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Global investor sentiment and bank performance: Evidence from African banks

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Abstract

Purpose: This study aims to address the underexplored implications of investor sentiment on the performance of banks operating in African economies. It investigates how investor sentiment affects bank performance across different regulatory frameworks, market conditions, and bank-specific attributes.

Design/Methodology/Approach: Using panel data from 35 commercial banks listed on African stock exchanges from 2000 to 2022, this study employs a fixed effects model to assess the impact of investor sentiment on bank performance.

Findings: The findings indicate that investor sentiment positively impacts bank performance. This relationship is further influenced by bank-specific attributes, regulatory frameworks, and market contexts. Notably, confidence in the Basel regulatory framework enhances this sentiment-performance relationship, underscoring the importance of compliance for attracting investment.

Practical Implications: The results suggest several key policy implications: policymakers can utilize these insights to promote stable regulatory environments that support positive investor sentiment. Basel compliance further strengthens investor confidence, which contributes to improved bank performance in African banks. Bank managers can integrate sentiment analysis into their risk management strategies to anticipate shifts in investor confidence, thereby mitigating performance volatility and ensuring sustainable profitability.

Originality/Value: This study contributes to the literature by highlighting the significant role of investor sentiment in influencing bank performance within the African context. It emphasizes the importance of regulatory frameworks and sentiment-driven market dynamics in emerging economies, offering valuable insights for policymakers and bank managers aiming to enhance financial stability.

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INTRODUCTION

Background

Over the past two decades, African banking has experienced substantial transformation driven by market-oriented reforms and strategic infrastructure development. These developments have played a crucial role in fostering economic growth and strengthening regional economies (Archibong, Coulibaly and Okonjo-Iweala 2021), enhancing the performance of African banks. Consequently, African banks have become more appealing to global stakeholders seeking emerging market opportunities and collaborative ventures in today's interconnected financial environment (Shah and Albaity 2022). However, as these banks expand within this dynamic landscape, their performance is increasingly shaped by domestic factors and global forces, particularly shifts in global investor sentiment. Despite the importance of these dynamics, the influence of global and behavioural factors, such as investor sentiment, on bank performance remains underexplored, highlighting the need and relevance of this study. Without such explorations, it becomes challenging to understand the risks and opportunities banks face fully.

Global investor sentiment is critical in influencing financial markets, and its impact is increasingly evident in the banking sector worldwide (Chen 2021). The interconnected nature of today's financial markets and systems means that shifts in global investor sentiment can have far-reaching implications, affecting capital flows (Muguto, Rupande and Muzindutsi 2019), credit availability (Chen 2021), and overall market stability (Rupande, Muguto and Muzindutsi 2019; Muzindutsi et al. 2023; Aboluwodi, Muzindutsi and Nomlala 2024). Many African banks are still relatively small in absolute terms, underdeveloped, and fragile compared to their global counterparts. Thus, these global fluctuations in investor sentiment may significantly influence the African banks' strategic decisions, risk and operations. Furthermore, the banking sector in Africa faces regulatory challenges, such as a lack of compliance with Basel capital requirements, which can exacerbate their vulnerability to shifts in global investor sentiment (Dayi et al. 2022; Oyetade, Obalade, and Muzindutsi 2023).

African banks face challenges such as high non-performing loans and low capitalisation. However, some have demonstrated strong profitability, with Nigerian and South African banks achieving a return on equity (ROE) above 15 per cent in 2022, comparable to leading American banks (Dayi et al., 2022; Statista, 2023). This trend extends across the continent, reflecting the resilience of certain African financial institutions in navigating economic and operational challenges. Nonetheless, African banks remain limited in offering comprehensive financial services, relying primarily on basic products such as short-term loans, unlike their counterparts in developed economies that provide a broader range of financial solutions, including short-, medium-, and long-term loans (Oyetade, Obalade and Muzindutsi 2021). As competition in global financial markets intensifies, these limitations could hinder African banks' ability to remain competitive and meet the evolving needs of their clients, especially as they strive to attract international investment and foster sustainable growth.

Another challenge is the impact of shifts in global investor sentiment, which can trigger significant capital outflows, directly influencing bank performance (Chen 2021). These sentiment shifts can propagate through interconnected financial networks, amplifying their effects on banks, particularly African banks whose relative fragility and insufficient capitalisation make them more susceptible to external shocks. While favourable sentiment can attract capital inflows, boosting liquidity, fostering investment, and enhancing bank performance (Irresberger, Mühlnickel and Weiß 2015; Chen 2021), negative sentiment may lead to capital flight, increase funding costs, and exacerbate existing vulnerabilities, further weakening bank performance and straining the sector. This concern is heightened by the limited compliance of many African banks with Basel capital standards, leaving them ill-prepared for such shocks. However, the extent to which global investor sentiment influences African bank performance remains underexplored, highlighting the complexity of this relationship and the need for further research.

The introduction of Basel III capital requirements following the 2008 financial crisis aimed to establish higher-quality minimum capital standards to mitigate banking risks (Bandt et al. 2018; BCBS 2017). Ideally, these regulations would have strengthened banks' resilience and enhanced financial stability. However, many African banks struggle to meet the existing Basel II requirements, while countries such as the USA, European nations, and South Africa have swiftly adopted Basel III. As a result, many African banks are left with low capital buffers, increasing their vulnerability to risks driven by fluctuating investor sentiment, which negatively impacts profitability. Furthermore, non-compliance with higher capital standards fosters negative investor sentiment, as such banks are perceived as high-risk, reducing their attractiveness to potential investors (Faia 2017). This lack of access to investor capital limits the funds available for African banks to lend and invest, further constraining profitability and weakening their financial standing.

Profitability is essential for banks and is traditionally influenced by bank-specific factors, such as size and non-performing loans, and macroeconomic conditions (Bandt et al. 2018). However, recent research

highlights that investor sentiment also plays a critical role in shaping bank behaviour, particularly influencing risk-taking decisions (Cubillas, Ferrer and Suárez 2021). Investor sentiment has further been shown to impact bond returns, bond yields, capital flows, and liquidity management, all closely tied to bank performance (Muguto et al. 2022; Chen 2021). For example, negative sentiment can drive up interest rates and bond yields, raising borrowing costs for banks and their customers while also heightening sovereign risk, ultimately deteriorating asset quality and profitability. Nevertheless, the influence of global investor sentiment on African banks — operating in less developed markets with unique regulatory frameworks and vulnerabilities — remains underexplored, revealing a critical gap in the literature that warrants further investigation.

This study investigated how global investor sentiment impacts bank performance in Africa. By exploring this relationship, this study aimed to inform policymakers and stakeholders in developing effective strategies to mitigate negative sentiment risks, attract investors, and enhance bank profitability. Additionally, the study introduced a new global sentiment index to assess African banks' sensitivity to sentiment shifts, addressing a gap in the behavioural finance literature. The findings are expected to empower bank managers to help them leverage positive sentiment for long-term success. They also offer policy recommendations for policymakers and regulators to enhance the resilience and stability of the African banking sector. This research contributes to the limited knowledge of investor sentiment's influence on bank performance, particularly in Africa. The justification for choosing African banks for this study is that African banks present unique vulnerabilities in offering comprehensive financial services but still have growing significance in global markets.

Over the past two decades, African banking has grown rapidly, attracting significant interest from global investors. However, many banks struggle with challenges such as limited compliance with Basel III capital requirements, leaving them vulnerable to shifts in global investor sentiment (Oyetade, Obalade and Muzindutsi 2023). Weaker capital buffers and higher non-performing loans further expose these banks to external shocks, amplifying the impact of sentiment-driven capital flows. Despite these challenges, research on the influence of global investor sentiment on African banks remains limited, highlighting a gap in the literature. This study aims to bridge that gap by examining how investor sentiment affects bank performance in Africa, providing valuable insights into how these banks can mitigate risks, capitalise on positive sentiment, attract investment, and enhance profitability. Investigating sentiment in the context of African banks also offers a deeper understanding of investor behaviour in emerging markets, an area that remains underexplored.

The remainder of this article is as follows. The next two subsections present the theoretical framework and empirical literature. Section 2 describes the data, and the methods used to analyse such data. Section 3 presents the results and discusses the findings. Section 4 concludes the article and provides necessary recommendations.

Theoretical framework

There are competing theories regarding the impact of behavioural biases, an amalgam of which constitutes sentiment. Market-wide investor sentiment reflects the collective attitude of investors toward specific assets, markets, or economies, often driven by emotions, beliefs, and perceptions rather than fundamental information (Shen, Yu and Zhao 2017). These biases influence investor decisions, affecting buying and selling behaviour and impacting asset prices and market dynamics (Kamoune and Ibenrissoul 2022). High sentiment fosters optimism and bullish behaviour, while low sentiment triggers pessimism and bearishness, leading to volatility (Muguto et al. 2022). Behavioural finance argues that sentiment contributes to market inefficiencies, causing prices to deviate from fundamental values (Shah and Albaity 2022). These psychological influences drive trends that fundamental information alone cannot explain, making sentiment a key factor. Behavioral finance provides a valuable framework for examining how these dynamics influence decision-making in the banking sector, particularly in emerging markets like Africa.

In contrast, traditional finance theory, primarily encompassing the efficient market hypothesis, assumes that financial markets are rational, with prices reflecting all publicly available information (Kamoune and Ibenrissoul 2022). Investors are presumed to make decisions based on objective evaluations of risk and return, unaffected by psychological biases or emotions (Shen, Yu, and Zhao, 2017). Market movements are considered responses to new information, with no influence from sentiment-driven factors, and any deviations from fundamental values are seen as temporary anomalies (Cordes, Nolte, and Schneider 2023). Traditional finance emphasises that rational participants quickly correct inefficiencies through arbitrage. This perspective downplays the role of psychological biases, asserting that information and fundamentals drive prices and market behaviour (Faia 2017). However, these assumptions are increasingly questioned, particularly in emerging markets where inefficiencies persist, and behavioural influences shape investment decisions (Oyetade, Obalade and Muzindutsi 2021).

Despite the incongruence between behavioural and traditional finance theories, the impact of

sentiment on financial markets and bank performance is becoming increasingly apparent. Behavioural finance offers more profound insights into how psychological biases, such as optimism or fear, affect asset prices, capital flows, and liquidity management, especially in less developed markets (Muguto et al. 2022; Chen, 2021). These dynamics are critical for African banks, which operate in environments where sentiment-driven capital inflows and outflows significantly impact profitability and stability (Oyetade, Obalade and Muzindutsi 2021). As African banks face challenges such as non-compliance with Basel standards, low capital buffers, and high non-performing loans, they are more susceptible to shifts in investor sentiment (Dayi et al. 2022; Statista 2023). Understanding these sentiment-driven dynamics helps banks mitigate risks, attract investment, and improve profitability, making behavioural finance a crucial perspective for evaluating bank performance in emerging markets.

Empirical literature

Investor sentiment refers to the process by which investors with high sentiment often make over-optimistic investment decisions, while those with low sentiment lean towards pessimistic decisions (Agoraki, Aslanidis and Kouretas 2022). During periods of high sentiment, investors tend to act irrationally, relying less on fundamental analysis and more on emotions, leading to over-reaction and over-valuation of assets (Ali and Gurun 2009; Stambaugh, Yu and Yuan 2012). This can encourage banks to take more significant risks in pursuit of higher returns. Conversely, investors become more cautious and rational during low sentiment periods, often undervaluing assets below their fundamental values (Shen, Yu and Zhao 2017). These fluctuations in sentiment can have varying impacts on bank behaviour, including their lending practices and profitability, depending on the regional regulatory framework and market conditions.

In developed markets, where regulatory frameworks are more robust, banks tend to be less sensitive to investor sentiment than those in emerging markets (Stambaugh, Yu and Yuan 2012; Di, Shaiban and Hasanov 2021). For example, during major financial events like the 2008 crisis and the COVID-19 pandemic, sentiment significantly impacted bank stability and lending behaviour, with stronger creditor protections mitigating these effects (Cubillas, Ferrer and Suárez 2021). In markets with weaker regulatory frameworks, such as those in many African countries, the absence of strong legal protections amplifies the adverse effects of negative sentiment, increasing funding costs, non-performing loans, and asset quality risks (Cubillas, Ferrer and Suárez 2021). Studies show that Islamic banks are susceptible to sentiment shifts, with optimistic sentiment generating a stronger positive impact on performance than pessimistic sentiment (Shah and Albaity 2022; Di, Shaiban and Hasanov 2021).

Investor sentiment also influences other aspects of bank performance, including liquidity, funding costs, and credit risk. Positive sentiment can enhance liquidity creation, but it may also encourage risky lending to maximise returns, leading to volatility in asset quality and higher credit risk (Cai, Pagano and Sedunov 2023; Agoraki, Aslanidis and Kouretas 2022). On the other hand, negative sentiment can increase sovereign risk, elevate funding costs, and constrain credit, reducing banks' lending capacity and profitability (Faia 2017; Cubillas, Ferrer and Suárez 2021). In African countries, where regulatory compliance is limited, investor sentiment plays a significant role. For example, banks that struggle to meet Basel III capital requirements are perceived as risky, driving negative sentiment and reducing access to capital (BCBS 2017; Oyetade, Obalade and Muzindutsi 2023). At the same time, well-capitalised banks may attract investors seeking lower bankruptcy risks and stable returns, highlighting the complex relationship between regulatory compliance, sentiment, and performance (Bandt et al. 2018).

This study addresses the gap in understanding how investor sentiment influences the performance of African banks, where market inefficiencies and weak regulatory compliance increase the importance of behavioural factors. Existing studies have mainly focused on developed markets, leaving the relationship between sentiment and bank performance in emerging markets underexplored. Furthermore, given that factors like bank size, non-performing loans, and economic stability influence the sentiment-performance relationship (Caglayan and Xu 2016), this study will also consider these elements within the African context. Regulatory changes, such as the transition from Basel II to Basel III, create additional sentiment dynamics that shape bank performance, making it essential to investigate how capital adequacy interacts with sentiment to affect profitability. By filling these gaps, this research provides insights into how African banks can manage sentiment-related risks, attract investment, and enhance stability, contributing to the broader literature on investor sentiment in under-researched markets.

METHODS

Data

This study employed a quantitative approach to investigate the impact of global investors' sentiment on the performance of African banks. Panel data of commercial banks listed on African stock exchanges from 2000 to 2022 were collected from multiple online databases. Their financial information and sentiment

proxies' data were sourced from the Bloomberg database, while macroeconomic variables data was sourced from the World Bank database. The initial dataset comprised 137 commercial banks listed on stock exchanges in Africa. Two sample selection criteria were used. Firstly, only those that have adopted either Basel II or Basel III capital ratios were selected, resulting in the exclusion of eighty banks due to a lack of additional information disclosure of regulatory capital. Furthermore, twenty-two banks were omitted due to insufficient data availability across the sample period. Consequently, the final sample consists of 35 commercial banks with sufficient data over the sample period, providing a focused dataset for analysis.

Global investor sentiment

This study constructed a global investor sentiment index using principal component analysis (PCA), as no universal investor sentiment measure exists. Different measures have been proposed and employed in the literature. This includes Google Trend data and lexicons analysing text drawing inferences about investors' prevailing sentiment (Agoraki, Aslanidis and Kouretas 2022, de Bandt et al. 2018, Shah and Albaity 2022). However, the most popular approach for panel data analysis is to use investor sentiment proxies (Cai, Pagano and Sedunov 2023; Shen, Yu and Zhao 2017). Baker and Wurgler (2006) and Rupande, Muguto and Muzindutsi (2019) found that proxies combined into indices measure sentiment better than individual, potentially imperfect proxies.

PCA helps combine these proxies into a single sentiment index, reducing data dimensionality, capturing maximum variance and improving measurement accuracy, especially for banking (Muguto et al. 2022). Accordingly, seven proxies were employed to construct a global sentiment index, namely: business confidence index, consumer confidence index, global price of gold and oil, US dollar index, Bloomberg commodity index and volatility index. These proxies were standardised to mitigate scale effects, orthogonalised against a set of global macroeconomic variables, extracting residuals for sentiment index construction. This approach removed macroeconomic effects from proxies, ensuring that only behavioural components are left in the proxies (Muguto et al. 2019). Table 1 below reports the results of the procedure.

Table 1. Principal component analysis output

Eigenvalues: (Sum = 7, Average = 1)						
Number	Value	Difference	Proportion	Cum. Value	Cum. Prop.	
1	3.0594	1.2462	0.4371	3.0594	0.4371	
2	1.8132	1.1312	0.2590	4.8727	0.6961	
3	0.6820	0.1471	0.0974	5.5547	0.7935	
4	0.5349	0.1316	0.0764	6.0897	0.8700	
5	0.4032	0.0821	0.0576	6.4930	0.9276	
6	0.3211	0.1353	0.0459	6.8141	0.9735	
7	0.1858	---	0.0265	7.0000	1.0000	
Eigenvectors (loadings)						
Variable	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7
Bci	-0.2768	0.4861	0.1189	0.7255	0.2882	0.0569	-0.2450
Cci	-0.3360	0.3934	0.5219	-0.3055	-0.4985	0.3433	0.0020
Com	0.3879	0.4592	0.1799	-0.0684	0.3078	-0.0383	0.7108
Gol	0.4568	-0.1253	-0.0952	0.5235	-0.5604	0.3866	0.1696
Oil	0.4770	0.2069	-0.0710	-0.2819	0.3095	0.5393	-0.5081
Usd	-0.4668	-0.1899	-0.3428	-0.0192	0.2614	0.6421	0.3838
Vix	0.0753	-0.5507	0.7411	0.1467	0.3086	0.1568	0.0159
Ordinary correlations							
	Bci	Cci	Com	Gol	Oil	Usd	Vix
Bci	1.0000						
Cci	0.5033	1.0000					
Com	0.0670	-0.0617	1.0000				
Gol	-0.3677	-0.5232	0.3551	1.0000			
Oil	-0.2678	-0.3249	0.7047	0.5264	1.0000		
Usd	0.2173	0.2438	-0.6783	-0.5597	-0.6255	1.0000	
Vix	-0.3942	-0.2753	-0.2450	0.1736	-0.0905	-0.0267	1.0000

Source: Authors' estimations (2024)

GlobSent was defined using PCA, where the first component accounts for 43.71 percent of the total variance. This is slightly lower than the 46 percent reported by Reis and Pinho (2020) on their European

index and the 53 percent reported by Baker and Wurgler (2006) on the US market. However, the figure is robust. Key variables correlating with this first principal component, denoted PC 1, are Oil (0.4770), USD (0.4668), and Gol (0.4568). However, Com (0.3879), Cci (0.3360) and Bci (0.2768) also have some significant correlation with the first principal component. However, Vix (0.0753) showed an exceptionally low correlation, likely influenced by macroeconomic factors against which it was orthorgonalised. Using these values, GlobSent was defined as:

$$\text{GlobSent} = -0.276\text{Bci} - 0.336\text{Cci} + 0.388\text{Com} + 0.457\text{Gol} + 0.477\text{Oil} - 0.467\text{Usd} + 0.075\text{Vix} \quad (1)$$

Estimation model

Sentiment and bank performance

Following similar studies such as Cubillas, Ferrer and Suárez (2021) and Cai, Pagano and Sedunov (2023), this study examines the impact of Globsent on bank performance using equation 1:

$$\text{ROA}_{it} = \beta_0 + \beta_1 \text{Globsent}_{it} + \beta_2 \text{Control}_{it} + \emptyset' \text{Year}_i + \varepsilon_{it} \quad (2)$$

where i is the individual bank in year t. Equation 2 controls for year effects by introducing year dummies ($Year_i$) in line with studies such as those of Cubillas, Ferrer, and Suárez (2021). Year effects are included to control for time-fixed effects, unobserved heterogeneity, and business cycles across the country over time (Bond and Eberhardt 2013). β and $\emptyset$ are coefficients of the model that capture the effects on the dependent variable, and ε is the error term.

Table 2. Definition of key variables

Variable	Abbreviation	Definition	Sources	Expected sign
Return on asset	ROA	ROA (%)=Net profit after tax/average total assets	de Bandt et al. (2018)	Dependent variable
Global investor sentiment	Globsent	A sentiment index constructed with seven indices	Author's own construct using PCA	Positive
Size	Isize	A natural logarithm of total asset. Divided into five quintiles	Di, Shaiban, and Hasanov (2021)	Positive or negative
Deposit ratio	Dep_growth	Total deposit/total asset as a measure of total liabilities	Cai, Pagano, and Sedunov (2023)	Negative
Loan growth	Loan_growth	The growth rate of total loans divided by total assets	Shah and Albaity (2022)	Positive
Non-performing loans	Npl_ta	Non-performing loans/Total assets	Shah and Albaity (2022)	Negative
Gross domestic product	GDP_growth	Real GDP which have been adjusted for inflation	Shah and Albaity (2022)	Positive
Inflation	Inflation	Proxy by consumer price index	Di, Shaiban, and Hasanov (2021)	Negative
Financial development	Findev	Domestic private credit by banks as a % of GDP		Positive

The dependent variable - ROA is the proxy for bank performance measure. ROA is a significant indicator of the quality of a bank's earnings (Di, Shaiban, and Hasanov 2021). It is also a widely used performance ratio to gauge bank profitability because it shows how efficiently a bank transforms available assets into earnings (Yuan et al. 2022). Furthermore, ROA is superior to other performance ratios, such as return on equity (ROE), because it allows investors to understand banks' capability to invest and use financial resources to generate profit (Yuan et al. 2022). Therefore, ROA was used as the performance measure for the dependent variable. For robustness checks, the study also uses net interest margin (NIM), return on

equity (ROE), and Zscore as alternative performance measures for equation 2.

The explanatory variables - The primary variable of interest for this study is the global investor sentiment proxy by $Globsent$. $Control$ represents two control variables, namely macroeconomic variables (GDP growth, inflation, and financial development proxy by domestic private credit by banks as a % of GDP) and bank-specific variables (deposit ratio, size, loan growth, and non-performing loans). Bank-specific variables, including deposit ratio, bank size, loan growth, and non-performing loans, may influence bank performance considerably (Shah and Albaity 2022). This study expects control variables to affect the Globsent-bank performance relationship in Africa.

Capital regulations and Globsent effect on bank performance

To examine whether the regulatory capital impacts the Globsent-performance relationship for African banks, CAP was introduced. It represents banks that are either Basel II or Basel III compliant. BII_cap represents banks that have implemented the Basel II capital ratio, and BIII_cap for banks that have implemented the Basel III capital ratio. A bank with low capital is likely to influence the effects of Globsent on profits. To test this hypothesis, capital ratios were introduced for regulatory capital to test the effect of capital adequacy on the relationship between Globsent and bank performance using Equation 3:

$$\mathrm{ROA}_{it} = \beta_0 + \beta_1 \mathrm{Globsent}_{it} + \beta_2 \mathrm{CAP}_{it} + \beta_3 \mathrm{Control}_{it} + \emptyset' \mathrm{Year}_i + \varepsilon_{it} \quad (3)$$

Equations (2) and (3) are estimated using fixed effects (FEM) and random effects (REM) models. Specification tests were carried out to test the validity of both estimation models. F-test was used to check the fit of the model to the appropriate estimator between Pooled ordinary least square (Pooled OLS), FEM, and REM.

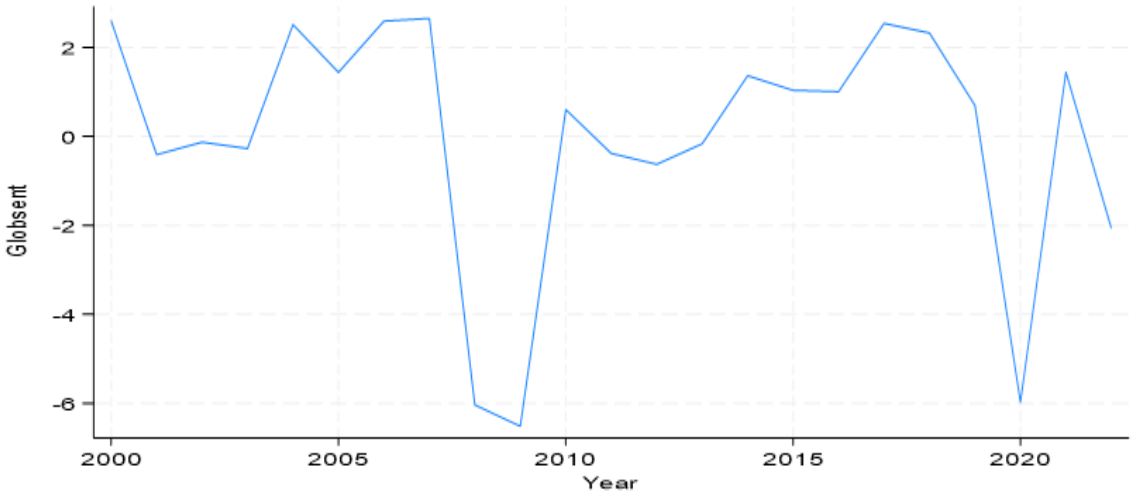
Furthermore, diagnostic tests were performed to account for issues with auto-correlation and heteroskedasticity in the panel data. Thus, a fixed effect model with robust standard error was reported to correct for these issues. Also, this choice was considered appropriate for this panel data analysis as it accounts for time-invariant, unobserved factors at the bank level that might influence performance. These unobserved factors could be bank-specific management styles, business strategies, or inherent risk profiles. By controlling for these fixed effects, the effects of the independent variables on bank performance within each bank over time were isolated, allowing their analysis.

RESULTS AND DISCUSSION

Descriptive statistics

Figure 1 presents the global investor sentiment index (GlobSent) from 2000 to 2022. The index effectively captured key global events corresponding to significant sentiment fluctuations, such as the 2008 financial crisis and the COVID-19 pandemic, affirming its reliability. These events triggered sharp declines in sentiment, driven by heightened investor pessimism and expectations of severe economic fallout, especially in the African banking sector. Investors anticipated adverse outcomes and feared their funds might become inaccessible amid the uncertainty, leading to a rapid downturn in sentiment. However, the index shows that sentiment rebounded swiftly after these crises, reflecting renewed investor confidence despite the initial pessimism.

This behaviour contrasts with trends observed in developed markets, where sentiment typically stabilises more gradually following major disruptions (Shen, Yu and Zhao 2017; Stambaugh, Yu and Yuan 2012). For example, investor sentiment did not decline drastically during the 2008 crisis in developed economies, suggesting that investors were less pessimistic and more resilient. These behavioural differences may stem from legal frameworks, regulatory institutions, and market infrastructure disparities between developed and emerging markets. More robust institutional frameworks in developed markets likely mitigate excessive pessimism, promoting more stable recovery patterns.



Source: Author's calculation based on data obtained from databases
Figure 1. Investor sentiment index

Table 3 presents the summary statistics for key variables, including the dependent variable, return on assets (ROA), and the independent variables - GlobSent, Basel capital ratios, bank-specific ratios, and macroeconomic indicators. Though modest, the average ROA of 2.3 percent surpasses that of banks from other emerging economies. For example, Yuan et al. (2022) reported an average ROA of just 0.11 percent for Indian and Bangladeshi banks. Notably, some African banks achieved ROA figures as high as 13 percent, indicating strong profitability and making these banks attractive to investors seeking higher returns. However, the concern lies in the average non-performing loan (NPL) ratio of 3.5 percent, with a standard deviation of 6 percent, which signals potential risks to future profits.

Table 3. Key variables

Variable	Obs	Mean	Std. dev.	Min	Max
ROA	783	2.302	1.832	-8.992	13.795
Globsent	805	0.011	2.7	-6.517	2.654
Dep_growth	664	10.50	27.179	-199.627	182.457
loan_growth	764	5.297	42.096	-199.064	164.813
Npl_ta	770	3.565	6.081	0	63.398
GDP_growth	796	4.144	3.178	-14.144	15.329
Inflation	790	9.247	5.688	-0.692	41.51
Findev	737	32.185	18.788	3.11	70.38
BII_capratio	554	16.352	8.804	4	147
BIII_capratio	523	17.947	7.026	2.901	73.807

Source: Author's calculation based on data obtained from databases

The deposit growth ratio averages 10.5 percent, which appears reasonable, but the high standard deviation of 27 percent indicates significant volatility, suggesting liquidity challenges across the sector. Some banks may struggle to gather adequate deposits, limiting their capacity to lend and expand operations. This liquidity constraint is reflected in the modest loan growth average of just 5 percent, highlighting a cautious lending environment. Such conservative lending practices, while potentially reducing risk, may also limit profitability and hinder the sector's growth. These findings emphasise the importance of balancing profitability with sound risk management to ensure sustainable performance in the African banking sector.

Empirical results

Table 4 presents the results of the impact of investor sentiment, captured by GlobSent, on bank performance in Africa, measured through return on assets (ROA). A fixed effects model with robust standard errors and year effects was employed across all models. Four performance measures were estimated: ROA, net interest margin (NIM), return on equity (ROE), and Z-score. Among these, the ROA model exhibited the highest adjusted R-squared, making it the most appropriate for explaining bank performance. The results align with theoretical expectations, showing a positive and significant relationship between GlobSent and ROA at the 5 percent significance level. This indicates that investor sentiment is crucial in influencing bank

performance, conditioned by bank-specific and macroeconomic factors. The findings confirm that investors in Africa consider both firm-level characteristics and broader economic conditions when making investment decisions, consistent with studies by Agoraki, Aslanidis and Kouretas (2022) and Cai, Pagano and Sedunov (2023).

Table 4. Globsent effect on bank performance

	ROA	NIM	ROE	Zscore
Globsent	0.586**	-0.054	4.334	-0.040**
	(0.288)	(0.136)	(2.612)	(0.015)
_Isize_2	-0.754	-0.093	0.482	-0.003
	(0.504)	(0.394)	(1.933)	(0.062)
_Isize_3	-0.852	-0.289	0.315	-0.005
	(0.656)	(0.389)	(2.140)	(0.084)
_Isize_4	-1.129*	-0.810*	-3.839	0.007
	(0.652)	(0.457)	(2.952)	(0.090)
_Isize_5	-2.058***	-1.049	-11.344***	-0.026
	(0.724)	(0.736)	(3.450)	(0.110)
Dep_growth	-0.000	-0.003	-0.028	0.001
	(0.003)	(0.003)	(0.021)	(0.001)
Loan_growth	-0.115	0.106	0.937	0.033
	(0.175)	(0.187)	(1.064)	(0.029)
Npl_ta	-0.075**	-0.001	-0.261*	-0.002*
	(0.035)	(0.023)	(0.145)	(0.001)
GDP_growth	0.045	0.088*	0.471**	0.003
	(0.032)	(0.048)	(0.227)	(0.003)
Inflation	0.005	0.040**	0.287***	-0.003**
	(0.009)	(0.016)	(0.095)	(0.001)
Findev	-0.031***	-0.025	-0.140	-0.003*
	(0.011)	(0.016)	(0.119)	(0.001)
_cons	4.814***	4.848***	27.625***	1.500***
	(0.757)	(0.683)	(6.657)	(0.106)
N	598	580	591	596
R-squared	0.2601	0.2181	0.1922	0.2647
Adjusted R-squared	0.168	0.062	0.090	0.116

*Robust standard errors are in parentheses * p<0.1, ** p<0.05, *** p<0.001*
Source: Author's calculation based on data obtained from databases

Control variables provide further insights into factors shaping ROA. Bank size exhibited a negative and significant impact on ROA, suggesting that larger banks may face challenges in efficiently utilising their assets and capital to generate higher profits. This outcome aligns with Agoraki, Aslanidis and Kouretas (2022), who found that larger US banks managed smaller loan portfolios, possibly explaining the negative size-performance relationship. Non-performing loans also significantly negatively affected ROA, underscoring the detrimental impact of poor loan quality on profitability. Additionally, financial development showed an unexpected negative and significant effect on ROA, implying that the relationship between financial development and bank performance in Africa may be more complex than anticipated, warranting further investigation. The findings related to macroeconomic variables, such as GDP growth and inflation, were statistically insignificant, indicating that broader economic conditions may have a limited direct influence on bank profitability over the observed period.

Table 5 examines how Basel capital adequacy requirements—specifically Basel II and Basel III—moderate the relationship between investor sentiment and bank performance. In Model 1, a positive and significant relationship was found between investor sentiment and bank performance for Basel II-compliant banks, suggesting that sentiment is crucial in driving profitability for these banks. Similarly, Model 2 showed a positive and significant impact of investor sentiment on the performance of Basel III-compliant banks. While investors typically view strict capital regulations as a potential drag on profitability due to reduced shareholder returns (Bandt et al. 2018), the positive impact of sentiment across both Basel II and Basel III-compliant banks indicates that investors may still favour these banks. This suggests that investors, driven by

sentiment, may irrationally prioritise short-term performance over strict capital buffers, perceiving these banks as stable and profitable despite regulatory constraints.

Table 5. Capital regulations and Globsent effect on bank performance

	Basel II	**Basel III**
	ROA	ROA
Globsent	0.965***	0.911***
	(0.139)	(0.121)
BII_cap	0.019	
	(0.017)	
BIII_cap		0.072***
		(0.014)
_Isize_2	-0.341	-0.639
	(0.580)	(0.447)
_Isize_3	-0.458	-0.791
	(0.725)	(0.534)
_Isize_4	-1.169	-1.188
	(0.870)	(0.834)
_Isize_5	-1.746**	-1.931**
	(0.745)	(0.838)
Dep_growth	-0.002	-0.002
	(0.004)	(0.003)
Loan_growth	-0.135	0.097
	(0.217)	(0.241)
Npl_ta	-0.082*	-0.078*
	(0.042)	(0.045)
GDP_growth	0.019	-0.001
	(0.042)	(0.038)
Inflation	0.027	0.024
	(0.017)	(0.019)
Findev	-0.010	-0.001
	(0.021)	(0.019)
_cons	4.711***	3.480***
	(0.678)	(0.784)
N	482	461
R-squared	0.3203	0.4937
Adjusted R-squared	0.1702	0.301

*Robust standard errors are in parentheses * p<0.1, ** p<0.05, *** p<0.001*
Source: Author's calculation based on data obtained from databases

Interestingly, both models reveal that investor sentiment positively influences the return on assets (ROA) for banks compliant with either Basel II or Basel III standards. This indicates that a baseline capital adequacy level promotes investor confidence beyond the specific capital framework, reinforcing the positive relationship between sentiment and performance. Investors appear to be drawn to banks meeting regulatory standards, as these banks are perceived as less risky and capable of maintaining profitability even during downturns. The findings imply that while capital adequacy regulations shape investor perceptions, sentiment remains a powerful force influencing bank performance across regulatory frameworks. However, the direct impact of Basel II compliance on performance is insignificant, suggesting that stricter Basel III standards may substantially influence investor behaviour.

The results also confirm several patterns observed in previous models regarding control variables. Bank size continues to exhibit a negative and significant effect on performance, indicating that larger banks may struggle with efficiently utilising assets to generate profits. Similarly, non-performing loans retain their negative and significant impact, emphasising the critical need for effective loan management to protect profitability. The mixed but generally insignificant effects of inflation, GDP growth, and financial development on ROA suggest that macroeconomic conditions play a limited role in directly driving bank performance, warranting further exploration. These findings highlight the nuanced interplay between capital regulations, investor sentiment, and performance, underscoring the importance of regulatory compliance

and sentiment-driven behaviour in shaping the outcomes for African banks.

Specification tests were carried out to test the validity of both estimation models. As a result, the Hausman test was carried out (see Table 6: Appendix) to select the best estimation technique. Although the Hausman test chose RE, in the F-test used to check the model's fit, we rejected the null hypothesis that fixed effects are non-zero, implying that the cross-sectional or time-specific effects (year dummies) are significant. Therefore, OLS and random effect will be biased; thus, FE is considered an appropriate and efficient estimator.

Diagnostic tests were carried out to test the presence of autocorrelation and heteroscedasticity for the validity of estimation models and the validity of the findings. The diagnostic tests conducted, namely the Modified Wald and Woolridge tests, were used to detect and correct heteroskedasticity and autocorrelation, respectively. The hypotheses for these tests were *H0* of homoskedasticity and no autocorrelation. The results presented in Table 8 indicate the presence of both heteroskedasticity and autocorrelation, as H0 was rejected for both tests. This implies that the OLS assumptions are violated, leading to biased coefficient estimates. Also, t-statistics and confidence intervals would be invalid for inference problems. Thus, robust standard errors were used in the regression to address these issues.

Discussion of findings

Our findings reveal that investors become extremely pessimistic toward African banks during major crises, with sharp declines in sentiment posing significant risks. This is dangerous for African banks, as investors may exploit the situation to undervalue these institutions, especially given the less developed regulatory environments in African markets. This contrasts with the neutral investor behaviour observed by Shen, Yu and Zhao (2017) in developed markets, where investors remained measured during the 2008 financial crisis. These findings suggest a distinct dynamic in African markets, where investor sentiment may be more responsive to growth opportunities and less influenced by past crises. Our study highlights the vulnerability of African banks to pessimism during crises. It highlights the need for African policymakers to develop robust legal and institutional frameworks to protect banks from harmful investment behaviour.

Our findings further demonstrate that bank-specific and macroeconomic factors and the level of financial development play crucial roles in the positive and significant impact of investor sentiment on bank performance in Africa. Interestingly, this result diverges from behavioural finance theory, as the positive sentiment reflects an optimistic outlook on key controlling factors, contributing to improved bank performance. These results align with Cai, Pagano and Sedunov (2023) for liquidity creation in banks and with Agoraki, Aslanidis and Kouretas (2022) for US bank lending. Optimistic sentiment may encourage banks to expand operations and take advantage of favourable market conditions, thus enhancing profitability. This finding highlights the importance of understanding how sentiment influences bank performance, particularly in regions where financial markets are still developing.

Control variables provide additional insights into the challenges faced by African banks. Non-performing loans negatively and significantly impact bank performance, emphasising the importance of managing loan quality. Similarly, bank size has a negative and significant effect, suggesting that larger banks may struggle with operational inefficiencies, diminishing profitability and asset quality. This result aligns with Shah and Albaity (2022) for banks in MENA and Gulf countries and Agoraki, Aslanidis and Kouretas (2022) for US banks. Larger African banks may also face stricter regulatory constraints, including compliance costs for "too-big-to-fail" institutions, further impacting profitability. Addressing these operational challenges is essential for improving the performance of larger banks and enhancing their competitiveness in the region.

The impact of financial development on bank performance is also negative and significant, highlighting the general and widespread underdevelopment of Africa's financial markets, institutions, and regulatory frameworks. In developed financial systems, lower transaction costs, better access to liquidity, and more efficient capital mobilisation foster bank growth and economic development (World Bank Group 2012). While positive sentiment can create opportunities for expansion, negative sentiment may prompt more conservative strategies. Over the long term, sustaining positive sentiment requires African banks to focus on operational efficiency, building customer trust, and ensuring regulatory compliance. These strategies will improve profitability and performance, helping African banks navigate volatile market conditions better.

Our results also reveal that compliance with Basel II and Basel III capital standards positively influences the relationship between investor sentiment and bank performance. This suggests that investors view banks adhering to Basel standards as less risky, regardless of whether they comply with Basel II or the more recent and encompassing Basel III. However, only Basel III compliance directly influences bank performance, reflecting its stricter regulatory framework. Although this finding contrasts with Faia (2017), who observed that investors favoured banks with strong capital bases during sovereign risk periods, it indicates that investor confidence in Basel-compliant African banks remains high. This optimism may be

driven by the strong financial positions and growth potential of African economies, which enhance the appeal of these banks to investors.

The findings offer valuable insights. Policymakers should encourage African banks to adopt higher Basel standards to attract global investors seeking low-risk opportunities. Tailored business models and innovative financial products are essential for larger banks to overcome the negative impact of size on performance. Strengthening risk management practices and improving operational efficiency are crucial to enhancing profitability. Robust regulatory frameworks, including enhanced investor protection, will attract more capital inflows to African banks. Finally, recognising investor sentiment as a powerful performance driver underlines the importance of fostering stable policies to build investor confidence. Adequate creditor protection, sound governance, and robust risk management practices will help mitigate the adverse effects of investor pessimism during crises, supporting sustainable growth in Africa's banking sector.

CONCLUSION

This study explored the intricate relationship between investor sentiment and bank performance in Africa, shaped by individual bank characteristics and broader macroeconomic conditions. While the findings confirmed a generally positive impact of investor sentiment on bank performance, variability based on bank-specific attributes and market contexts indicated that investors weigh risks and opportunities rationally. Notably, compliance with Basel II and Basel III capital requirements strengthened the relationship between sentiment and performance, though only the higher Basel III standards significantly enhanced bank performance. This highlights the importance of stricter capital regulations in improving profitability and stability within the African banking sector.

Tailored policy responses are necessary to address African banks' unique challenges, including the regulatory disparities across different regions. Policymakers can use these insights to enhance legal frameworks and investor protection policies, creating an environment that attracts global capital, fosters investor confidence, and mitigates the risks of sentiment-driven capital flows, particularly during financial turbulence. Strengthening central bank oversight and encouraging robust risk management practices are also critical to increasing the resilience of African banks to fluctuating investor sentiment.

Promoting sound governance and risk management frameworks will help banks mitigate the potential adverse effects of sentiment on performance. These measures will also enable banks to capitalise on positive sentiment, driving growth and profitability. By aligning investor perceptions with banks' true risk profiles, policymakers can ensure a more stable financial environment, better preparing African banks to withstand market volatility. This study provides a foundation for future research further to investigate the mechanisms behind sentiment-driven behaviour in African banking and explore strategies for sustainable growth in the sector.

REFERENCES

Aboluwodi, D., P. F. Muzindutsi, and B. Nomlala. 2024. Investor sentiments and performance of selected ESG indices in BRICS markets during bull and bear conditions. *Investment Analysts Journal*, 1-18. doi: https://doi.org/10.1080/10293523.2024.2397889.

Agoraki, M-E., A. Nektarios, and P. Georgios. 2022. US banks' lending, financial stability, and text-based sentiment analysis. *Journal of Economic Behavior & Organization* 197:73-90. doi: https://doi.org/10.1016/j.jebo.2022.02.025.

Ali, A., and U. Gurun. 2009. Investor Sentiment, Accruals Anomaly, and Accruals Management. *Journal of Accounting, Auditing & Finance* 24 (3):415-431. doi: 10.1177/0148558X0902400305.

Archibong, B., C. Brahima, and N. Okonjo-Iweala. 2021. Washington Consensus Reforms and Lessons for Economic Performance in Sub-Saharan Africa. *Journal of Economic Perspectives* 35 (3):133-56. doi: 10.1257/jep.35.3.133.

Baker, M., and J. Wurgler. 2006. Investor Sentiment and the Cross-Section of Stock Returns. *The Journal of Finance* 61 (4):1645-1680. doi: https://doi.org/10.1111/j.1540-6261.2006.00885.x.

BCBS. 2017. Basel III: Finalising post-crisis reforms. *Basel Committee on Banking Supervision*:1-162. https://www.bis.org/bcbs/publ/d424.htm.

Bond, S., and M. Eberhardt. 2013. Accounting for unobserved heterogeneity in panel time series models. *University of Oxford*:1-11. https://ora.ox.ac.uk/.

Caglayan, M., and B. Xu. 2016. Sentiment volatility and bank lending behaviour. *International Review of Financial Analysis* 45:107-120. doi: https://doi.org/10.1016/j.irfa.2016.03.009.

Cai, J., M. Pagano, and J. Sedunov. 2023. The role of investor sentiment in bank liquidity creation. *Finance Research Letters* 58:104663. doi: https://doi.org/10.1016/j.frl.2023.104663.

Chen, W. 2021. Equity investor sentiment and bond market reaction: Test of overinvestment and capital flow hypotheses. *Journal of Financial Markets* 55:100589. doi: https://doi.org/10.1016/j.finmar.2020.100589.

Cordes, H., S. Nolte, and J. Schneider. 2023. Dynamics of stock market developments, financial behaviour, and emotions. *Journal of Banking & Finance* 154:106711. doi: https://doi.org/10.1016/j.jbankfin.2022.106711.

Cubillas, E., E. Ferrer, and N. Suárez. 2021. Does investor sentiment affect bank stability? International evidence from lending behaviour. *Journal of International Money and Finance* 113:102351. doi: https://doi.org/10.1016/j.jimonfin.2020.102351.

Dayi, O., F. Girancourt, A. Fjer, and Z. Makgatho. 2022. African banking: The productivity opportunity. *McKinsey & Company*. https://www.mckinsey.com/industries/financial-services/our-insights/african-banking-the-productivity-opportunity.

Bandt, O., B. Camara, A. Maitre, and P. Pessarossi. 2018. Optimal capital, regulatory requirements and bank performance in times of crisis: Evidence from France. *Journal of Financial Stability* 39:175-186. doi: https://doi.org/10.1016/j.jfs.2017.03.002.

Di, L, M. Sharaf, and A. Hasanov. 2021. The power of investor sentiment in explaining bank stock performance: Listed conventional vs. Islamic banks. *Pacific-Basin Finance Journal* 66:101509. doi: https://doi.org/10.1016/j.pacfin.2021.101509.

Faia, E. 2017. Sovereign risk, bank funding and investors' pessimism. *Journal of Economic Dynamics and Control* 79:79-96. doi: https://doi.org/10.1016/j.jedc.2017.03.010.

Irresberger, F., J. Mühlnickel, and G. Weiß. 2015. Explaining bank stock performance with crisis sentiment. *Journal of Banking & Finance* 59:311-329. doi: https://doi.org/10.1016/j.jbankfin.2015.06.001.

Kamoune, A., and N. Ibenrissoul. 2022. Traditional versus Behavioral Finance Theory. *International Journal of Accounting, Finance, Auditing, Management and Economics* 3 (2-1):282-294. doi: 10.5281/zenodo.6392167.

Muguto, H., L. Muguto, A. Bhayat, H. Ncalane, J. Jack, S. Abdullah, T. Nkosi, and P-F. Muzindutsi. 2022. The impact of investor sentiment on sectoral returns and volatility: Evidence from the Johannesburg stock exchange. *Cogent Economics & Finance* 10 (1):2158007. doi: 10.1080/23322039.2022.2158007.

Muguto, H., L. Rupande, and P-F. Muzindutsi. 2019. Investor sentiment and foreign financial flows: Evidence from South Africa. *Zbornik Radova Ekonomski Fakultet u Rijeka* 37 (2):473-498. doi: https://doi.org/10.18045/zbefri.2019.2.473.

Muzindutsi, P-F., R. Apau, L. Muguto, H. T. Muguto. 2023. The impact of investor sentiment on housing prices and the property stock index volatility in South Africa. Real Estate Management and Valuation, 31(2):1-17. doi:10.2478/remav-2023-0009.

Nartea, G., H. Bai, and J. Wu. 2020. Investor sentiment and the economic policy uncertainty premium. *Pacific-Basin Finance Journal* 64:101438. doi: https://doi.org/10.1016/j.pacfin.2020.101438.

Oyetade, D., A. Obalade, and P-F. Muzindutsi. 2021. Basel capital requirements, portfolio shift and bank lending in Africa. *ACRN Journal of Finance and Risk Perspectives* 10:296-319. https://www.acrn-journals.eu/jofrpvol1001p296.html.

Oyetade, D., A. Obalade, and P-F. Muzindutsi. 2023. Basel IV capital requirements and the performance of commercial banks in Africa. *Journal of Banking Regulation*. doi: 10.1057/s41261-021-00181-1.

Reis, P., M. Nogueira, and C. Pinho. 2020. A new European investor sentiment index (EURsent) and its return and volatility predictability. *Journal of Behavioral and Experimental Finance* 27:100373. doi: https://doi.org/10.1016/j.jbef.2020.100373.

Rupande, L., H. Muguto, P-F. Muzindutsi. 2019. Investor sentiment and stock return volatility: Evidence from the Johannesburg Stock Exchange. *Cogent Economics & Finance* 7 (1):1600233. doi: 10.1080/23322039.2019.1600233.

Shah, S., and M. Albaity. 2022. The role of trust, investor sentiment, and uncertainty on bank stock return performance: Evidence from the MENA region. *The Journal of Economic Asymmetries* 26:e00260. doi: https://doi.org/10.1016/j.jeca.2022.e00260.

Shen, J., J. Yu, and S. Zhao. 2017. Investor sentiment and economic forces. *Journal of Monetary Economics* 86:1-21. doi: https://doi.org/10.1016/j.jmoneco.2017.01.001.

Stambaugh, R., J.Yu, Y. Yuan. 2012. The short of it: Investor sentiment and anomalies. *Journal of Financial Economics* 104 (2):288-302. doi: https://doi.org/10.1016/j.jfineco.2011.12.001.

Statista. 2023. Largest banks in the United States 2022, by return on equity. Online: Statista Research Department. https://www.statista.com/.

World Bank Group. 2012. Global Financial Development Report 2013: Rethinking the Role of the State in Finance. Online: World Bank, Wahington DC. https://openknowledge.worldbank.org/entities/.

Yuan, D., I. Harymawan, B. Dhar, and A. Hossain. 2022. Profitability determining factors of the banking sector: Panel data analysis of commercial banks in South Asian countries. *Frontiers in Psychology* 13. doi: 10.3389/fpsyg.2022.1000412.

APPENDIX

Table 6. Hausman test

Hausman	ROA	ROE	NIM	Capital
	P>10 percent Fail to reject Ho	P<1 percent Reject Ho	P>10 percent Fail to reject Ho	P<1 percent Reject Ho
Decision	Random effect is preferred	Fixed effect is preferred	Random effect is preferred	Fixed effect is preferred

Note: Hausman hypothesis-H0: Random effects is preferred. *H*1: Fixed effects is preferred

Table 7. F-test for OLS vs Fixed effect model

	Statistics	**P-value**
F-test (34, 531)	15.97	0.000

Table 8. Modified Wald test

Modified Wald test		Woolridge test for auto-correlation	
Chibar2 (26)	283.31	F (1, 531)	20.32
Prob > Chi2	0.000	Prob > F	0.000

Note: Modified Wald test for heteroskedasticity in FEM and Woolridge test for autocorrelation in panel data

Source: Author's Compilation