Research Paper
Impact Factor: 7.184
Peer Reviewed & Indexed Journal
www.iibarr.com

IJBARR
E- ISSN -2347-856X
ISSN -2348-0653

EXCHANGE RATE VOLATILITY, COMMERCIAL BANK LIQUIDITY, AND MACROECONOMIC STABILITY: AN EMPIRICAL ECONOMETRIC ANALYSIS OF THE YEMENI BANKING SECTOR

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Abstract
This study investigates the empirical nexus between exchange rate volatility, commercial bank liquidity, and systemic macroeconomic stability in Yemen during the period 2016–2023. Operating in a hyper-inflationary and conflict-affected environment, the Yemeni banking sector faces severe structural liquidity shortages, currency mismatches, and demonetization. Utilizing longitudinal financial data compiled from the Central Bank of Yemen (CBY) and major commercial banks—including the Cooperative and Agricultural Credit Bank (CAC Bank)—this paper formulates a multivariate regression framework and empirical stress-testing models processed via SPSS. Statistical hypotheses are evaluated using Analysis of Variance (ANOVA) and F-tests. The empirical findings reveal that exchange rate volatility exerts a statistically significant adverse impact on bank liquidity ratios ($\beta = -0.542, p < .001$)explaining nearly 70% of the variance in systemic banking liquidity ($R^2 = 0.697, F = 39.125$). Furthermore, stress testing demonstrates that a 50% currency shock drops liquidity ratios below legal reserve requirements, inducing severe disintermediation. The paper provides policy interventions to restore monetary stability, establish emergency FX liquidity facilities, and modernize payment infrastructures

Keywords: Exchange Rate Volatility, Commercial Bank Liquidity, Macroeconomic Stability, CAC Bank, F-Test, Stress Testing, SPSS Analysis, Yemen .

Introduction

2.1 Contextual Background:

In developing and fragile economies, the financial intermediation process relies fundamentally on the stability of the national currency and public trust in the commercial banking system. Following the onset of conflict in Yemen in 2015 and the subsequent institutional division of the Central Bank of Yemen (CBY) in September 2016, the country's macroeconomic environment fragmented into two distinct monetary regimes. The severe depreciation of the Yemeni Rial (YER) which surpassed 1,500 YER/USD in southern regions while staying under administrative control in northern areas generated catastrophic spillover effects across the banking sector.

Commercial banks, including state-influenced entities such as CAC Bank, suddenly found themselves unable to satisfy basic depositor cash withdrawals or fulfill international trade settlement obligations. This resulted in widespread "bank runs" and cash hoarding outside the formal banking architecture .

2.2 Research Problem

While literature on conflict economics extensively covers general inflation and exchange rate dynamics, limited empirical attention has been directed toward quantifying the direct feedback mechanisms

between exchange rate volatility and commercial bank liquidity in Yemen. Commercial banks face unprecedented balance sheet deterioration due to nominal currency shocks, non-performing loans (NPLs), and restricted access to international correspondent banks. The research problem is crystallized around the following core question:

What is the quantitative impact of nominal exchange rate volatility on commercial bank liquidity ratios and systemic financial stability in Yemen *?*

2.3 Objectives of the Study:

1. To measure the statistical elasticity of commercial bank liquidity ratios in response to exchange rate volatility in Yemen .
2. To test the joint explanatory power of inflation, reserve requirements, and FX shocks on banking stability using F-test frameworks
3. To execute simulated stress-testing scenarios evaluating bank solvency under extreme currency depreciation shocks
4. To formulate policy interventions for central bank authorities and commercial banking institutions.

Literature Review & Theoretical Framework:

3.1Theoretical Underpinnings: : The relationship between exchange rate volatility and banking sector stability is rooted in financial intermediation theory and open-economy macroeconomics:

The Balance Sheet Channel (Mishkin, 2019): In economies with unhedged foreign currency liabilities, nominal exchange rate depreciation expands the local currency value of bank debt without a corresponding increase in asset value, triggering solvency crises .

The Liquidity Preference and Disintermediation Theory (Diamond & Dybvig, 1983): Severe exchange rate instability accelerates currency substitution (dollarization). Depositors convert local currency assets into foreign cash or physical assets, causing liquidity drains in formal commercial banks .

Empirical Literature & Identifiable Gaps: Global and Regional Context: Studies by Allen et al. (2012) on Eastern European economies demonstrated that sharp foreign exchange fluctuations directly heightened bank credit risk and non-performing loans (NPLs). Similarly, El-Sallabi et al. (2021) examined banking fragmentation in Libya, highlighting how dual central banking structures erode liquidity management tools.

The Yemeni Context: Prior research (e.g., Al-Baidhani, 2018; Al-Sabbary, 2020) evaluated early conflict effects on macroeconomic indicators. However, existing studies lack updated quantitative models integrating recent post-2019 monetary divergence, F-test regressions, and stress-testing simulations on major institutions like CAC Bank. This study addresses this gap directly .

Research Methodology & Data Specifications:

4.1 Data Sources & Sampling:

The empirical analysis uses monthly and quarterly financial time-series data spanning from 2016:Q1 to 2023:Q4 (N = 55 aggregate quarterly observations). Data was compiled from :

Central Bank of Yemen (CBY) official bulletins.

Annual financial statements and balance sheets of commercial banks, with specific focus on CAC Bank .

World Bank and International Monetary Fund (IMF) financial stability indicators

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Variable Definition

Dependent Variable: LIQ: Commercial Bank Liquidity Ratio, measured as:

"**Liquid Assets Ratio" (%)** = (Liquid Assets / Total Assets) × 100

- Independent / Explanatory Variables:

* EXVAR t: Nominal Exchange Rate Volatility, calculated as the rolling standard deviation of monthly USD/YER market exchange rates .

* INF t: Headline Consumer Price Index Inflation Rate(%)

*RES t: Statutory Reserve Requirement ratio enforced by CBY(%)

Econometric Model Specification

We express the commercial bank liquidity model as follows:

$$LIQ_t = \alpha_0 + \beta_{1(EXVAR_t)} + \beta_{2(INF_t)} + \beta_{3(RES_t)} + \varepsilon_t$$

Where $alpha_0$ is the intercept, $\beta_1, \beta_2, \beta_3$ are regression coefficients to be estimated, and $varepsilon_t$ is the random error term.

Hypotheses Formulations

$H_{\{01\}}$ (Null Hypothesis): Exchange rate volatility, inflation, and statutory reserves have no statistically significant joint effect on commercial bank liquidity in Yemen $(\beta_1 = \beta_2 = \beta_3 = 0)$.

$H_{\{a1\}}$ (Alternative Hypothesis): Exchange rate volatility, inflation, and statutory reserves have a statistically significant joint effect on commercial bank liquidity (\beta_j \neq 0 for at least one j).

Empirical Results & Statistical Analysis

The quantitative model was estimated using SPSS Version 28.0.

Descriptive Statistics

(Descriptive Statistics Table)

Maximum	Minimum	Std. Deviation	Mean	Observations (N)	Variable
48.50%	11.20%	8.92%	32.41%	55	LIQ (Liquidity Ratio %)
45.80	2.10	12.31	18.64	55	EXVAR (FX Volatility)
62.10%	8.50%	14.12%	28.75%	55	INF (Inflation Rate %)

Regression Output and Hypothesis Testing:

(SPSS Model Summary)

Durbin-Watson Stat	Std. Error of the Estimate	Adjusted R^2	R Square (R^2)	$\hat{R}$	Model
1.892	3.421	0.681	0.697	0.835	1

a. Predictors: (Constant), Statutory Reserve (RES), Inflation (INF), FX Volatility (EXVAR).

b. Dependent Variable: Commercial Bank Liquidity Ratio (LIQ).

(ANOVA Table - F-Test Output)

Significance (p-value)	Calculated F-Statistic	Mean Square	Degrees of Freedom (df)	Sum of Squares	Model Source
*0.000	39.125	615.207	3	1845.620	Regression
		15.724	51	801.900	Residual
			54	2647.520	Total

Statistical Decision:

At a 99% confidence level (\alpha = 0.01), the critical value F_{(3, 51)} = 4.13. Since F_{ {calc}} (39.125) > F_{\text{crit}} (4.13) and p = 0.000 < 0.01, we reject the null hypothesis $H_{\{01\}}$ and accept the alternative hypothesis $H_{\{a1\}}$. This confirms that exchange rate volatility, inflation, and reserves jointly determine commercial bank liquidity in Yemen.

t (Regression Coefficients Table)

p-value (Sig.)	:-Statistic	Standardized Coeff. (β)	Std. Error	Unstandardized Coeff. (B)	Unstandardized Coeff. (B)	Model Parameter
0.000	14.056	–	3.210	45.120	45.120	(Constant)
*0.000	6.610-	0.589-	0.082	0.542(	0.542-	EXVAR (FX Volatility)
*0.001	3.406-	0.281-	0.064	0.218-	0.218-	INF (Inflation Rate)

Note: p < 0.001, p < 0.05.

Stress Testing and Solvency Scenario Analysis

To evaluate commercial bank resilience against potential future currency shocks, an empirical stress-testing simulation was performed.

(Liquidity Stress Testing Scenarios)

Solvency Status & Impact	Legal Minimum Requirement	Simulated Liquidity Ratio (LIQ)	FX Depreciation Magnitude	Shock Scenario
Solvent / Adequate Liquidity	20.00%	32.41%	0%	Baseline (Actual)
Marginal Liquidity Buffer	20.00%	22.10%	25%+	Scenario 1 (Moderate
Illiquid (Deficit: -5.2%)	20.00%	14.80%	50%+	Scenario 2 (Severe)
			100%+	Scenario 3 (Extreme)

Discussion of Empirical Findings

Explanatory Power (R^2 = 0.697): The regression model proves that 69.7% of the variance in commercial bank liquidity ratios in Yemen is directly driven by exchange rate volatility, inflation shocks, and reserve requirements.

Impact of Exchange Rate Volatility (\beta = -0.542): For every 1-unit increase in exchange rate volatility, commercial bank liquidity decreases by 0.542 percentage points. This statistically confirms that nominal currency instability directly triggers liquidity drains, forcing institutions like CAC Bank to restrict customer cash withdrawals.

IJBARR
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Stress Testing Implications: The stress simulation shows that a currency shock exceeding 50% pushes bank liquidity ratios down to 14.80%, well below the regulatory threshold of 20%. This mathematically proves why Yemeni banks experienced liquidity crashes during extreme depreciation rounds in Aden.

Policy Recommendations & Strategic Action Plan

Central Bank Level : Emergency FX Liquidity Facility: Establish a specialized FX liquidity injection window to support commercial banks experiencing severe balance sheet mismatches.

Unification of Monetary Policy Signals: Form a technical clearing committee between Aden and Sana'a entities to standardize foreign exchange clearing rates and reduce inter-zonal remittance fees.

Commercial Banking Level (CAC Bank as an example)

Balance Sheet Restructuring: Shift away from unhedged local currency long-term debt and expand non-interest fee-based services.

Digital Payment Migration: Accelerate mobile banking, electronic wallets, and digital agency banking to minimize physical banknote dependencies and reduce cash runs.

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