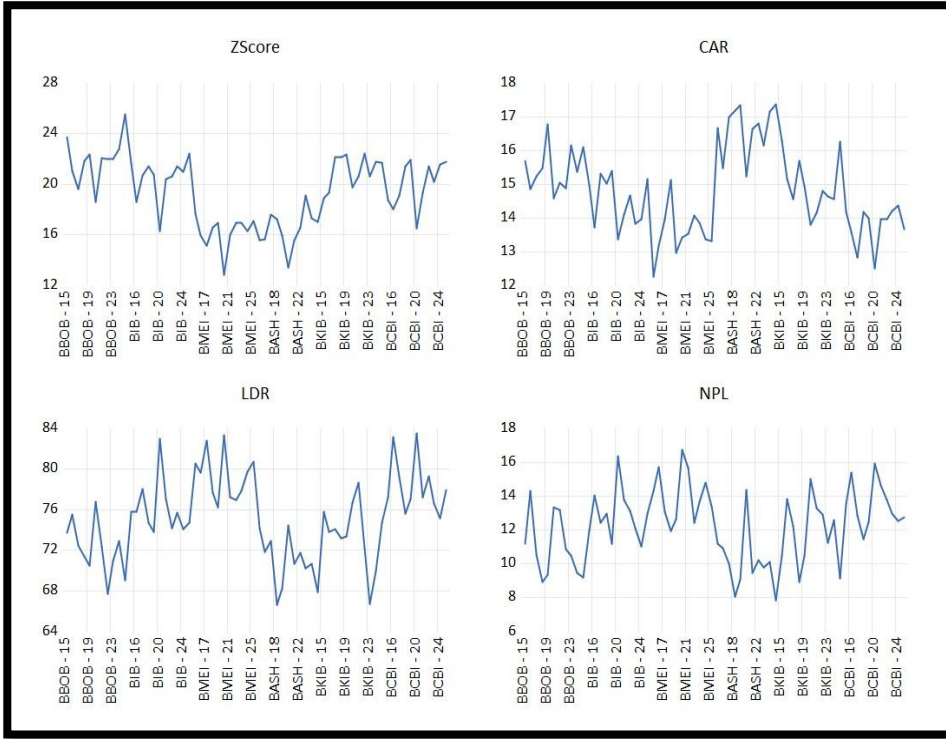
**Source: Prepared by the researcher based on data from Iraqi banks using EViews13**

The distributional properties of the four core constructs applied in the analysis (which include Financial Sustainability and Risk Absorption Capacity, and Funding Structure) are reported in Table 2 where Bank Stability (ZScore) and Funding Structure (Loan-to-Deposit Ratio) explain Financial Sustainability, and Capital Adequacy (CAR) and Asset Quality (NPL) explain Risk Absorption Capacity. The sample indicates that the mean ZScore is 19.355 and the standard deviation is 2.707 and the range is 12.830 to 25.520, so there is significant variation in the place of stability across the

bank-year observations and not a mechanically stable ratio. The mean of CAR is 14.814 with 1.254 standard deviation implying different capital headroom across the banks. LDR has the average of 75.057 with a standard deviation of 4.082 and a range of 66.660 to 83.490 which is also in line with a heterogeneous funding pressure and intermediation intensity. The mean of NPL is 12.227 with a standard deviation of 2.127 with a range of 7.830 to 16.720 which confirms that NPL has a high cross-bank dispersion in the risk of credit. The Jarque-Bra statistics of ZScore 0.329, CAR 0.366, LDR 0.851 and NPL 0.515 do not reveal that there are severe deviations of normality in the pooled sample, and this implies that further residual-based diagnostics are interpretable in the VAR context.

Figure 1 captures the dynamics of the bank-years of ZScore, CAR, LDR and NPL of the six listed banks between 2015 and 2025 and brings out two empirically pertinent features that would be used subsequently in the modelling. First, the series display obvious time-varying motions and heterogeneity of banks instead of flat trends, which is in line with an environment where the joint influence of common macro conditions and bank-specific decision-making determine stability, capitalization, liquidity position, and credit quality. Second, the pattern of co-movement can be economically explained: higher levels of NPL are observed to coincide with less optimal stability profile in ZScore and with changes in LDR whereas CAR varies in a manner that may be interpreted as active adjustment of the balance sheet as opposed to a buffer. This visual data inspires a collaborative dynamic model since it seems that sustainability and absorption

measures are developing in tandem, and they are likely to be self-sustaining in their influence.



**Figure 1**

**Dynamics of ZScore CAR LDR and NPL Across Banks Over 2015 to2025**

**Source:** Prepared by the researcher based on data from Iraqi banks using EViews13

**Table 3**

**Cross-Section Dependence Test Results Breusch-Pagan LM for Study Variables**

Variable code	Test information	d.f.	LM statistic	Prob.
CAR	Breusch–Pagan LM Cross Section Dependence Test	15	30.33066	0.0108

LDR	Breusch–Pagan LM Cross Section Dependence Test	15	46.99182	0.0000
NPL	Breusch–Pagan LM Cross Section Dependence Test	15	92.85569	0.0000
ZSCORE	Breusch–Pagan LM Cross Section Dependence Test	15	65.53490	0.0000

**Source:** Prepared by the researcher based on data from Iraqi banks using EViews13

Table 3 affirms that the variable of the panel is not independent among banks, as it is anticipated given the fact that all the banks are exposed to the same macro-financial environment. Pagan LM test rejects the null of no cross-section dependence of CAR LM 30.331 p-value 0.011 and strongly rejects the null of no cross-section dependence of LDR LM 46.992 p-value 0.000 and NPL LM 92.856 p-value 0.000 and ZScore LM 65.535 p-value 0.000. How these results are empirically suggest that shocks and adjustments in banks are partly synchronized and modelling decisions should account for that fact through common dependence instead of assuming each bank is a single entity.

**Table 4**

**Panel Unit Root Test Results with Cross-Sectional Dependence  
Pesaran CIPS**

Variable code	Test information	Cross-sections	Balanced obs. per bank	Total obs.	Deterministics	CIPS statistic	p-value
CAR	Pesaran CIPS panel unit root test with cross-sectional dependence	6	10	60	None	-3.14868	<0.01

LDR	Pesaran CIPS panel unit root test with cross-sectional dependence	6	10	60	None	-3.38021	<0.01
NPL	Pesaran CIPS panel unit root test with cross-sectional dependence	6	10	60	Constant	-3.09634	<0.01
ZSCORE	Pesaran CIPS panel unit root test with cross-sectional dependence	6	10	60	Constant	-3.14277	<0.01

**Source:** Prepared by the researcher based on data from Iraqi banks using EViews13

Table 4 displays the Pesaran CIPS unit root test model that is meant to be applied on cross-sectionally dependent panels and indicates all the variables under study reject the unit root null at the 1 percent level. CAR has a statistic of -3.149 with a p-value of less than 0.010, LDR has -3.380, NPL has -3.096 and ZScore has -3.143. This is the reason why we should work with the variables in levels in the dynamic system, as the core series exhibit stationarity when common dependence is controlled, which is better in impulse-response analysis and decomposition of history.

**Table 5**  
**Panel VAR Lag Order Selection Criteria for Endogenous Variables ZSCORE LDR CAR NPL**

PANEL VAR Lag Order Selection Criteria						
Endogenous variables: ZSCORE LDR CAR NPL						
Exogenous variables: C						
Sample: 2015 2025						
Included observations: 54						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-422.4136	NA	84.91126	15.79310	15.94043	15.84992
1	-368.1877	98.41000*	20.65470*	14.37732*	15.11398*	14.66142*

2	-357.0897	18.49679	25.02620	14.55888	15.88487	15.07026
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

**Source: Prepared by the researcher based on data from Iraqi banks using EViews13**

Table 5 chooses the best lag length of the Panel VAR system in the use of endogenous variables ZScore, LDR, CAR and NPL. All key criteria are indicating lag 1 as the favored dynamic order with LogL -368.188 and LR 98.410 and with the minimum FPE 20.655, AIC 14.377, SC 15.114 and HQ 14.661 at lag 1 and higher at lag 0 and lag 2. This choice suggests that one-period persistence is a good description of the fundamental modification in the system but is also in harmony with short-horizon persistence of balance sheets in banking panels.

**Table 6**

**Structural Panel VAR Estimation Results Maximum Likelihood Newton-Raphson**

Structural PANEL VAR Estimates				
Sample (adjusted): 2016 2025				
Included observations: 60 after adjustments				
Estimation method: Maximum likelihood via Newton-Raphson (analytic derivatives)				
Convergence achieved after 24 iterations				
Structural VAR is just-identified				
Model: $e = \Phi * F_u$ where $E[uu'] = I$				
F =				
C(1)	0	0	0	
C(2)	C(5)	0	0	
C(3)	C(6)	C(8)	0	
C(4)	C(7)	C(9)	C(10)	
	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	9.611127	0.877372	10.95445	0.0000
C(2)	4.149763	1.560988	2.658421	0.0079

C(3)	-2.528848	0.531185	-4.760769	0.0000
C(4)	2.244910	0.732879	3.063137	0.0022
C(5)	11.72991	1.070790	10.95445	0.0000
C(6)	-3.628333	0.345193	-10.51101	0.0000
C(7)	5.270747	0.513429	10.26578	0.0000
C(8)	0.753066	0.068745	10.95445	0.0000
C(9)	-0.861466	0.160991	-5.351018	0.0000
C(10)	1.088129	0.099332	10.95445	0.0000
Log likelihood	-420.5450			
Estimated S matrix:				
1.544182	-1.098501	0.172041	-0.251399	
-0.270680	3.085193	0.954520	0.436374	
-0.033938	-0.724668	0.472543	0.012455	
-0.125214	1.322118	-0.513594	1.212699	
Estimated F matrix:				
9.611127	0.000000	0.000000	0.000000	
4.149763	11.72991	0.000000	0.000000	
-2.528848	-3.628333	0.753066	0.000000	
2.244910	5.270747	-0.861466	1.088129	

**Source: Prepared by the researcher based on data from Iraqi banks using EViews13**

Table 6 indicates the Structural Panel VAR estimates through maximum likelihood with Newton-Raphson and that the structural system is just-identified and contains statistically significant contemporaneous linkage. The estimated impact coefficients are all significantly large with C(1) 9.611 (p-value 0.000), C(2) 4.150 (p-value 0.008), C(3) -2.529 (p-value 0.000), C(4) 2.245 (p-value 0.002), C(5) 11.730 (p-value 0.000), C(6) -3.628 (p- The sign structure shows that certain channels contemporaneous are stabilizing links and others are transmitting the pressure which is consistent with the banking intuition that capital and funding position can either fraternize or exacerbate the movements in relation to the direction of the shocks and the balance-sheet constraint prevailing. Non-zero off-diagonal effects are also expected to be of economic interest in the estimated matrices,

explaining the adoption of a structural representation as opposed to a reduced-form representation.

**Table 7**

**Panel VAR Residual Normality Tests Jarque-Bera Component and Joint Results**

Component	Jarque-Bera	df	Prob.
1	3.510029	2	0.1729
2	2.670527	2	0.2631
3	0.685115	2	0.7100
4	1.706193	2	0.4261
Joint	8.571864	8	0.3797

**Source: Prepared by the researcher based on data from Iraqi banks using EViews13**

Table 7 assesses the normality of the Panel VAR residuals by Jarque-Bra test of each component and at once. The probability of the components are 0.173, 0.263, 0.710, and 0.426 and the joint probability is 8.572, p-value 0.380. These findings do not disapprove residual normality, which justifies the application of conventional inference and the interpretable nature of the impulse response confidence bands that will follow in the future, at least in the light of the small-scale nature of the balanced panel.

**Table 8.**

**Panel VAR Residual Heteroskedasticity Test Results Includes Cross Terms**

PANEL VAR Residual Heteroskedasticity Tests (Includes Cross Terms)			
Date: 01/25/26 Time: 14:20			
Sample: 2015 2025			
Included observations: 60			
Joint test:			
Chi-sq	df	Prob.	
160.9428	140	0.1087	

**Source: Prepared by the researcher based on data from Iraqi banks using EViews13**

Table 8 indicates the panel var residual heteroskedasticity test with cross terms and indicates that the heteroskedasticity is not accepted statistically at normal levels. The chi-square statistic of

160.943 at a df of 140 is 0.109 and so the null hypothesis that the residuals are homoskedastic cannot be rejected. The result would enhance the validity of system-based inference since otherwise volatility clustering in the residuals would bias standard errors and increase uncertainty around dynamic responses.

**Table 9**

**Panel VAR Residual Serial Correlation LM Test Results**

PANEL VAR Residual Serial Correlation LM Tests						
Sample: 2015 2025						
Included observations: 60						
Null hypothesis: No serial correlation at lag h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	19.17409	16	0.2597	1.218136	(16, 147.3)	0.2606
2	15.39934	16	0.4956	0.966209	(16, 147.3)	0.4965

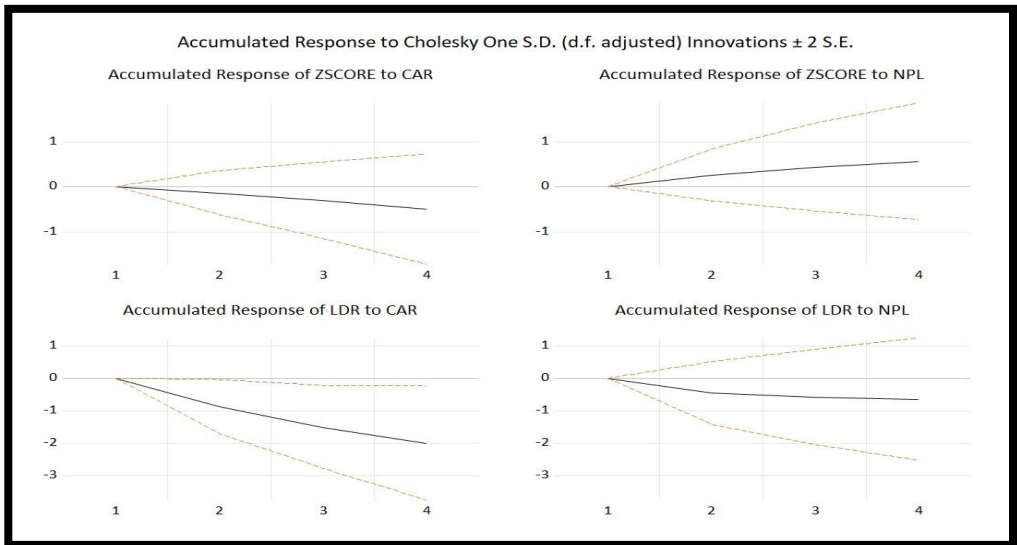
**Source:** Prepared by the researcher based on data from Iraqi banks using EViews13

Table 9 evaluates remaining serial correlation in the Panel VAR, by running LM tests at lag 1 and lag 2 and does not obtain any evidence of further autocorrelation. The LRE value at lag 1 is 19.174 and the p-value of 0.260 and the Rao F-statistic is 1.218 and p-value is 0.261. The LRE value at lag 2 is 15.399 at p-value 0.496 and Rao F- value of 0.966 at p-value 0.497. These diagnostics suggest that the selected lag order is sufficiently large, and the dynamic specification has obtained the principal persistence structure in the panel.

Figure 2 shows cumulative impulse responses within standard error band of +2 and summarizes transmitters of shock to risk absorption indicators to sustainability measures over the forecast horizon. The cumulative effect of ZScore to CAR shock is negative in the point estimate but increases with time and the uncertainty bands have zero points at the initial horizons, indicating that the sign is directionally informative but should be considered considering statistical uncertainty. The cumulative reaction of ZScore to an NPL shock is positive in the point estimate and increases slowly, but the confidence interval is wide, which means that credit-risk shocks are related to a cumulative shift in stability which is significant but non-trivial. To ensure sustainability of funding, LDR presents a negative

cumulative reaction to the CAR shocks, which is manifestly negative, which can be interpreted as the fact that the better capitalization is, the more progressive the relaxation of the funding pressure and the more stable the intermediation position. LDR also reacts negatively to NPL shocks on cumulative basis meaning that deteriorating asset quality is coupled with changes that decrease the loan to deposit ratio in the long term and this is in line with a deleveraging or credit tightening channel under credit stress.

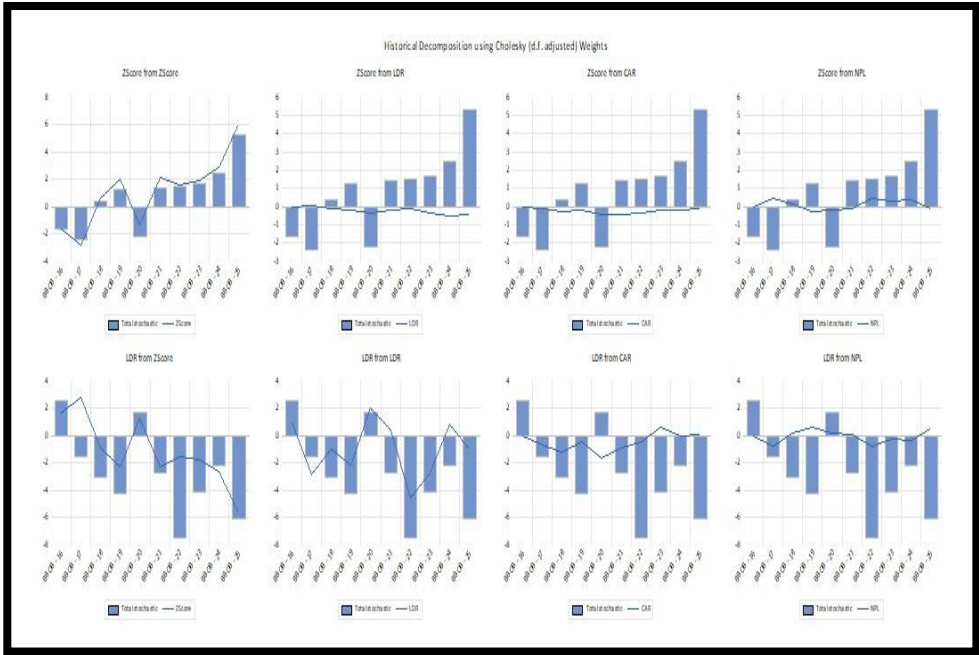
The impulse responses suggest that capitalization and asset-quality shocks transmit to sustainability through balance-sheet adjustment rather than immediate linear effects. Higher capital adequacy gradually eases funding stress and supports a more stable intermediation stance, consistent with precautionary liquidity management and improved market confidence. By contrast, higher non-performing loans trigger a long-run deleveraging channel, where banks tighten credit and lower loan-to-deposit ratios to preserve solvency and funding resilience.



**Figure 2**

**Cumulative Impulse Response Functions from the Structural Panel VAR with 2 S.E. Bands**

**Source:** Prepared by the researcher based on data from Iraqi banks using EViews13



**Figure 3**

### **Historical Decomposition from the Structural Panel VAR Using Cholesky Weights**

**Source:** Prepared by the researcher based on data from Iraqi banks using EViews13

Figure 3 provides reports of historical decomposition on Cholesky-adjusted weights and breaks down the historical paths of ZScore and LDR into their own innovations contributions as well as innovations in the other system variables. Through the decomposition of ZScore, it is possible to observe that the contribution of the own shocks and shocks caused by the LDR, CAR, and NPL during the sample window have different signs, and later periods have larger positive contributions that coincide with the increase in the observed stability path. In the case of LDR, the decomposition implies that the negative elements of the shocks of ZScore, CAR, and NPL are often present, which is associated with the fact that stability and capitalization innovations, alongside credit-risk innovations, form the

adjustments to the funding structure as a result of dynamic feedback. All in all, the decomposition suggests the empirical story that it is not only individual factor that drives financial sustainability in Iraqi private banks, but rather the interaction of shocks and feedback between stability, capitalization, funding pressure, and asset quality in a mutually dynamic macro-financial environment.

#### **4. Conclusions and Recommendations:**

The empirical evidence suggests that financial stability of Iraqi private banks by 2015/2025 can be interpreted as a dynamic system of jointness between the stability of the banks and the structure of its funding, and internal reserves of capital adequacy and asset quality in the common macro-financial environment. Descriptive statistics affirm economically significant varying dispersion of ZScore, CAR, LDR and NPL, and it means that sustainability and absorption capacity is not moving in a mechanical manner across banks and time, but in a material way. The cross-section dependence tests indicate that the four series are strongly correlated between banks and this can be interpreted as the fact that common market shocks and common funding terms across markets generate the coordinated balance-sheet movements. Once this dependence has been considered, Pesaran CIPS information no longer supports the unit root of all variables and therefore levels modelling should be used within a dynamic model. The structural Panel VAR also confirms the existence of a transmission process whereby shocks to capital adequacy and non-performing loans are transmitted to sustainability actions across the horizon, where impulse responses and historical decompositions show that sustainability outcomes are not identifying bank-specific effects. The combination of these findings suggests that risk absorption capacity is not just relevant in its contemporaneous relationship with sustainability but also by the process of determining the dynamic adjustment trajectory of the relationship between stability and funding pressure in response to shock, which was the key

attribute of supervisory assessment and bank-level resilience planning.

Policy and managerial implications on the basis of these findings include resilience as a system property, as opposed to a bank-by-bank accounting objective. Sustainability can be enhanced by supervisors and the Central Bank of Iraq by focusing on future capital planning that retains usable buffers during times of stress, and will be supplemented with increased monitoring of asset-quality migration so as to avoid the accumulation of non-performing loans in the sustainability-negative dynamic feedback loop. Transparency can be increased by market-level authorities and the Iraq Stock Exchange through standardization of disclosure frequency, and the granularity of credit-risk and capital components to provide comparability and early warning signals in an environment with recorded cross-sectional dependence. At the bank level, management needs to consider CAR and NPL as operational resilience levers associated with funding sustainability rather than just solvency measures by combining credit-risk limits, provisioning discipline, and liquidity planning into a unified stress-testing exercise that aims at promoting stability and LDR collectively. Lastly, resilience plans in future must state clearly common-shock exposure through sector-wide stress-testing scenarios and coordinated responses through prudential mechanisms since synchronized responses among banks denotes that localized adjustments might not be adequate as macro-financial stress escalates.

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