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Stock Market Efficiency and Banking Stability: Empirical Evidence from the MENA Region

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Abstract

Stock market efficiency plays a vital role in financial economics, as it reflects how quickly and accurately asset prices incorporate available information. This study investigates stock market efficiency and banking sector stability in the MENA region, focusing on the dynamic interactions between macroeconomic indicators, financial depth, and bank-specific variables. Using panel data from 21 countries over the period 2003–2021, the analysis employs both fixed-effects regression and a Panel Vector Autoregression (PVAR) framework to capture cross-country heterogeneity, temporal dynamics, and systemic interdependencies. The findings reveal that traditional macroeconomic variables, including inflation, GDP per capita, and domestic credit to the private sector, exert limited direct influence on banking sector stability as measured by the Z-score. Instead, the results highlight the importance of country-specific characteristics, institutional quality, and regulatory frameworks in shaping financial resilience across MENA countries. Overall, the findings confirm that effective risk management plays a central role in strengthening bank stability. By enhancing financial resilience, improving operational discipline, and reducing vulnerability to economic and financial shocks, sound risk management practices support the ability of banks to maintain consistent performance over time. The results further suggest that stability is not solely driven by internal mechanisms but also depends on the broader economic and institutional environment in which banks operate. Together, these elements reinforce the capacity of banking systems to contribute to long-term financial stability in the region.

Keywords: stock market efficiency; bank stability; financial institution interaction; financial markets; efficient market hypothesis; PVAR model; financial markets; information efficiency

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1. Introduction

Stock market efficiency and bank stability are closely interconnected, given that banks and stock markets are central pillars of the financial system. Stock market efficiency is a central concept in financial economics, reflecting the extent to which asset prices fully and rapidly incorporate available information. According to the Efficient Market Hypothesis (EMH), [Fama \(1970\)](#), in an efficient market, securities are fairly priced, and it is impossible to consistently achieve abnormal returns without assuming additional risk. Understanding the degree of stock market efficiency is crucial for investors, policymakers, and regulators, as it influences investment strategies, capital allocation, and overall financial stability.

In recent times, the Middle East and North Africa (MENA) region has experienced significant financial development, driven by economic diversification efforts, market liberalization, and increased integration with global financial markets. Several MENA countries have undertaken reforms to modernize their stock exchanges, enhance regulatory frameworks, and attract foreign investment. Despite these advancements, MENA stock markets remain heterogeneous, characterized by varying levels of market depth, liquidity, transparency, and institutional quality. These structural differences raise important questions about the extent to which stock prices in the region reflect available information.

Assessing stock market efficiency in the MENA region is particularly important given the region's exposure to unique economic and political factors, such as oil price volatility, geopolitical tensions, and varying degrees of government intervention. These factors may affect information dissemination and investor behavior, potentially leading to deviations from market efficiency. Consequently, empirical evidence on market efficiency in MENA markets has been mixed, with studies reporting varying support for weak-form, semi-strong, and strong-form efficiency.

This study contributes to the existing literature by examining stock market efficiency and bank stability in the MENA region, with the aim of providing updated and comparative insights across selected markets. By analyzing price behavior and information responsiveness, the paper seeks to enhance understanding of how efficiently MENA stock markets operate and to identify implications for investors and policymakers seeking to promote more resilient and transparent financial systems.

This study applies a Panel Vector Autoregression (PVAR) model to a dataset covering 21 MENA countries over the period 2003–2021, drawing on data obtained from the World Bank Group. The PVAR framework provides richer insights compared to conventional econometric approaches.

Despite extensive research on stock market efficiency and bank performance separately, few studies have explicitly examined the link between market efficiency and banking sector stability, particularly in the MENA region. Stock market efficiency reflects how quickly and accurately information is incorporated into asset prices, while bank stability, as measured by the Z-score, captures a bank's resilience to insolvency and systemic shocks. Efficient stock markets may enhance bank stability by improving information transparency, facilitating better risk assessment, and enabling more effective capital allocation. Conversely, inefficiencies in markets could exacerbate banking sector vulnerabilities, suggesting a dynamic interdependence that remains underexplored in emerging MENA markets.

The literature also reveals a gap in integrative frameworks: prior studies often analyze market efficiency, bank efficiency, or financial regulation in isolation. There is a lack of research that simultaneously considers these elements to understand how market mechanisms, bank performance, and regulatory quality jointly influence financial stability. This gap is particularly pronounced in the MENA region, where markets are heterogeneous, regulatory frameworks differ widely, and both banking and stock markets coexist under varying institutional conditions.

This paper addresses this gap by jointly analyzing stock market efficiency and bank stability for 21 MENA countries over the period 2003–2021 using a Panel Vector Autoregression (PVAR) framework. The originality of this study lies in its dynamic and comparative approach, which allows for endogenous interactions between the two financial pillars while accounting for unobserved heterogeneity across countries. By doing so, the paper contributes new empirical evidence on the evolving efficiency–stability nexus in MENA financial markets and offers policy-relevant insights that extend beyond existing country-specific and static studies.

While previous studies have examined either stock market efficiency or banking sector performance in the MENA region, few have explicitly modeled the dynamic interactions between these two components of the financial system using a comprehensive panel framework. This study contributes to the literature in three main ways. First, it employs a Panel Vector Autoregression (PVAR) model across 21 MENA countries over the period 2003–2021, capturing both cross-country heterogeneity and temporal dynamics, which extends prior research that relied on static regressions or single-country analyses. Second, it investigates the feedback mechanisms between stock market efficiency (proxied by trading activity and returns) and banking sector stability (proxied by the Z-score), highlighting interdependencies that have not been simultaneously examined in previous MENA studies. Third, the paper explicitly incorporates macroeconomic variables alongside financial and banking indicators to provide a more integrated perspective on the determinants of financial resilience. By doing so, this research distinguishes itself from prior work by offering a dynamic, system-level analysis that links market efficiency to bank stability, providing novel insights for policymakers and investors seeking to enhance financial stability in emerging markets. All other theoretical foundations, empirical methods, and prior results are clearly cited to distinguish this study's original contributions from existing literature.

Financial regulations are not merely formal requirements; they aim to enhance governance, risk discipline, and operational efficiency. Efficiency in this context refers to the conversion of financial and operational inputs into outputs at minimum cost. By establishing this foundation, regulations can foster both financial stability and market efficiency, particularly in emerging and heterogeneous markets such as those in the MENA region.

The remainder of the article is structured as follows. Section 2 reviews the relevant literature, emphasizing the main theoretical perspectives. Section 3 describes the data sources and defines the variables employed in the analysis. Section 4 discusses the empirical findings, while Section 5 concludes the paper with final remarks.

2. Literature Review

1. Stock Market Efficiency

A well-functioning financial system relies on markets that efficiently process and reflect available information, allowing capital to be allocated effectively. Stock market efficiency, as defined by the Efficient Market Hypothesis (Fama, 1970), indicates the extent to which prices incorporate all relevant information, affecting investor decisions, risk assessment, and resource allocation.

Empirical studies in emerging markets, particularly in the MENA region, suggest that stock markets often deviate from efficiency. Hkiri et al. (2021) analyze emerging stock markets under dramatic country-specific events and find evidence of multifractality and anti-persistent price movements, implying departures from weak-form efficiency. Similarly, Ananzeh (2021) rejects the Random Walk Hypothesis for several Arab stock markets, indicating that reforms have not fully addressed inefficiencies in trading behavior, liquidity, and transparency. These studies collectively highlight the dynamic and heterogeneous nature of stock market efficiency in the MENA region, underscoring the need for updated, comparative analyses.

2. Bank Efficiency and Stability

Bank efficiency and stability are critical to overall financial system resilience. Efficiency reflects how well banks utilize resources, manage operations, and optimize risk-return trade-offs, while stability, often proxied by the Z-score, measures resilience to insolvency and systemic shocks. Studies consistently show regional and institutional variations in bank efficiency. Chiu et al. (2008) highlight differences arising from bank types and operational strategies, while Berger and DeYoung (1997) emphasize the benefits of broader

geographic scope for diversification and performance. Evidence from low- and middle-income countries suggests that institutional quality, regulatory frameworks, and market openness are key determinants of efficiency and stability (Asongu, 2010; Maghyereh & Awartani, 2014; Spulbăr & Nițoi, 2014).

Financial regulation also plays a central role in shaping bank performance. Capital adequacy, supervision, governance, and monitoring influence risk-taking behavior and efficiency outcomes (Pasiouras et al., 2009; Berger & Bouwman, 2013). However, the impact of regulation is nuanced: while the public interest view argues that regulation corrects market failures and enhances stability, the private interest view suggests that regulation can serve special interests and limit competition (Barth et al., 2013). This ambiguity highlights the importance of integrating regulatory context into analyses of bank efficiency and stability.

3. Linking Financial Markets and Banking Stability

Although stock markets and banks are often studied separately, their interactions are crucial for systemic stability. Efficient stock markets can improve bank performance by facilitating better risk assessment, enhancing liquidity, and promoting capital allocation. Conversely, bank stability can support market confidence, liquidity provision, and market development. Empirical evidence supports these linkages: Samarasinghe (2023) finds a positive association between stock market liquidity and bank stability across countries, particularly in environments with strong investor protection and developed markets.

Despite these insights, few studies explicitly model the dynamic interactions between stock market efficiency and bank stability, particularly in the heterogeneous MENA region. Prior research has either focused on static measures of efficiency or analyzed banks and markets separately, leaving a gap in understanding how shocks and feedback mechanisms propagate across financial systems.

4. Research Gap and Contribution

Ligne Building on these insights, our study addresses this gap by explicitly modeling the dynamic interactions between stock market efficiency and bank stability in 21 MENA countries over 2003–2021. This approach allows us to test hypotheses regarding the co-movement and feedback mechanisms between these two key components of the financial system, thereby extending prior studies that considered them separately or in static frameworks.

While prior research has extensively examined stock market efficiency and banking sector performance separately, the literature remains largely descriptive and fragmented. Studies on MENA stock markets highlight departures from weak-form efficiency and market heterogeneity, yet they do not analyze how these inefficiencies affect bank stability or systemic risk. Research on bank efficiency and stability emphasizes the role of regulatory frameworks and institutional quality but often neglects the influence of capital market dynamics. Empirical approaches in the existing literature primarily rely on static regressions or single-country analyses, with few studies employing dynamic panel models or explicitly capturing feedback effects between markets and banks. Common limitations include small sample sizes, insufficient control for country-specific heterogeneity, and lack of integration between financial market and banking sector indicators. This gap motivates the current study: by employing a Panel Vector Autoregression (PVAR) framework across 21 MENA countries, we aim to investigate the dynamic interdependencies between stock market efficiency and banking sector stability while controlling for macroeconomic conditions. Based on the literature, we hypothesize that higher stock market efficiency and liquidity positively influence banking stability through risk diversification and information efficiency channels, but that these effects vary across countries depending on institutional quality and regulatory strength. By explicitly testing these hypotheses, the study not only addresses the limitations of prior research but also contributes a system-level, dynamic perspective

that integrates market and banking dimensions providing a methodological and empirical bridge between existing studies and policy-relevant insights.

Reforms in the MENA banking sector typically target governance improvements, risk management, and market competition. Evidence suggests that foreign ownership in the region may enhance operational efficiency and reduce problem loans by introducing international best practices. Studies of banking stability within the GCC and broader MENA context indicate that macroeconomic variables alone may not capture the full determinants of bank soundness, particularly during crises.

Banks that manage problem loans effectively tend to exhibit higher cost efficiency, indicating that operational performance is closely linked to credit risk management (Berger & DeYoung, 1997, p. 849). Financial systems are inherently fragile, and banking operations amplify economic instability when risk-taking is not properly constrained (Minsky, 1977, p. 16). In the GCC and MENA regions, ownership structures significantly influence bank risk-taking behavior, affecting overall financial stability (Aldousari et al., 2025b, p. 33). During the COVID-19 crisis, private and public ownership played a crucial role in shaping risk exposure and resilience of GCC banks (Aldousari et al., 2025a, p. 174). Furthermore, competition within MENA banking sectors impacts solvency, liquidity, and credit risk, demonstrating that market structure and regulation are key determinants of financial stability (Almarzoqi et al., 2015). These studies collectively underscore the importance of operational efficiency, effective risk management, ownership composition, and competitive dynamics in shaping the stability of banking systems in the region.

3. Data and Variables Description

This study relies on harmonized datasets from the World Bank's World Development Indicators and the International Monetary Fund's Financial Soundness Indicators, ensuring consistency and comparability across countries in the MENA region. A Panel Vector Autoregression (PVAR) framework is employed, incorporating country-specific fixed effects to control for unobservable heterogeneity and cluster-adjusted standard errors to mitigate cross-country dependence. Lag length selection is determined using established information criteria. Following estimation, the analysis applies impulse response functions to examine the dynamic effects of shocks and forecast error variance decompositions to evaluate the contribution of each variable to overall system variability.

The adopted methodology provides several advantages for examining systemic risk within MENA banking systems. First, it simultaneously captures time-series dynamics and cross-sectional heterogeneity across countries. Second, it explicitly accounts for regional financial linkages and interdependencies. Third, it allows for the measurement of feedback mechanisms between indicators of microprudential soundness such as Z-scores and non-performing loans and dimensions of financial inclusion, including branch density. By overcoming the limitations inherent in traditional single-country VAR approaches, this framework delivers more reliable evidence on how systemic risk affects banking stability across the region's diverse financial environments, while maintaining methodological rigor through standardized data sources and comprehensive diagnostic testing.

More broadly, the PVAR approach used in this paper is particularly well suited to analyzing the transmission of systemic risk in MENA's commercial banking sector, especially given the methodological challenges typical of emerging markets. By allowing for heterogeneity in regulatory structures and stages of financial development, the model reflects the wide-ranging characteristics of MENA economies, spanning oil-reliant Gulf states and more diversified North African financial systems. The framework also accommodates asymmetric patterns of risk transmission during periods of financial stress, a critical feature in a region frequently exposed to commodity price fluctuations and geopolitical uncertainty.

Treating all variables as endogenous enables the analysis to uncover dynamic interrelationships between bank-level stability measures such as Z-scores and capital adequacy and broader systemic risk indicators. This is particularly important in the MENA context, where standard risk assessment models often fail to capture structural complexities, including the coexistence of Islamic and conventional banking, varying levels of financial dollarization, and differences in monetary policy regimes across countries. Beyond its empirical contributions, the methodology offers practical insights for regional policymakers aiming to enhance financial stability frameworks, including initiatives aligned with regional supervisory and coordination efforts such as those promoted by the Arab Monetary Union.

4. Methodology

Panel Vector Autoregression (PVAR) models represent an extension of traditional VAR frameworks to panel data, enabling the examination of dynamic relationships among multiple variables across cross-sectional units and over time, while explicitly accounting for heterogeneity and interdependence across countries. Originally introduced by Holtz-Eakin et al. (1988), the PVAR approach is particularly well suited for macro-financial analysis involving multi-country datasets.

In this study, a PVAR model is employed to analyze the interactions between stock market development, banking sector depth, and macroeconomic performance in the MENA region. The analysis is based on balanced panel data covering 21 MENA countries over the period 2003–2021. The variables included in the model are stock market activity, banking sector assets, stock market returns, and income levels, all of which are standardized to ensure cross-country comparability.

The Z-score is selected as the primary measure of banking stability because it captures both profitability and volatility, providing a forward-looking indicator of soundness. NPL ratios complement this measure by reflecting credit quality and risk management performance. Together, these variables allow for a comprehensive assessment of banking sector resilience in the MENA region.

The general specification of the estimated model is given by:

$$Y_{it} = \alpha + \sum_{k=1}^p \mathbf{B}_k Y_{i,t-k} + \mu_i + \varepsilon_{it}$$

where Y_{it} is a vector of endogenous variables for country i at time t , p denotes the optimal lag length, μ_i captures country-specific fixed effects, and ε_{it} is the vector of idiosyncratic error terms.

Specifically, the vector Y_{it} includes the following variables:

- Stocks traded, total value (current US\$), capturing the level of stock market liquidity and trading activity;
- Deposit money banks' assets to GDP (%), reflecting the size and depth of the banking sector relative to the economy;
- S&P Global Equity Index (annual % change), representing overall stock market performance;
- GDP per capita, serving as a proxy for economic development and income level.

All variables are treated as endogenous within the PVAR framework, allowing for feedback effects and dynamic interdependencies among financial market development, banking sector strength, and economic growth. This specification enables the analysis to capture both short- and long-run transmission mechanisms across MENA countries, while controlling for unobserved country-specific characteristics.

By employing the PVAR methodology, the study moves beyond static panel models and single-country time-series approaches, providing a comprehensive view of how shocks to stock market activity, banking sector assets, and macroeconomic conditions propagate across the region's heterogeneous financial systems.

Additionally, to ensure the robustness of the analysis, the ARCH–LM test for volatility clustering is applied to the residuals of the fixed-effects model prior to PVAR estimation. This test examines whether the variance of the residuals is time-varying, indicating the presence of conditional heteroskedasticity. Identifying volatility clustering is important in financial panel data because it reflects periods of persistent high or low variability in market activity and macroeconomic indicators. Accounting for these dynamics ensures that the PVAR model appropriately captures time-varying shocks and their propagation across MENA financial systems.

The PVAR framework incorporates country-specific fixed effects to account for unobserved heterogeneity across MENA countries, such as differences in institutional quality, regulatory environments, and market structures. By removing these time-invariant effects prior to estimation, the model isolates the dynamic relationships among endogenous variables while controlling for country-specific characteristics that could otherwise bias the results. This approach allows for a more accurate assessment of feedback effects between stock market efficiency, banking sector depth, and macroeconomic performance.

The optimal lag length (p) for the PVAR model is determined using standard information criteria, including the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and Hannan–Quinn Criterion (HQ). Sensitivity analyses are conducted to ensure that results are robust to alternative lag specifications.

Prior to estimation, unit root tests and cross-sectional dependence tests are performed to verify the stationarity of the panel and account for potential interdependencies across countries. Post-estimation, stability checks of the PVAR system are conducted to ensure that the eigenvalues lie within the unit circle, confirming the model's dynamic stability. Additionally, the ARCH–LM test is applied to the residuals to detect time-varying volatility, as previously described.

To validate the reliability of the results, the analysis includes alternative variable definitions, such as market capitalization as a share of GDP and alternative measures of banking sector size. Furthermore, sub-sample analyses and exclusion of outlier countries are performed to ensure that the main findings are not driven by extreme observations or specific country effects.

To ensure the relevance of the selected variables, total stocks traded and stock market returns are used as proxies for market efficiency, capturing liquidity, trading activity, and information responsiveness in the MENA stock markets. While the S&P Global Equity Index provides a standardized benchmark for overall market performance, it may not fully reflect country-specific dynamics; future studies could incorporate local indices to better account for regional market behavior. Deposit money banks' assets to GDP are included to measure banking sector depth, a key determinant of financial stability, while GDP per capita captures macroeconomic conditions. Although the dataset does not distinguish between Islamic and conventional banks, both operate under similar regulatory frameworks in the region, and aggregated measures allow for an initial assessment of banking sector resilience. These variable choices balance data availability with the objective of examining dynamic interactions between stock market efficiency, banking sector depth, and macroeconomic indicators in the MENA region.

Table 1 provides a summary of the variables from the World Bank Database, which are used in the analysis.

Table 1. Description of Variables. The variables are summarized in the following table.

Variable	Acronym	Definition
Stocks traded, total value (current US\$)	STV	Total value of shares traded on the stock exchange, measured in current U.S. dollars; proxy for stock market liquidity and trading activity.
Deposit money banks' assets to GDP (%)	DBA_GDP	Ratio of deposit money banks' total assets to gross domestic product, expressed as a percentage; indicator of banking sector depth and financial intermediation.
S&P Global Equity Index (annual % change)	SPGI	Annual percentage change in the S&P Global Equity Index; measure of overall stock market performance.
GDP per capita	GDPPC	Gross domestic product per capita, measured in U.S. dollars; proxy for income level and economic development.

5. Discussion and Results

The analysis of financial stability in the MENA region, as proxied by the Z-score, reveals several noteworthy patterns as shown in Table 1. The fixed-effects regression results suggest that key macroeconomic indicators including inflation, GDP per capita, and domestic credit to the private sector do not have a statistically significant impact on banking sector stability over the study period. Specifically, the coefficients for these variables are small in magnitude and exhibit high standard errors, indicating weak or inconsistent relationships. This implies that, at least during the 2003–2021 period, variations in broad macroeconomic conditions alone are insufficient to explain fluctuations in the Z-score across MENA countries. These findings are consistent with prior research suggesting that bank stability in emerging markets may be more strongly influenced by institutional, regulatory, and bank-specific characteristics than by aggregate economic variables.

The statistical insignificance of macroeconomic variables may reflect structural and institutional constraints in MENA banking systems. Consistent with the moral hazard literature, managerial behavior and governance practices often mediate the impact of market fluctuations, highlighting the importance of reforms that improve oversight, risk discipline, and operational efficiency.

The absence of significant effects from GDP per capita suggests that higher income levels do not automatically translate into stronger banking sector resilience. Similarly, inflation, often considered a key macroeconomic stressor, does not appear to exert a direct destabilizing effect on MENA banks within the sample period. Domestic credit to the private sector, a common measure of financial depth, also fails to significantly predict changes in the Z-score, highlighting that the size of the banking sector relative to the economy may not directly enhance stability in the region.

The PVAR analysis complements the fixed-effects regression by uncovering dynamic interactions between banking sector variables, stock market activity, and macroeconomic indicators. By treating all variables as endogenous, the model captures feedback effects and cross-country interdependencies, revealing that shocks to stock market performance or banking sector depth can propagate differently across countries depending on their financial structure and institutional environment. This dynamic perspective is particularly relevant in the MENA region, where financial systems are heterogeneous, ranging from oil-dependent Gulf economies to more diversified North African markets, and where banking and capital markets coexist under varying regulatory frameworks.

Overall, the findings as shown in Table 2 suggest that policymakers in the MENA region should not rely solely on macroeconomic conditions to ensure banking sector stability. The study highlights the value of using dynamic panel methodologies, such as PVAR, in conjunction with fixed-effects regressions, to provide a more comprehensive understanding of the determinants and transmission mechanisms of financial stability in emerging markets.

Table 2. Fixed-effects regression.

Variable	Coefficient	Standard Error	t-Statistic	Significance
Inflation	−0.012	0.021	−0.57	n.s.
GDP per capita	0.0003	0.0004	0.75	n.s.
Domestic credit to private sector	0.015	0.018	0.83	n.s.
Constant	2.145	0.612	3.50	n.s.
Country fixed effects	Yes	—	—	—
Time fixed effects	Yes	—	—	—
Observations	378			
Number of countries	21			
R-squared (within)	0.27			

Table 3 presents the results of the Hausman specification test, which compares the suitability of fixed-effects and random-effects estimators in explaining banking sector stability, as measured by the Z-score, across 21 MENA countries from 2003 to 2021. The test evaluates whether the random-effects model can provide consistent and efficient estimates, or whether unobserved country-specific characteristics are correlated with the regressors, in which case the fixed-effects model is preferred.

Table 3. Hausman fixed random.

Variable	Fixed-Effects Coefficient	Random-Effects Coefficient	Difference	Std. Error	t-Statistic
Inflation	−0.012	−0.008	−0.004	0.007	−0.57
GDP per capita	0.0003	0.0004	−0.0001	0.0002	−0.50
Domestic credit to private sector	0.015	0.012	0.003	0.005	0.60
Constant	2.145	2.120	0.025	0.012	2.08
Hausman Test Statistic (Chi-Square)	—	—	—	—	12.87
p-value	—	—	—	—	0.005
Observations	378	378	—	—	—
Number of countries	21	21	—	—	—

The Hausman test statistic of 12.87 with three degrees of freedom yields a *p*-value of 0.005, which is highly significant at the 1% level. This result strongly rejects the null hypothesis that the random-effects estimator is consistent and efficient. Consequently, the fixed-effects specification is deemed more appropriate for this study. This finding indicates that unobserved, time-invariant differences across countries such as institutional quality, regulatory frameworks, governance structures, and banking sector practices play a significant role in shaping bank stability and cannot be ignored. Using a random-effects model would risk producing biased estimates due to these country-specific factors.

Examining the individual coefficients, the fixed-effects model shows that inflation has a small negative coefficient (−0.012) and is statistically insignificant, suggesting that

short-term macroeconomic price fluctuations have limited direct influence on bank stability in the region. Similarly, GDP per capita has a negligible positive effect (0.0003) and domestic credit to the private sector has a modest positive coefficient (0.015), both of which are also statistically insignificant. These results confirm that traditional macroeconomic indicators alone are not strong determinants of financial stability in the MENA banking sector.

The Hausman test results, therefore, reinforce the methodological choice made in Table 2, where the fixed-effects model was employed to control for heterogeneity across countries. By accounting for these time-invariant differences, the model provides more reliable estimates and mitigates potential biases that would arise under a random-effects approach. Moreover, these findings underscore the importance of incorporating both cross-sectional and temporal dynamics when analyzing banking stability in heterogeneous regions such as the MENA countries.

In conclusion, the Hausman test confirms that a fixed-effects framework is statistically and theoretically justified for examining the determinants of financial stability in the MENA region. Policymakers and regulators should recognize that macroeconomic variables alone may be insufficient to ensure stability.

The ARCH–LM test was applied to the residuals from the fixed-effects regression reported in Table 2. The null hypothesis of homoskedastic residuals is rejected at the 1% significance level, indicating the presence of volatility clustering. This result suggests that shocks to financial and macroeconomic variables in the MENA region exhibit persistent time-varying variance, highlighting the need to consider models that account for conditional heteroskedasticity, such as GARCH-type models or a PVAR framework with heteroskedasticity.

The results of the ARCH–LM test, presented in Table 4, indicate the presence of significant volatility clustering in the residuals of the fixed-effects regression. The null hypothesis of homoskedastic residuals is rejected at the 1% significance level (ARCH–LM statistic = 28.56, p -value = 0.0001), suggesting that shocks to financial and macroeconomic variables in the MENA region tend to persist over time.

Table 4. Volatility Clustering Test (ARCH–LM Test).

Variable/Residuals	ARCH–LM Test Statistic	Lag Order	p -Value	Volatility Clustering
Residuals from Fixed-Effects Regression	28.56	5	0.0001	Yes

This implies that periods of high or low variability in stock market activity, banking sector indicators, and economic growth are likely to be followed by similar periods, confirming the existence of time-varying conditional volatility. From a market efficiency perspective, this persistence in volatility indicates that the markets do not fully adjust instantly to new information, highlighting a departure from the weak-form Efficient Market Hypothesis.

Overall, the findings support the use of dynamic modeling approaches, such as GARCH-type models or the PVAR framework, to adequately capture the short- and long-run transmission mechanisms among financial markets, banking sector development, and economic growth in MENA countries. These results also provide valuable insights for investors and policymakers by emphasizing the need to account for volatility clustering when forecasting, managing risk, and designing financial reforms.

While the analysis highlights deviations from the weak-form Efficient Market Hypothesis in MENA stock markets, it is also essential to consider the implications for banking efficiency and managerial behavior. Evidence from foundational studies shows that inefficiencies in financial markets can exacerbate problem loans and risk-taking by bank

managers, creating moral hazard issues. When market signals are imperfect or delayed, banks may misprice risk or overextend credit, undermining stability. This perspective links stock market efficiency directly to bank-level outcomes: effective market discipline incentivizes prudent managerial decisions, whereas market inefficiencies can amplify systemic vulnerabilities. In the MENA context, where institutional quality and regulatory frameworks vary widely, such inefficiencies may interact with bank-specific practices, further influencing the Z-score and overall financial stability. Integrating insights from the literature on bank efficiency, problem loans, and managerial behavior provides a more comprehensive framework for understanding the interplay between stock market dynamics and banking sector resilience.

The small and statistically insignificant coefficients for inflation, GDP per capita, and domestic credit to the private sector suggest that macro-level variables alone are insufficient to explain banking sector resilience in MENA countries. In practical terms, this implies that policymakers cannot rely solely on economic growth or inflation targeting to safeguard banking stability; they must also strengthen supervisory practices and promote effective governance within banks.

The PVAR results reveal feedback effects between stock market performance and banking sector depth, indicating that shocks in one segment can propagate to the other over time. For example, an unexpected decline in stock market returns may reduce bank stability by affecting asset valuations or collateral quality, while changes in banking sector size can influence market liquidity through lending and investment activities. These dynamics underscore the interconnectedness of financial markets and banking systems, particularly in heterogeneous regions such as MENA, where countries differ in market structure, oil dependence, and regulatory sophistication.

The significant ARCH-LM results indicate persistent time-varying volatility, suggesting that MENA financial markets do not fully absorb new information instantaneously. From an economic perspective, this persistence implies that investors face periods of heightened risk, and that banks operating in these environments may experience amplified exposure to market shocks.

Taken together, the fixed-effects, PVAR, and volatility analyses provide a comprehensive view of financial stability determinants in the MENA region. While traditional macroeconomic variables show limited explanatory power, the dynamic interactions between banking and capital markets, coupled with time-varying volatility, emerge as key drivers of systemic risk. These insights directly inform the study's hypotheses by demonstrating that an integrated, dynamic perspective is essential to understanding the efficiency–stability nexus in emerging markets, with clear implications for regulatory design, investor decision-making, and cross-country policy coordination.

The results reveal that traditional macroeconomic indicators such as inflation, GDP per capita, and domestic credit to the private sector have limited direct impact on banking sector stability in the MENA region. This finding contrasts with some prior studies that emphasize the stabilizing role of economic growth or financial depth, highlighting that country-specific institutional quality, regulatory frameworks, and bank-level practices may play a more decisive role. The PVAR analysis further shows that shocks in stock market performance propagate differently across countries, underlining the heterogeneity of MENA financial systems, from oil-dependent Gulf economies to more diversified North African markets. To ensure robustness, future analyses should incorporate alternative measures of market efficiency, distinguish between Islamic and conventional banks, and examine sub-periods to account for structural breaks or major economic events. From a practical perspective, these results suggest that policymakers should design stability-enhancing measures that are tailored to national contexts, focusing on strengthening institutional qual-

ity, improving market transparency, and fostering risk management practices rather than relying solely on macroeconomic fundamentals. This dynamic, cross-country perspective also provides actionable guidance for investors, highlighting the need to consider both market efficiency and banking system resilience when making portfolio allocation and risk management decisions.

6. Conclusions

This study investigates stock market efficiency and banking sector stability in the MENA region, using panel data from 21 countries over 2003–2021 and combining fixed-effects regression with a Panel Vector Autoregression (PVAR) framework. By capturing both cross-country heterogeneity and dynamic feedback effects, the analysis provides a comprehensive view of the determinants of financial stability in a highly diverse region. The results reveal that traditional macroeconomic variables such as inflation, GDP per capita, and domestic credit to the private sector exert limited direct influence on banking sector stability. Instead, country-specific characteristics, institutional quality, and regulatory frameworks emerge as key drivers of resilience. The PVAR results further highlight dynamic interactions between banking stability, stock market performance, and systemic risk, underscoring the complex interdependencies often overlooked in static or single-country models.

The study makes three main contributions. First, it demonstrates the value of dynamic panel methodologies for analyzing financial stability in heterogeneous emerging markets. Second, it shows that macro-level fundamentals alone are insufficient to ensure banking sector resilience, emphasizing the importance of robust institutions, governance, and regulatory quality. Third, it provides new evidence on the interconnectedness of banking and capital markets, illustrating how shocks propagate across financial systems and affect stability over time.

These findings carry clear policy implications. Policymakers should implement tailored supervisory and regulatory measures that account for differences across MENA countries, strengthen institutional frameworks, and promote sound risk management practices within banks. Encouraging coordinated development of banking and capital markets can further reduce systemic vulnerabilities, improve market efficiency, and enhance overall financial resilience.

Future research could extend this analysis by incorporating alternative measures of market efficiency, examining the role of Islamic banking alongside conventional banks, or assessing the impact of geopolitical and commodity-related shocks on financial stability. Such studies would deepen understanding of the mechanisms driving financial resilience in emerging and heterogeneous markets like those of the MENA region.

Despite providing new insights into the dynamic interactions between stock market efficiency and banking sector stability in the MENA region, this study has several limitations. First, the analysis relies on aggregated banking data and does not distinguish between Islamic and conventional banks, which may exhibit different risk profiles and regulatory responses. Second, the use of the S&P Global Equity Index may not fully capture country-specific market dynamics, potentially limiting the precision of market efficiency measures. Third, the study focuses on broad macroeconomic and financial indicators, while firm-level or transaction-level data could provide a more granular understanding of market behavior. Future research could address these limitations by incorporating local stock indices, disaggregating bank types, and including additional measures of market efficiency and financial regulation. Furthermore, examining the effects of geopolitical events, commodity price shocks, or regulatory reforms could deepen understanding of the mechanisms driving financial resilience in heterogeneous MENA markets.

While this study provides insights into the dynamic interactions between market efficiency and banking stability in the MENA region, it is limited by the exclusion of bank-type distinctions and the reliance on broad macroeconomic indicators. Future research should address these gaps to enhance the robustness and policy relevance of the findings.

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