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A Fixed-Effects Analysis of Saudi Bank Capital Adequacy: Examining Pandemic Shocks, Capital Structure, and Macroeconomic Drivers

Soumaya Hechmi[1]

Abstract

This study analyzes data from ten major banks that form the backbone of the kingdom's financial system in order to investigate the macroeconomic and bank-level variables that influence banking performance in Saudi Arabia during the revolutionary years of 2015–2024 using a fixed-effects panel regression model with cluster-robust standard errors. The results show that while higher leverage had a negative effect on performance, COVID-19 had a significant positive impact on bank returns, indicating effective regulatory interventions. While bank size and profitability metrics were negligible, GDP growth had marginally positive effects. By showing how regulated banking systems with concentrated market structures react to external shocks and structural changes, the study adds to the body of knowledge on emerging market banking. The findings provide crucial information for investors, bank managers, and regulators navigating Saudi Arabia's changing financial environment.

Keywords: *Capital Adequacy Ratio, Covid-19, Economic Growth, Saudi Banking Sector, Leverage.*

Introduction

The banking sector plays a core role in economic development through financial intermediation, savings mobilization, and optimal capital allocation (Levine, 2005). Emerging economy banks face unique challenges posed by economic volatility, regulatory reforms, and external shocks that have significant implications for their performance (Demirgüç-Kunt & Huizinga, 2010). The banking system of Saudi Arabia, the Middle East's largest, presents a fascinating case study due to its double exposure to oil price volatility and ambitious economic diversification agenda under Vision 2030 (SAMA, 2022).

This study examines the determinants of bank performance in Saudi Arabia during the transformative period of 2015-2024, which encompassed multiple economic cycles including oil price declines, fiscal reforms, and the COVID-19 pandemic.

The study makes a number of important contributions to the literature. First, it extends traditional models of banking performance through the incorporation of bank-specific variables (leverage, size, profitability) and macroeconomic shocks (pandemic shock, GDP growth). Second, it offers empirical evidence from a state-controlled banking sector that is structurally different from Western economies in state involvement and crisis resolution. Third, the research covers a critical period of economic transformation in Saudi Arabia, and implications can be applied to other natural-resource-based economies diversifying.

Understanding Saudi Arabian bank performance drivers has important implications for different

[1] Department of Finance, College of Business, Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh, Saudi Arabia, Email: sbhechmi@imamu.edu.sa, ORCID: ID: 0000-0002-6082-8120.

stakeholders. For regulators, it provides evidence to refine prudential policies and crisis management approaches. For bank managers, it offers recommendations on optimal capital structures and risk management strategies. For investors, it offers better insight into the way Saudi banks cope with economic cycles. In general, this research contributes to applied policymaking as well as to the academic literature in emerging market banking.

The paper is organized as follows. The next section presents a review of the literature that underpins this research. Section 3 details the methodology, including the empirical model, variable selection, and data sources. Section 4 presents the empirical results, analyzing the relationships between the key variables. Section 5 discusses these findings, exploring their theoretical and practical implications. Finally, Section 6 concludes the paper by summarizing the key insights and their broader significance for academia, policymakers, and banking practitioners.

Literature Review

Economic Growth and Capital Adequacy

Emerging markets have seen much research on the link between economic development and bank capital adequacy, with studies stressing the twin influence of macroeconomic conditions and regulatory frameworks on banks' capital buffers. Recent studies of several banking systems expose both consistent trends and context-specific dynamics.

Gharaibeh (2023) tested Jordanian banking system determinants of capital adequacy using an autoregressive distributed lag (ARDL) model and determined that GDP growth has a positive long-run relationship with CAR. This suggests that economic development enhances the ability of banks to maintain buffers of capital, perhaps through improved loan quality and higher profitability. However, the study also notes that this influence is non-linear in nature: when there is excessive credit growth, the interaction between CAR and GDP weakens as risk-taking becomes more severe.

To complement these findings, Junos et al. (2021) analyzed ASEAN banks and demonstrated that macroeconomic stability (measured in terms of inflation and exchange rate volatility) is equally critical for CAR maintenance. Their panel data evidence provided evidence that GDP growth is correlated with CAR, but the relationship becomes weaker during financial crises. Notably, they highlight that macroprudential policy (e.g., countercyclical capital buffers) can strengthen or weaken this link depending on its design.

Contextual subtleties show up in Naoaj (2023) research of Bangladeshi commercial banks, where foreign-owned banks were more sensitive to CAR-GDP than home banks. This captures the ways in which ownership structures sit between the nexus of capital adequacy and growth. The study also noted a threshold effect: whereas growth above 5% consolidates capital bases, GDP growth below 5% slows CAR with increasing non-performing loans (NPLs).

Covid-19 and Capital Adequacy

The COVID-19 crisis posed unprecedented challenges for global banking systems with a stress test of capital adequacy frameworks. Recent evidence across emerging markets illustrates how banks reacted to this crisis and implications for regulation policy and risk management.

Systemically important institutions maintained CAR above 14% versus 10-12% for smaller banks, according to Hasan and Pareek (2022), which found COVID-19 caused different capital adequacy responses in Bangladeshi banks. While digitally advanced banks more effectively preserved capital buffers through 30% lower operational risk charges, regulatory forbearance measures artificially inflated CAR by 1.2-1.8 percentage points during 2020-2021.

Tran's (2024) cross-country study revealed COVID-19's disproportionate impact on bank capital adequacy, with government stimulus packages limiting CAR declines to just 0.3% compared to 2.1% in less-supported markets.

Mathenge and Muniu (2024) studied the Kenyan perspective and found a V-shaped recovery pattern in the capital adequacy of commercial banks. According to their analysis, when NPLs increased in Q2 2020, CAR fell precipitously by 3.5 percentage points; however, by Q4 2021, it had recovered quickly, by 82%.

Bank's Internal Factors and Capital Adequacy

The effect of leverage on capital adequacy varies by nation. Higher leverage may be linked to stronger capital buffers, perhaps as a result of strategic or regulatory considerations, according to studies from Jordan (Gharaibeh, 2023) and Vietnam (Tran, 2024). On the other hand, data from Bangladesh indicates a negative correlation, indicating that a bank's capital adequacy is diminished by an overreliance on debt (Naoaj, 2023). These variations show how national banking practices and regulatory frameworks have an impact.

Profitability is commonly regarded as a key driver of solid capital adequacy. If banks are more profitable, then they should be capable of generating bigger safety cushions. However, the evidence is a blurry picture. In Bangladesh, Naoaj (2023) concluded that net profit has a straightforward, direct effect on capital adequacy, more profit means more capital strength. Not all countries, though, paint this picture. In Vietnam, Tran (2024) found that return on equity did not significantly impact capital sizes. The same was true for Bhattarai (2020) in Nepal, where profitability also did not significantly influence the amount of capital available with banks. These divergent findings suggest that profits may not always be invested in capital cushions, possibly because of differences in banks' earnings management, dividend payout, or responses to regulator expectations.

There is a complicated relationship between capital adequacy and bank size. Because of their size and market access, larger banks may appear more stable, but research indicates that they frequently maintain lower capital ratios. Both Bhattarai (2020) in Nepal and Tran (2024) in Vietnam, for instance, discovered a negative correlation between size and capital adequacy, implying that larger banks might take on greater risk or rely on their perceived importance to avoid holding more capital. A weak but marginally beneficial effect was discovered by Pham and Nguyen (2017). The study's overall findings indicate that banks do not always develop larger capital buffers as they expand, perhaps as a result of regulatory leniency or a sense of security in their market position.

This study contributes to the literature by assessing macro-economic and bank-level capital adequacy drivers in a high-concentration, oil-related economy that is transforming digitally and into regulation, an environment not in earlier cross-country or single-economy studies.

Data and Methodology

Sample and Data Description

This study examines the impact of economic growth, COVID-19, leverage, bank size, and profitability (ROE) on the capital adequacy of 10 Saudi banks listed on Tadawul over the period 2015–2024. The dataset forms a balanced panel, with all banks having complete observations for each year, ensuring methodological rigor and eliminating survivorship bias. Data were collected from bank annual reports, official websites, and the World Bank for macroeconomic indicators. The sample represents Saudi Arabia's banking sector comprehensively, covering both conventional and Islamic banks while excluding non-listed or inactive institutions. The definition of the variables is presented in Table 1.

Variable	Index	Formula	Source
Dependent Variable			
Capital Adequacy Ratio	CAR	Percentage (%)	Bank annual reports
Independent Variables			
Economic Growth	LGDPC	GDP per capita, current prices (U.S. dollars per capita)	World Bank Indicators
COVID-19	COVID	Pandemic dummy (1 for 2020–2021, 0 otherwise)	Author's construction
Leverage	LEV	$\frac{Total\ liability}{Owners'\ equity}$	Tran (2024)
Bank Size	SIZE	Ln (total assets)	Hechmi and Saanoun (2024)
Profitability	ROE	$\frac{Earnings\ before\ interest\ \&tax}{Owners'\ equity}$	Tran (2024)

Table 1. Variable Definitions and Sources

The balanced panel structure allows for robust econometric analysis, including fixed/random effects and tests for cross-sectional dependence. The inclusion of pre-pandemic, pandemic, and post-pandemic years enables a comprehensive assessment of COVID-19's impact on capital adequacy. In this study, the logged variable is economic growth (LGDPC).

Variable	Obs	Mean	Std. Dev.	Min	Max

CAR	100	19.666	1.98	15.46	27.48
LGDPC	100	4.429	.067	4.333	4.537
LEV	100	6.867	1.14	4.73	9.67
SIZE	100	8.304	.311	7.709	9.043
ROE	100	12.53	4.856	-7.74	23.87

Table 2. Descriptive Statistics

The descriptive statistics (Table 2) reveal notable patterns in the variables under study. Capital adequacy (CAR) displays relatively stable levels across banks, with moderate dispersion, suggesting consistent regulatory compliance. GDP growth (LGDPC) exhibits minimal variation, reflecting steady macroeconomic conditions during the period. Leverage (LEV) shows moderate variability, indicating differing debt strategies among banks. Bank size (SIZE) varies within a narrow range, implying homogeneity in asset scales. Return on equity (ROE) has the widest dispersion, highlighting significant differences in profitability performance, including instances of negative returns. Overall, the data suggest a stable banking environment with varying efficiency and risk profiles.

Methodology

Panel unit root tests examine the stationarity properties of variables in panel data to avoid spurious regression results. Unlike time series unit root tests (e.g., ADF, PP), panel-based tests such as Levin, Lin, and Chu (LLC) test (Levin et al., 2002), Harris-Tzavalis Test (Harris and Tzavalis, 1999), and Fisher-type tests based on augmented Dickey-Fuller and Phillips-Perron methodologies (Choi, 2001; Maddala and Wu, 1999) enhance power by combining cross-sectional and time-series dimensions. We apply some of these tests in order to determine whether variables contain stochastic trends, necessitating differencing for reliable estimation.

Cross-sectional dependence (CD) tests assess whether residuals across panel units are correlated, which may arise due to unobserved common shocks or spatial spillovers. Pesaran’s CD test (Pesaran, 2004), Friedman’s test (Friedman, 1937), and Frees’ test (Frees, 1995) detect such dependence, which, if ignored, can lead to biased estimators (Chudik & Pesaran, 2015).

To further explore whether the impact of explanatory variables on the outcome variable varies across different countries, we conduct tests for slope heterogeneity. One robust technique in this context is the procedure proposed by Pesaran and Yamagata (2008), which helps examine structural differences across entities.

To investigate long-term equilibrium relationships among variables, panel cointegration tests are employed. Widely used methods include the Kao test (Kao, 1999), the Pedroni test (Pedroni, 2004), and the Engle-Granger-based panel test (Wang & Zhang, 2014).

Once these preliminary tests are completed, the next step is model estimation. Panel data regression models typically take one of three forms:

- ***Pooled Ordinary Least Squares (POLS):*** Assumes homogeneity across units, treating all observations as part of a single dataset.

$$Y_{it}=\beta_0+\beta_1 X_{it}+\epsilon_{it} \quad (1)$$

Where Y_{it} is the outcome variable for unit i at time t, X_{it} is the set of predictors, β_0 is a constant term, β_1 denotes coefficients of regressors, and ϵ_{it} is the error term. POLS model is efficient if no heterogeneity exists (Wooldridge, 2010).

- ***Fixed Effects Model (FE):*** Controls for time-invariant heterogeneity by allowing unit-specific intercepts.

$$Y_{it}=\beta_0+\beta_1 X_{it}+\mu_i+\epsilon_{it} \quad (2)$$

Where μ_i captures unobserved heterogeneity, and ϵ_{it} is the idiosyncratic error (Cameron and Trivedi, 2005). FE model is consistent if μ_i correlates with X_{it}.

- ***Random Effects Model (RE):*** Assumes unit-specific effects are uncorrelated with predictors.

$$Y_{it}=\beta_0+\beta_1 X_{it}+\mu+u_{it} \quad (3)$$

Where μ is the overall mean, and u_{it} combines individual and random errors. RE model is efficient if μ is uncorrelated with regressors (Hsiao, 2022).

To identify the most appropriate model specification, diagnostic comparisons are essential. The Hausman test (Hausman, 1978) is conducted to compare FE and RE estimations, evaluating whether the RE estimator is consistent. Meanwhile, the Breusch-Pagan Lagrange Multiplier test (Breusch & Pagan, 1980) is applied to distinguish between the pooled and random-effects models.

In order to ensure robustness, Post-estimation tests were applied, including serial correlation and heteroskedasticity tests.

Results

Panel Unit Root Tests

Table 3 represents the result of the panel unit root test with Levin-Lin-Chu (LLC) unit-root test and Harris-Tzavalis Test.

	Variables	I(0)	I(1)
Levin-Lin-Chu unit-root test (LLC)	CAR	-6.6938***	-6.5990***
	LGDPC	-5.3870***	-28.8077***
	LEV	-5.5177**	-7.5613***
	SIZE	-0.8021***	-2.6877***
	ROE	-3.9793***	-6.6687***
Harris-Tzavalis Test (HT)	CAR	-4.6336***	-9.2482***
	LGDPC	-1.2383	-8.4847***
	LEV	-2.5009***	-9.1821***
	SIZE	3.2175	-8.9214***
	ROE	-3.7636***	-9.8322***
*** and ** imply the significance at 1% and 5% level, respectively			

Table 3. Panel Unit Root Results

The panel unit root test results reveal distinct patterns of stationarity across variables. Both the Levin-Lin-Chu (LLC) and Harris-Tzavalis (HT) tests indicate that CAR, LEV, and ROE are stationary at level [I(0)], as evidenced by their statistically significant negative statistics. In contrast, LGDPC and SIZE exhibit non-stationarity at level but become stationary after first differencing [I(1)], with highly significant results. The HT test provides additional clarity for SIZE, showing a positive coefficient at level (3.2175) that confirms its non-stationary nature before transformation. These findings are consistent across both tests, suggesting robust conclusions about the integration order of each variable. The agreement between LLC and HT results strengthens the reliability of these conclusions for subsequent analysis.

Panel Cross-Sectional Dependence Tests

In this analysis, we employed Pesaran's CD test, Friedman's test and Frees' test to assess cross-sectional dependence among the panel data (Table 4).

Pesaran's Test	
Statistic	**P-value**
1.138	0.2553
Friedman's Test	
Statistic	**P-value**
11.804	0.2246
Frees' Test	
Statistic	**Critical values**
0.282	alpha = 0.10 : 0.2559 alpha = 0.05 : 0.3429 alpha = 0.01 : 0.5198

Table 4. Panel Cross-Sectional Dependence Estimations

The cross-sectional dependence tests yield consistent evidence of weak spatial correlations in the panel data. Pesaran's test (statistic = 1.138, p-value = 0.255) and Friedman's test (statistic = 11.804, p-value = 0.225) both fail to reject the null hypothesis of independence at conventional significance levels. Frees' test shows slightly stronger but still limited evidence (statistic = 0.282), exceeding the 10% critical value (0.256) while remaining below stricter thresholds. Taken together, these results suggest marginal cross-sectional dependence that doesn't reach standard significance levels, though some weak common factors may be present.

Slope Heterogeneity Test

The Pesaran-Yamagata slope homogeneity test (Pesaran and Yamagata, 2008) evaluates whether regression coefficients are identical across cross-sectional units in panel data models. The null hypothesis (H_0) states that slope coefficients are homogeneous (equal for all panels), while the alternative suggests heterogeneity (coefficients vary significantly). This test is particularly useful for determining whether pooled estimators (e.g., POLS, FE, RE) are appropriate or if heterogeneous models (e.g., MG, AMG) should be employed. The test provides two statistics, Delta (asymptotic) and adjusted Delta (finite-sample correction), to assess slope consistency across groups.

The results of the test for slope heterogeneity based are summarized in the Table 5.

Pesaran, Yamagata test		
	Delta	**P-value**

	0.958	0.338
adj.	1.748	0.080*
* implies the significance at 10% level.		

Table 5. Testing For Slope Heterogeneity

The results indicate strong evidence that the slope coefficients vary across different cross-sectional units. This suggests that the impact of the independent variables on GDP varies significantly across the different groups in the dataset, reflecting differences in the response to the explanatory variables. This suggests that there is significant slope heterogeneity among the panel data.

Panel Co-Integration Tests

In our analysis, we employed the Kao and Pedroni co-integration tests to investigate the long-run relationships among the selected variables. Results are presented in Table 6.

Kao test		**Pedroni test**	
Augmented Dickey-Fuller t	-2.2932**	Panel PP-statistic	-5.5169***
		Group PP-statistic	-5.3344***
*** and ** imply the significance at 1% and 5% level, respectively.			

Table 6. Panel Co-Integration Results

The combined results from the Kao and Pedroni tests provide strong evidence of cointegration among the variables. The Kao test (ADF t = -2.29, p < 0.05) rejects the null hypothesis of no cointegration at the 5% significance level, while the Pedroni test reinforces this conclusion with highly significant Panel PP (-5.52, p < 0.01) and Group PP (-5.33, p < 0.01) statistics. These findings confirm a stable long-run equilibrium relationship exists in the data, validating the use of POLS, FE, and RE models for long-run estimation. While these pooled estimators require homogeneous slopes (supported by the Kao test's single cointegrating vector), the significant cointegration justifies their application.

Panel Regressions

We estimate three regressions Fixed-Effects Model, Random-Effects Model and Pooled regression (Table 7).

Variables	**Fixed-effects regression**	**Random-effects regression**	**Pooled regression**
LGDPC	5.7539 (3.1904)*	6.3279 (2.6653)**	4.8630 (2.8890)*
COVID	1.1466 (0.3732)***	1.1760 (0.3824)***	1.1520 (0.4741)**
LEV	-1.6426 (0.2491) ***	-1.2615 (0.2175)***	-0.5678 (0.1862) ***
SIZE	-0.5896 (1.5935)	-1.0197 (1.0670)	-0.2462 (0.7538)
ROE	-0.0402	-0.0509	-0.0544

	(0.0441)	(0.0437)	(0.0479)
_cons	10.6348 (9.3390)	9.1752 (9.6854)	4.5256 (12.1169)
R-squared Within Between Overall	 0.5026 0.0150 0.1940	 0.4967 0.0129 0.2087	 0.2285
***, **, and * imply the significance at 1%, 5%, and 10% level, respectively.			

Table 7. Model Regression

The fixed-effects regression model demonstrates the strongest explanatory power for within-bank variations, with an R-squared of 0.50. This model reveals that GDP growth (LGDPC) has a significant positive impact at the 10% level on bank performance, while the COVID variable shows an even stronger positive effect at the 1% significance level. Bank leverage (LEV) emerges as a consistently negative factor across all models, but its effect is most pronounced in the fixed-effects specification. However, this model does not account for between-bank differences, as shown by the low between R-squared of just 0.01.

The random-effects model offers a balanced approach for analyzing bank performance, capturing both within-bank and between-bank variations. It produces results similar to the fixed-effects model but suggests a stronger GDP growth impact (6.33 versus 5.75) that is significant at the 5% level. The COVID effect remains robustly positive at the 1% level across all banks, while leverage continues to show a significant negative relationship with performance.

The pooled OLS regression, while simplest to implement, appears least reliable for bank performance analysis. It underestimates the GDP growth impact compared to both FE and RE models (4.86 versus 5.75 and 6.33) and fails to account for bank-specific effects. The model does confirm the robust positive COVID effect (significant at 5%) and negative leverage impact on bank performance, but with weaker magnitude. With an overall R-squared of just 0.23, it explains less variation than the other approaches. The results consistently show that bank SIZE and ROE lack statistical significance across all model specifications, suggesting these factors may not be important determinants of bank performance in this study.

Model Specifications Tests

We determine which model is the most appropriate for our panel. The validity test to choose between the three models is presented in Table 8.

Test	**Tested**	**P-value**	
Hausman test	fixed / random model	0.0017***	Fixed
Breusch-Pagan LM Test	pooled / random model	0.0000***	Random
Hausman test	pooled / fixed model	0.0000***	Fixed
***imply the significance at 1% level			

Table 8. Specifications Results

The model specification tests in Table 8 guide the appropriate choice of panel data estimation technique. The Hausman test comparing the fixed and random effects models yields a significant p-value (0.0017), indicating that the fixed effects model is preferred because the random effects assumption of no correlation between the regressors and the individual effects is violated. The

Breusch-Pagan LM test, which distinguishes between pooled OLS and random effects, is also highly significant (p = 0.0000), suggesting that the random effects model is better than pooled OLS, i.e., unobserved heterogeneity across entities matters. Lastly, the second Hausman test comparing pooled and fixed effects again confirms (p = 0.0000) that fixed effects is superior to the pooled model. Together, these results robustly support the use of the fixed effects estimator for the main panel regression analysis.

Validity Tests

To ensure the robustness of our regression results, it is essential to verify that the model's underlying assumptions hold true. Specifically, violations such as autocorrelation (serial correlation) and heteroskedasticity (non-constant variance of errors) can compromise the reliability of statistical inference.

We assess these potential violations using diagnostic tests, with results summarized in Table 9.

Diagnostic test	**Coeff.**	**Prob.**	**Outcomes**
Breusch-Pagan LM test of independence Test	58.386	0.0869*	Weak cross-sectional dependence
Modified Wald test for groupwise heteroskedasticity	173.73	0.000***	Heteroscedasticity exists

*** and * imply the significance at 1% and 10% level, respectively.

Table 9. Test of Autocorrelation and Heteroscedasticity.

The diagnostic tests reveal significant heteroskedasticity (p=0.000) and weak cross-sectional dependence (p=0.0869) in the panel data model, violating classical regression assumptions. To address these issues and ensure valid inference, cluster-robust standard errors (Table 10) should be employed, which simultaneously correct for both heteroskedasticity and within-panel correlation (Cameron and Miller, 2015). This approach maintains the original coefficient estimates while providing reliable standard errors that are robust to these violations.

Estimation Results

Variables	**Coefficient**	**t-statistic**	**95% Confidence Interval**
LGDPC	5.749 (2.871)*	2.00	[-0.746, 12.243]
COVID	1.168 (0.345)***	3.39	[0.389, 1.948]
LEV	-1.718 (0.543)**	-3.16	[-2.947, -0.489]
SIZE	-0.687 (2.562)	-0.27	[-6.483, 5.109]
ROE	-0.183 (0.112)	-1.63	[-0.437, 0.071]
_cons	11.793 (13.996)	0.84	[-19.868, 43.455]
R-squared			

Within Between Overall	0.4997 0.0155 0.1913		
***, **, and * imply the significance at 1%, 5%, and 10% level, respectively.			

Table 10. Regression Results: Fixed Effects Model with Cluster-Robust Standard Errors.

The results indicate that COVID and LEV are statistically significant predictors of CAR, with COVID showing a positive effect and leverage (LEV) a negative effect. LGDPC is marginally significant, while SIZE and ROE show no significant impact. The model's high within R-squared value of 49.97% bears testimony to its fitness in capturing bank-specific performance dynamics on the time dimension, particularly for time-varying determinants like pandemic impacts and shifts in leverage. The low between R-squared value of 1.55% is to be expected in a fixed-effects framework where focus is on within-bank variation and accounting for persistent differences between institutions. The use of cluster-robust standard errors provides confidence to such conclusions by alleviating the problem of possible heteroskedasticity and autocorrelation, particularly relevant given the duration of the study period across different economic cycles and shocks. Such methodological approaches provide a guarantee that the expressed relationships are not spurious but represent robust statistical proof.

Robustness Check

In order to check the robustness of our baseline fixed-effects estimates with cluster-robust standard errors, we employ panel Fully Modified Ordinary Least Squares (FMOLS) as a test of robustness. FMOLS accounts for potential endogeneity and serial correlation in panel data and provides efficient long-run coefficient estimates (Hechmi, 2025). The panel FMOLS estimation results are presented in Table11.

Variables	**Coefficient**	**t-statistic**	**Prob.**
LGDPC	4.297 (1.254) ***	3.427	0.001
COVID	1.093 (0.142)***	7.674	0.000
LEV	-1.747 (0.102)***	-17.110	0.000
SIZE	-1.230 (0.637)*	-0.27	0.058
ROE	0.017 (0.018)	0.930	0.356
R-squared **Adj R-squared**	0.6004 0.5258		
*** and * imply the significance at 1% and 10% level, respectively.			

Table 11. Regression results: Fully Modified Ordinary Least Squares (FMOLS).

FMOLS estimates firmly validate our baseline fixed-effects findings as well as provide additional information regarding long-term dynamics. Both models clearly document negative leverage and positive COVID-19 impacts on capital adequacy. FMOLS reports more significant long-run GDP growth impact as well as slightly significant size effect, while both approaches agree on the insignificance of profitability (ROE). These results indicate that while basic relationships are strong across specifications, FMOLS identifies more long-run economic impacts and fixed effects identify more precisely within-bank variation. Convergence of key findings across different methods confirms the robustness of our results concerning Saudi banks' capital adequacy determinants.

Discussion

The positive and statistically significant coefficient of COVID-19 indicates that the financial performance of Saudi banks was better during the pandemic period. Our results are consistent with those of Tran (2024). Our finding demonstrates the effectiveness of regulatory policies by the Saudi Central Bank (SAMA), including liquidity provision facilities and loan deferment programs, in maintaining banking sector stability. The faster adoption of digital banking channels during this period would have aided operating efficiencies and broader customer reach, additionally supporting bank returns. While this positive impact is against the initial global trend of banking sector losses, the same aligns with regional evidence demonstrating the resilience of GCC financial institutions during crises. The persistence of this impact through 2024 suggests that pandemic-induced changes would have brought long-lasting structural benefits to Saudi banks, though the long-term sustainability of the gains ought to be subjected to further scrutiny with the normalization of the economy.

The robust negative relationship between leverage (LEV) and returns from banks helps highlight the risks of higher debt levels in the Saudi banking landscape. Our findings are consistent with those of Naoaj (2023). Our result is in favour of capital structure theory but experiences noteworthy regional intricacy as Saudi banks possess a unique regulatory environment moderated by Basel III standards and macroeconomic uncertainty. The sample period saw significant volatility in oil prices and also fiscal reforms that may have increased the negative effect of leverage by elevating borrower default risk. The finding shows that while debt capital may be a source of growth capital, excessive leverage in economic uncertainty appears to be restraining Saudi banks' performance, maybe by limiting their operating flexibility or triggering higher capital charges under regulatory regimes.

The marginally significant positive coefficient for bank performance (LGDPC) suggests a tentative connection between economic growth and bank performance but one in the Saudi context that is relatively weak. This may suggest partial decoupling of the banking sector from overall economic trends as Saudi banks have found growing revenue away from traditional GDP-sensitive interest income. The Vision 2030 economic diversification policy could have created a transition period where GDP growth gains have yet to be entirely captured by the banking sector. Alternatively, the composite aggregate GDP measure may hide important sectoral variations with oil-based growth potentially having different implications for banks than non-oil based economic growth. Our findings are consistent with those of Gharaibeh (2023) and Junos et al. (2021).

The statistically insignificant SIZE coefficient of bank size is a refutation of conventional scale advantage hypotheses in banking. This finding suggests that within the concentrated Saudi banking market, size does not necessarily correspond with enhanced performance, perhaps due to regulatory homogeneity limiting competitive differentiation or early-stage diseconomies of scale in the post-merger environment. The 2021 merger of National Commercial Bank with

SABB to create one of the region's largest banking groups does not appear to have brought much in terms of performance advantage at least in the short term (Alsharif, 2023). This revelation invites even more examination of scale's behavior in regulated banking oligopolies like Saudi Arabia's, in which competitive pressures can be very different from more dispersed banking markets.

Similarly, the non-relevance of profitability (ROE) implies that this traditional profitability measure could be an unreliable indicator of market-based performance measures in the Saudi environment. This could reflect timing differences between accounting-based measures like ROE and future-oriented market returns. The find would also suggest that investors in Saudi banks place greater importance on macroeconomic and regulatory factors than on historical profitability measures when valuing bank stocks, considering the sector's exposure to oil price volatility as well as to economic transformation under Vision 2030.

Conclusion

This study examined the determinants of Saudi bank performance between 2015 and 2024 through the fixed-effects model with cluster-robust standard errors for reliable inference. The results highlight that COVID-19 had a positive impact on bank returns, reflecting the effectiveness of regulatory intervention and digitalization. Conversely, higher leverage had a negative effect on performance, suggesting that too much borrowing is dangerous in times of economic uncertainty. GDP growth had a negligible positive effect, while bank size and ROE were insignificant, indicating that macroeconomic and regulatory conditions overshadow traditional performance indicators in the unique banking setting of Saudi Arabia.

The findings emphasize the effectiveness of crisis interventions like liquidity injections and loan roll-overs, and propose that these be enshrined in Saudi Arabia's stability plan. Because leverage has a devastating influence, regulators need to tighten controls on banks' capital structures, particularly when the economy is under pressure. The lagged gain on performance from such mergers as NCB-SABB means that there needs to be greater transparent integration timelines and progress markers for future consolidation steps.

The results suggest more prudent leverage policies with ongoing investment in digital transformation, which played a critical role during the pandemic. Operational efficiency and diversifying into lending to the non-oil sectors are key areas for banks to work on in alignment with Vision 2030 objectives. The muted impact of size on performance suggests consolidation should be based on strategic synergies rather than considerations of size alone.

The investors need to realize that Saudi bank performance remains more sensitive to macroeconomic shocks and regulatory action than to traditional finance measures. The study identifies the importance of the observation of SAMA policy change and oil market movement in tracking bank values. Market participants should account for long integration times in cases of consolidation, considering that synergies will be fully realized after several years.

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