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Impact of Select Variables on Tangible Book Value Multiple of U.S. Regional Banks

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Authors' contributions

This work was conducted in collaboration among all authors. Author SCU designed the study, performed the statistical analysis, and wrote the protocol. Authors SCU and AOA wrote the first draft of the manuscript and managed the analyses of the findings. Authors BEA and OFA managed the literature searches and study significance. Author NAA conceptualized the study and took part in the statistical analysis. All authors read and approved the final manuscript.

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ABSTRACT

Aims: This study explores the relationship between regional banks' Price-to-Tangible Book Value (P/TBV) multiple and metrics such as profitability, liquidity, capital adequacy, asset quality, leverage, and operational efficiency.

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Study Design: A longitudinal panel data analysis of 101 regional U.S. banks, covering the financial years from 2003 to 2023. It employs fixed effects, random effects, and pooled OLS regression models to determine the drivers of P/TBV multiple. The analysis controls for time-specific factors such as pre – and post – financial crisis periods, enabling a more comprehensive evaluation of valuation trends over different economic cycles.
Results: All three models were statistically significant in identifying the determinants of P/TBV. However, the fixed effects model was deemed the most appropriate, as confirmed by the Hausman test ($p < 0.001$), which demonstrated its consistency over the random effects model. Additionally, the F-test ($p < 0.001$) indicated the relevance of the fixed effects model over the pooled OLS model by highlighting the significance of individual effects. The fixed effects model and the fixed effects model with robust standard errors revealed that return on equity and bank efficiency positively influenced P/TBV, while asset size, non-performing loans, leverage, and dividend yield had significant negative effect. The model also showed higher valuations for regional banks in the pre-2008 financial crisis period compared to the post-crisis era. Additionally, upon accounting for the impact of heteroscedasticity, the statistical significance of loan-to-deposit ratio variable noted in the fixed effects model turns out to be insignificant.
Conclusion: Financial stability, profitability, capital, and asset quality are crucial in determining regional bank valuations. The insights from this study will help bank managers identify key focus areas to optimize valuation and pricing strategies, ensuring that banks can align internal financial health with broader market dynamics for sustainable growth. Additionally, the findings will benefit investors by providing a deeper understanding of the financial factors driving bank valuations, enabling more informed investment decisions. While this research does not directly address the impact of macroeconomic variables on regional banks' valuations, it highlights an area that merits further investigation in future research.

Keywords: Bank valuation; regional banks; asset quality; capital adequacy; financial stability.

1. INTRODUCTION

Regional banks play a pivotal role in the United States' banking system, mainly by providing critical financial services to smaller markets, which larger national institutions often underserve. These banks cater to the needs of local economies by offering credit to small and medium-sized enterprises (SMEs), managing deposits, and extending other banking services essential for regional economic stability. Smaller banks are often the primary financial intermediaries in their regions, which positions them as significant drivers of local economic growth and development (Berger et al., 1995). These banks also have closer relationships with their clients, providing them with personalized services that larger banks may not offer. This role became especially apparent during financial crises, where regional banks played a significant role in supporting the local economy (Berger & Bouwman, 2013).

Given the critical role of these banks in supporting local economies, accurately assessing their financial health is essential for both investors and policymakers. The Price-to-Tangible Book Value (P/TBV) multiple, a critical valuation metric, provides a clearer picture of a bank's net asset value by excluding intangible assets such as goodwill, patents, and trademarks. Unlike traditional book value, Tangible Book Value (TBV) emphasizes a bank's core assets that can be realized from sales or liquidated, making it particularly dependable in the asset-heavy banking industry. As Healy & Palepu (1993) suggest, TBV offers investors insight into the minimum value that could be recovered in liquidation or bankruptcy, ensuring a more conservative estimation of a bank's value.

For financial institutions, tangible assets are crucial to balance sheet strength, operational stability, and future profitability. TBV is indispensable for investors and analysts, especially during market volatility or downturns, when tangible assets are critical in maintaining solvency. The conservative nature of TBV guards against overvaluation, particularly in an industry where intangible assets can inflate book value without adding real-world value (Penman, 1996).

The P/TBV multiple extends this concept, offering insights into how the market perceives a bank's value relative to its tangible assets. By comparing the market price of a bank's shares to its TBV per share, investors can gauge whether a bank is overvalued or undervalued. A higher

P/TBV multiple (>1.0x) may reflect expectations of future solid profitability, while a lower multiple (<1.0X) may signal concerns about asset quality or financial health (Brewer et al., 2014). Analyzing the P/TBV multiple is crucial for making informed investment decisions, as it captures both market sentiment and the fundamental strength of a bank's tangible assets, linking market perception with the concrete value represented on the balance sheet.

In determining the variables that affect P/TBV multiple, three key theoretical frameworks—Efficient Market Hypothesis (EMH), Capital Structure Theory, and Risk-Return Tradeoff Theory—provide deep insights into how market efficiency, capital structure, and risk-return dynamics affect firm valuation. EMH, as proposed by Fama (1970), posits that market prices fully reflect available information, suggesting that the P/TBV multiple incorporates a bank's risk profile, profitability, and tangible assets. However, market inefficiencies and frictions may cause temporary mispricing (Flannery & Rangan, 2008; Modigliani & Miller, 1958). As highlighted by Hughes et al. (1999), Capital Structure Theory emphasizes that a firm's capital structure—specifically its leverage and capital—directly affects its valuation. Lower equity levels and higher leverage are associated with lower valuations, as they increase the perceived riskiness of the firm and lead to expectations of lower returns (Flannery & Rangan, 2008; Hughes et al., 1999). Lastly, applying (Merton, 1974) Risk-Return Tradeoff Theory to banks underscores that higher return on equity (ROE) and return on assets (ROA) positively drive higher valuation multiples such as P/TBV, as these metrics signal robust profitability. In contrast, increased credit risk, as reflected by high non-performing loan ratios, depress valuations (Demirgüç-Kunt & Huizinga, 2010; Dietrich & Wanzenried, 2011; Louzis et al., 2010).

1.1 Research Problem and Objectives

Accurate bank valuation using the P/TBV multiple is crucial for investors, regulators, and bank management to make informed decisions. This valuation metric is shaped by various financial and operational factors that impact a bank's profitability, financial and operational risk profile, and capital adequacy. Failure to understand these fundamental drivers can lead to overvaluation or undervaluation, potentially resulting in poor investment decisions and flawed risk assessments. This study will investigate how specific profitability, liquidity, capital, leverage, asset quality, and efficiency metrics influence the P/TBV multiple using 20 years of historical financial data, with the aim of quantifying the relative impact these variables may have on bank valuation.

2. LITERATURE REVIEW

While the use of P/TBV multiple in determining the valuation of financial institutions is a widely accepted industry practice, empirical and academic research in this subject area is limited within the context of regional bank valuation. Forte et al. (2020) investigated the accuracy of relative valuation in the banking industry and concluded that the accuracy of multiples declines in case of smaller commercial banks compared to larger commercial banks and between non-investment banks and investment banks. This suggests that for smaller banks such as regional banks, the valuation exercise becomes more complicated.

Other literature emphasizes the complex factors influencing Tangible Book Value, Return on Assets (ROA) and Return on Equity (ROE), are central to bank valuations (Claessens & Laeven, 2004; Molyneux & Thornton, 1992). ROA, which measures a bank’s efficiency in generating profits from its assets, is associated with resilience and the ability to withstand economic downturns. Cole & White (2012) found that banks with lower ROA are likely to fail due to a limited capacity to absorb losses, leading to lower market valuations. Similarly, ROE, which reflects profitability relative to shareholder equity, indicates a bank’s ability to manage shareholder investments effectively. Nawawi et al. (2024) highlighted that a higher ROE drives premium valuations, reflecting investor confidence in governance and operational efficiency. Numerous studies have further emphasized the critical role of both ROA and ROE, demonstrating that banks with consistently strong ROA and ROE tend to attract higher valuations due to effective resource management and risk mitigation (Rahman et al., 2020; ang et al., 2019; Assfaw, 2019; Alyousef et al., 2019).

Liquidity ratios and capital adequacy are crucial in bank profitability and valuation. While liquidity management is essential for a bank’s stability, its impact on profitability can vary across different regions and banking landscapes. Almazari (2014) found a positive relationship between liquidity ratios and profitability in Saudi and Jordanian banks, while Al-Homaidi et al. (2018)

reported a similar relationship for Indian banks. Conversely, Fang et al. (2019) suggested that liquidity risk is negatively related to ROA in China, indicating that higher liquidity levels may lead to lower profitability. These findings imply that the optimal level of liquidity may depend on the specific context.

Similarly, capital adequacy ratios (CAR), which reflect a bank's ability to absorb losses, exhibit a positive relationship with profitability, as demonstrated by Rahman et al. (2020); Almazari (2014); Aspal et al. (2019); Anbar & Alper (2011). Al-Homaidi et al. (2018); Masood et al. (2015) also showed a direct relationship between CAR and ROA. However, the relationship between CAR and ROE is more nuanced. Al-Homaidi et al. (2018) found that while capital ratios were positively related to ROE in random-effects models, the relationship was inverse in pooling and fixed-effects models. Similarly, Knezevic & Dobromirov (2016) identified a negative coefficient for CAR when analyzing Serbian banks, although the relationship became positive when focusing solely on domestic banks.

Asset quality, particularly the prevalence of non-performing loans (NPLs) and the adequacy of loan loss provisions, plays a critical role in shaping investor perceptions and influencing TBV multiples. A high NPL ratio signals elevated credit risk, eroding investor confidence, reducing profitability, and lowering a bank's valuation. Conversely, robust loan loss provisions, indicative of proactive risk management, can bolster investor trust and contribute to higher profitability and valuations (Barakat et al., 2024; Kingu et al., 2018). Rjoub et al. (2017); Zampara et al. (2017) evaluated the impact of capital adequacy ratio, asset quality ratio, liquidity ratio, operating efficiency ratio, deposit ratio, and bank size on profitability. Their findings align with the broader literature, underscoring the importance of these metrics in shaping bank performance. Similarly, studies by Al-Homaidi et al. (2018); Anbar & Alper (2011) found that larger asset sizes positively correlate with profitability, with larger banks tending to outperform smaller ones.

Literature consistently underscores the need for a deeper understanding of the variables that drive bank valuations. While profitability metrics such as ROA and ROE are essential, factors like liquidity management, capital adequacy, and asset quality are equally influential. This study addresses these gaps by providing a comprehensive analysis of the financial and operational determinants of Price-to-Tangible Book Value (P/TBV) multiples in U.S. regional banks—a subject that remains underexplored in banking valuation research. Distinct from prior studies that often focus on larger institutions, this research will highlight the specific characteristics of regional banks, exploring the nuances of profitability, asset quality, leverage, and efficiency metrics. These insights offer valuable guidance for investors, policymakers, and bank managers to optimize valuation strategies attuned to the unique dynamics of regional banks.

3. MATERIALS AND METHODS

3.1 Data Collection

The data for this study was obtained from S&P Capital IQ and focused on listed regional U.S. banks. Initially, the raw dataset included over two hundred banks present in both the U.S. and Canada, on which specific selection criteria were applied. First, banks that are domiciled in Canada were excluded. Banks with missing key data points such as total assets, loans and advances, deposits, and net income were excluded. Additionally, banks that had not been actively listed over the past 20 years, including those that had been liquidated or failed, were excluded. The final sample consisted of 101 regional banks, representing a broad range of asset sizes, market capitalization and varying business models. This comprehensive panel dataset spans two decades, providing insights into regional banks' performance, capital structure, and financial metrics. It allows for a robust analysis of trends, relationships, and performance variations aligned with the research objectives, including insights into how these banks navigated different macroeconomic conditions, both pre-and post-financial crises.

3.2 Variables and Metrics

The key variables and metrics obtained from S&P Capital IQ comprised historical financial and operational data, such as total assets, total equity, total intangible assets, total deposits, gross loans and advances, net loans and advances, and the number of staff each year. Additionally, metrics such as Return on Equity (ROE), dividend per share, and share price were collected. These metrics allowed for determining other essential variables, including tangible common equity (TCE), dividend yield, non-performing loans ratio, leverage, and loans-to-deposit ratio. These variables provide insights into banks' performance and are essential to comprehend the factors that influence valuation over time. Table 1 summarizes the key variables, their definition and expected effect on P/TBV.

The variables considered in this research are consistent with existing literature, interest both investors and regulators, and fit naturally within the Capital Adequacy, Asset Quality, Management Quality, Earnings, and Liquidity (CAMEL) framework, which is widely used to evaluate banks' overall health and performance Qureshi & Siddiqui (2023); Othman et al. (2024). However, a fundamental limitation of this study is showing how macroeconomic variables in addition to the financial variables affect the overall valuation of regional banks in the U.S. Numerous studies, including those by Louzis et al. (2010); Dietrich & Wanzenried (2014); Messai & Jouini (2013), have demonstrated that macroeconomic factors, such as GDP growth, inflation, and interest rates, can significantly influence banks' performance and valuation. Hence, the potential impact of external economic conditions on the banks' price-to-tangible book value multiple needs to be examined, highlighting a fundamental limitation of the scope of study.

Table 1. Summary of selected independent variables and applicable notations

Class	Metric	Notation	Definition and Expected Impact on P/TBV
Profitability	Return on Equity	ROE	ROE, given as net income divided by average total equity. Higher ROE indicates strong profitability, which leads to higher P/TBV multiples as it reflects a bank's efficient use of equity to drive returns.
Asset Quality	Non-Performing Loans Ratio	NPL	NPL represents the proportion of default loans and directly affects asset quality. A higher NPL ratio signals deteriorating asset quality, which is expected to reduce the P/TBV multiple.
Capital	Tangible Common Equity / Total Assets	TCE/TA	TCE/TA shows the proportion of a bank's tangible assets financed by common equity. A higher TCE/TA ratio signals a robust capital base and financial stability, which are associated with a higher P/TBV multiple.
Liquidity	Loan to Deposit Ratio	LDR	LDR is a liquidity measure that compares total loans to total deposits. While a higher LDR can enhance profitability, excessive reliance on loans could increase liquidity risk, potentially lowering P/TBV multiple if the market perceives it negatively.
Leverage	Leverage Ratio	LEV	LEV measures the ratio of total debt to total equity. Higher leverage increases financial risk, resulting in lower P/TBV multiples if the market perceives the bank as over-leveraged.
Size	Total Consolidated Assets	LN_ASSETS	Total consolidated assets represent a proxy for Bank size, and larger banks typically benefit from economies of scale and greater market power. This could potentially lead to higher P/TBV multiples due to improved operational efficiency and lower risk.
Shareholder's Return	Dividend Yield	DIV_YIELD	Dividend yield measures the return on investment for shareholders through dividends. While higher dividend yields may attract investors, unsustainably high yields can signal limited growth prospects and may negatively affect P/TBV multiples.
Operational Efficiency	Revenue Per Staff	LN_REV_ STAFF	Efficiency metric measures revenue per employee. Higher efficiency is expected to affect P/TBV multiple positively.

The descriptive statistics presented in Table 2 reveal a wide range of financial profiles among the sampled banks. ROE, for instance, varies significantly, from -46.12 to 44.02, with a median of 10.00, indicating substantial losses for some banks and profitability for others. NPL ranges from 0.00 to 12.02, with a median and mean 1.00, suggesting low default rates for most banks but higher for a few. TCE_TA has a mean of 10.20, with values ranging from 4.10 to 18.11, demonstrating a robust capital base across most banks. LDR averages 0.84, with some banks conducting more lending than their deposits, as evidenced by the 1.49 maximum. LEV ranges from 0.00 to 20.00, with a median of 9.00, reflecting diverse leverage practices across the institutions. LN_ASSETS varies from 5.14 to 11.44, highlighting significant differences in bank size. DIV_YIELD ranges from 0.00 to a maximum of 14.58, with a median of 2.75, suggesting differences in banks' overall dividend policies. LN_REV_STAFF averages 5.29, peaking at 6.72, reflecting varied staff productivity.

Table 3 presents the correlation matrix and multicollinearity assessment for the independent variables used in this study. ROE exhibits a moderate negative correlation with NPL (-0.361), suggesting that higher non-performing loans are associated with lower profitability. TCE_TA shows a moderate positive correlation with LEV at 0.519, indicating that banks with higher leverage tend to have a more substantial capital base. While this may seem counterintuitive, it aligns with the notion that banks taking on higher risks, such as financing risks, tend to hold higher capital reserves to compensate for their higher risk profiles (Ingves, 2014). Other correlations are weak, indicating limited multicollinearity among most variables.

The Variance Inflation Factor (VIF) analysis confirms that multicollinearity is not a major concern, as all VIF values are well below the threshold of 10.00, and tolerance levels exceed 10.0% (Frazier et al., 2004; Cohen & Cohen, 1983). Leverage shows the highest VIF at 2.93, which suggests some collinearity but generally remains within acceptable limits. Overall, the correlation matrix reveals low to moderate correlations, indicating that the variables are sufficiently independent for reliable regression analysis.

Table 2. Descriptive statistics of variables

Variables*	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
P_TBV	0.44	1.33	1.69	1.84	2.22	5.91
ROE	-46.12	8.00	10.00	10.01	12.00	44.02
NPL	0.00	0.00	1.00	0.98	1.00	12.02
TCE_TA	4.10	9.02	10.00	10.20	12.06	18.11
LDR	0.15	0.75	0.86	0.84	0.95	1.49
LEV	0.00	9.20	9.00	9.63	10.00	20.00
LN_ASSETS	5.14	7.26	8.18	8.21	9.27	11.44
DIV_YIELD	0.00	1.98	2.75	2.90	3.70	14.58
LN_REV_STAFF	2.30	5.05	5.26	5.29	5.53	6.72

** Natural logarithm of variables is given as LN_[Variable]*

Table 3. Correlation matrix and multicollinearity

	ROE	NPL	LEV	TCE_TA	DIV_YIELD	LDR	LN_ASSETS	LN_REV_STAFF
ROE	1.00							
NPL	-0.36	1.00						
LEV	-0.10	0.07	1.00					
TCE_TA	-0.13	-0.12	0.52	1.00				
DIV_YIELD	-0.17	0.19	-0.14	-0.11	1.00			
LDR	-0.07	0.01	0.11	0.00	0.05	1.00		
LN_ASSETS	-0.01	-0.13	-0.05	0.30	-0.12	-0.04	1.00	
LN_REV_STAFF	0.28	-0.33	0.12	0.28	-0.19	-0.02	0.54	1.00
VIF	1.35	1.32	2.93	1.67	1.12	1.62	1.63	1.72
Tolerance Level	74.10%	75.60%	34.10%	59.80%	89.30%	61.90%	61.30%	58.00%

3.3 Empirical Models and Specification

Various studies have explored the determinants of bank profitability and performance by applying different functional linear models, including pooled OLS, fixed effects, and random effects models (Molyneux & Thornton, 1992; Rjoub et al., 2017; Short, 1979; Demirgüç-Kunt & Huizinga, 1999; Menicucci & Paolucci, 2016). These approaches have been utilized to capture time-invariant and time-varying factors influencing profitability, such as bank size, capital adequacy, asset quality, and operational efficiency. By accounting for these factors, these earlier works provide insights into how internal and external factors drive banks' profitability across different regions and market environments.

Other studies have taken a step further, integrating the Generalized Method of Moments (GMM) within a linear model framework to tackle unobserved heterogeneity and endogeneity issues that often arise when using panel data (Dietrich & Wanzenried, 2014; Le & Ngo, 2020). In a related study, Anbar & Alper (2011) examined bank-specific and macroeconomic factors that influence the profitability of Indian commercial banks using linear regression models, including pooled OLS, fixed effects, and random effects. This underscores the adaptability and versatility of these modelling approaches in banking research, providing a robust foundation for exploring the impact of select variables on U.S. regional banks' P/TBV multiple.

This study applies the fixed effects, random effects, and pooled OLS models on panel data of 101 banks to understand and quantify the relationships between P/TBV and the selected independent variables over a 20-year period. The following regression model for the panel data applies:

$$P/TBV_{it} = \alpha + \beta_1 ROE_{it} + \beta_2 NPL_{it} + \beta_3 TCE_{TA_{it}} + \beta_4 LDR_{it} + \beta_5 LEV_{it} + \beta_6 LN\_ASSETS_{it} + \beta_7 DIV\_YIELD_{it} + \beta_8 LN\_REV_S TAFF_{it} + \varepsilon_{it}$$

Where *'i'* and *'t'* relate to specific banks and years, respectively. For instance, ROE_{it} indicates return on equity for bank *'i'* in year *'t'*. *α,* is the intercept term on the explanatory variables β_n represents the coefficients for each independent variable, representing the magnitude of their impact on P/TBV_{it}. ε_{it} represents the error term that captures unobserved factors affecting P/TBV_{it} that are not included in the model. The error term may vary by time across banks.

To describe the impact of strategic shifts and regulatory changes adopted by banks following the 2007-2008 financial crisis, a dummy variable, *'as.factor(TIME)'* with its coefficient (γ) , was introduced in the model. This variable represents a time-specific fixed effect, where each year is treated as a categorical variable. It accounts for time-varying factors that uniformly affect all banks during a given period but may not be explained by other independent variables. Precisely, it reflects critical strategic adjustments in response to post-crisis regulatory reforms aimed at enhancing the stability and resilience of the banking sector, which influenced banks' financial performance and valuation. With the addition of this new dummy variable, the following revised regression model for the panel data applies:

$$P/TBV_{it} = \alpha + \beta_1 ROE_{it} + \beta_2 NPL_{it} + \beta_3 TCE\_TA_{it} + \beta_4 LDR_{it} + \beta_5 LEV_{it} + \beta_6 LN\_ASSETS_{it} + \beta_7 DIV\_YIELD_{it} + \beta_8 LN\_REV\_STAFF_{it} + \gamma_1 as.factor(TIME)_t + \varepsilon_{it}$$

4. RESULTS AND DISCUSSION

4.1 Results

Prior to performing the regression analysis, the dataset was examined for potential econometric issues using a correlation matrix. Specifically, the independence of the variables was assessed to ensure the absence of multicollinearity, which could compromise the validity of the results. The correlations among the variables included in the model are presented in Table 3. The following sections summarize the three regression results–Fixed Effects, Random Effects, and Pooled OLS models–used in estimating the impact of the variables under study on the P/TBV of U.S. regional banks.

4.1.1 Fixed effects model

The results of the fixed effects model, as presented in Table 4, reveal significant relationships between several key variables and Price-to-Tangible Book Value (P/TBV). Return on Equity (ROE) is statistically significant and positively associated with P/TBV (Estimate = 0.023, $p < 0.001$), indicating that banks with higher profitability tend to achieve higher valuations relative to their tangible book value. Similarly, the Loan-to-Deposit Ratio (LDR) has a positive and significant effect on P/TBV (Estimate = 0.242, p < 0.05), suggesting that banks with a higher proportion of loans compared to deposits are viewed more favorably by the market. Operational efficiency, as proxied by revenue per staff member (LN_REV_STAFF), is positively and significantly related to P/TBV (Estimate = 0.172, p < 0.01), indicating that the market places a premium on banks that operate more efficiently by generating higher revenue with less personnel.

In contrast, certain variables exert a negative influence on P/TBV. The asset size variable (LN_ASSETS) demonstrates a significant negative relationship with P/TBV (Estimate = -0.024, p < 0.001), indicating that smaller banks tend to command higher valuations. Non-Performing Loans (NPL) also show a significant negative impact (Estimate = -0.100, p < 0.001), suggesting that higher levels of non-performing loans reduce a bank's valuation. Leverage (LEV) similarly exerts a negative effect (Estimate = -0.065, p < 0.001), reflecting likely market concerns over increased financial risk associated with higher leverage. While the Tangible Common Equity to Total Assets ratio (TCE_TA) is not statistically significant, Dividend Yield (DIV_YIELD) has a strong negative relationship with P/TBV (Estimate = -0.165, p < 0.001), suggesting that higher dividend payouts, particularly in low-price environments, are associated with lower bank valuations. Finally, the time variable reveals that bank valuations were significantly higher during the pre-financial crisis period (as.factor(TIME)1) than in the post-crisis period (as.factor(TIME)2), as evidenced by a positive and highly significant coefficient for the pre-crisis period (Estimate = 0.446, p < 0.001).

Overall, the model explains a substantial portion of the variance in P/TBV, with an R-squared of 0.51 and an adjusted R-squared of 0.49, demonstrating its strong explanatory power. The F-statistics (224.60, p < 0.001) confirms the overall significance of the fixed effects model.

4.1.2 Random effects model

The random effects model summary in Table 5 shows that ROE remains positively and significantly associated with P/TBV (Estimate = 0.030, p < 0.001), reinforcing the conclusion that higher profitability leads to higher bank valuations. However, unlike in the fixed effects model, LDR is not statistically significant (Estimate = 0.054, p = 0.576), suggesting that the ratio of loans to deposits does not significantly affect P/TBV when accounting for bank-specific and time-related variations. On the other hand, NPL and LEV show a substantial negative impact on P/TBV (Estimate = -0.090, p < 0.001 and Estimate = -0.065, p < 0.001, respectively), indicating that higher levels of non-performing loans and greater leverage reduce bank valuations, reflecting market concerns over asset quality and risk exposure. The efficiency proxy variable LN_REV_STAFF exhibits a significant positive relationship with P/TBV (Estimate = 0.231, p < 0.001). DIV_YIELD significantly and negatively affects P/TBV (Estimate = -0.158, p < 0.001), indicating that higher dividend payouts are associated with lower market valuations, due to perceptions of reduced reinvestment and growth potential. Asset size, LN_ASSETS, positively influences P/TBV (Estimate = 0.102, p <0.001), implying that larger banks are valued higher, due to their perceived stability and operational advantages. This is contrary to the findings of the fixed effect model, which suggests a significant negative relationship between total assets and bank valuation. This conflict occurs because both models have different assumptions about unobserved heterogeneity and how it is treated in the analysis. While the fixed effect model removes any unobserved heterogeneity by focusing on the changes within each entity over time, the random effect model assumes that the unobserved heterogeneity is random and uncorrelated with the explanatory variables.

Additionally, the coefficient of the fixed effect model reflects how changes in the independent variable within each bank over time affect the bank's valuation. In the random effects model, the coefficient captures both within-bank changes and differences between banks. This might result in a positive association even if the within-entity effect is negative.

Finally, the time factor (as.factor(TIME)1) highlights a significant pre-financial crisis premium on bank valuations (Estimate = 0.505, p < 0.001), suggesting that regional banks were valued more favorably during this period. The model demonstrates a good fit, explaining 49.16% of the variation in P/TBV, with an adjusted R-squared of 48.93%.

Table 4. Fixed effects regression model estimates

Variables	Estimate	Std. Error	*t-value*	*Pr(>|t|)*
(Intercept)#	NA	NA	NA	NA
ROE	0.023	0.003	8.161	5.9e-16 ***
LDR	0.242	0.101	2.381	0.017 *
NPL	-0.100	0.011	-9.115	< 2.2e-16 ***
LEV	-0.065	0.009	-7.136	1.4e-12 ***
TCE_TA	-0.005	0.008	-0.641	0.522
LN_REV_STAFF	0.172	0.060	2.865	0.004**
DIV_YIELD	-0.165	0.008	-19.781	< 2.2e-16 ***
LN_ASSETS	-0.024	0.005	-4.756	2.1e-06***
as.factor(TIME)1	0.446	0.033	13.389	< 2.2e-16 ***
Model Statistics:				
R-Squared	*51.5%*			
Adj. R-Squared	*48.8%*			
Overall P-Value	*$< 2.22e^{-16}$*			

*Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1.*

 # The intercept in a fixed effects model is not directly estimated by the model because the transformation removes individual-specific effects. Each bank has its own intercept, so a single overall intercept is omitted, as the model focuses on deviations from entity-specific means rather than a constant term

Table 5. Random effects regression model estimates

Variables	Estimate	Std. Error	*t-value*	*Pr(>|t|)*
(Intercept)	2.860	0.258	11.098	< 2.2e-16 ***
ROE	0.030	0.003	10.925	< 2.2e-16 ***
LDR	0.054	0.096	0.560	0.576
NPL	-0.090	0.011	-8.154	3.5e-16 ***
LEV	-0.065	0.009	-7.171	7.5e-13 ***
TCE_TA	0.007	0.008	0.919	0.358
LN_REV_STAFF	0.231	0.054	4.278	2.0e-05 ***
DIV_YIELD	-0.158	0.008	-19.189	< 2.2e-16 ***
LN_ASSETS	0.102	0.020	5.205	1.9e-07 ***
as.factor(TIME)1	0.505	0.032	15.587	< 2.2e-16 ***
Model Statistics:				
R-Squared	49.2%			
Adj. R-Squared	48.9%			
Overall P-Value	$< 2.22e^{-16}$			

*Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

4.1.3 Pooled OLS model

Table 6 summarizes the results of the pooled OLS regression method. The relationship between ROE and P/TBV is positive and statistically significant (Estimate = 0.052, p < 0.001), indicating that higher profitability leads to more favorable valuations. In contrast, LDR has a negative and significant relationship with P/TBV (Estimate = -0.448, p < 0.001), implying that banks with higher loan-to-deposit ratios are perceived as riskier, leading to lower valuations.

Similarly, NPL and LEV exhibit negative and significant effects on P/TBV (Estimate = -0.064, p < 0.001 and Estimate = -0.091, p < 0.001, respectively), indicating that banks with poor loan quality and higher leverage are penalized by the market. TCE_TA positively influences P/TBV (Estimate = 0.070, p < 0.001), reflecting that a stronger capital base leads to higher valuations. LN_REV_STAFF exhibits a significant positive relationship with P/TBV (Estimate = 0.251, p < 0.001), while DIV_YIELD has negative and significant coefficients (Estimate = -0.106, p < 0.001). Consistent with the random effect model, the bank size variable, LN_ASSETS shows a positive and significant effect on P/TBV (Estimate = 0.148, p < 0.001), indicating that larger banks are valued more favorably. Lastly, the time variable (as.factor(TIME)1) shows that regional banks were valued higher during the pre-financial crisis period (Estimate = 0.593, p < 0.001). The model explains a good portion of the variance in P/TBV with an R-squared of 48.51% and an adjusted R-squared of 48.28%.

Table 6. Pooled OLS regression model estimates

Variables	Estimate	Std. Error	*t-value*	*Pr(>|t|)*
(Intercept)	2.201	0.245	8.999	< 2.2e-16 ***
ROE	0.052	0.003	18.050	< 2.2e-16 ***
LDR	-0.448	0.083	-5.410	7.1e-08 ***
NPL	-0.064	0.012	-5.157	2.8e-07 ***
LEV	-0.091	0.009	-9.863	< 2.2e-16 ***
TCE_TA	0.070	0.007	9.760	< 2.2e-16 ***
LN_REV_STAFF	0.251	0.049	5.098	3.8e-07 ***
DIV_YIELD	-0.106	0.008	-12.695	< 2.2e-16 ***
LN_ASSETS	0.148	0.011	13.773	< 2.2e-16 ***
as.factor(TIME)1	0.593	0.036	16.267	< 2.2e-16 ***
Model Statistics:				
R-Squared	48.5%			
Adj. R-Squared	48.3%			
Overall P-Value	$< 2.22e^{-16}$			

*Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

4.1.4 Model Validation

4.1.4.1 Hausman specification test

In determining the most suitable and appropriate model out of the three applied in this study, the Hausman specification test was utilized to select the fixed effects (FE) and random effects (RE) models. The test compared the efficiency of the two models by evaluating whether the RE model produces consistent estimates or whether the FE model is preferable.

The test statistics were determined using the expression:

$$H = (\hat{\beta}_{RE} - \hat{\beta}_{FE})' \left(Var(\hat{\beta}_{FE}) - Var(\hat{\beta}_{RE})\right)^{-1} (\hat{\beta}_{RE} - \hat{\beta}_{FE})$$

Where $\hat{\beta}_{RE} - \hat{\beta}_{FE}$ are the estimated coefficients from the random effects and fixed effects models, respectively; and $Var(\hat{\beta}_{FE}) - Var(\hat{\beta}_{RE})$ are the variance-covariance matrices of the *FE* and *RE* estimates. This test statistic follows a chi-squared distribution with degrees of freedom equal to the number of parameters being evaluated. The null hypothesis (H_0) of the Hausman test is that the RE model provides consistent and efficient estimates, making it the preferred model. The alternative hypothesis (H_1) is that the RE model is inconsistent, and the FE model should be used instead.

As shown in Table 7, the Hausman test yielded a chi-squared statistic of 69.17 with 9 degrees of freedom and a p-value of $2.22e^{-16}$. Since the p-value is significantly small we reject the null hypothesis, concluding that the RE estimator is inconsistent due to the correlation between the individual effects and the regressors. As a result, when compared to the RE model, the FE model is preferred.

Table 7. Summary of Hausman test results

Chi-squared	Degrees of freedom	p-value
69.168	9	$2.22e^{-16}$

By rejecting the null hypothesis, we confirm that the unobserved heterogeneity across banks, such as differences in management quality or risk tolerance, is correlated with the bank-specific variables, making the fixed effects model the more appropriate choice for estimating the determinants of P/TBV (Contoyannis & Rice, 2001; Hausman, 1978).

4.1.4.2 F-Test

The F-test for individual effects was conducted to determine whether individual-specific effects significantly explain the variation in the dependent variable (P/TBV) based on the relationship with the independent variables. The null hypothesis (H_0) assumes that there are no significant individual-specific effects, meaning that the pooled OLS model, which does not account for such effects, would be sufficient. However, the alternative hypothesis (H_1) posits that individual-specific effects are significant and should be included in the model.

Table 8 presents the results of the F-test, which yielded an F-statistic of 16.59, with degrees of freedom df1 = 100 and df2 = 1,905 and a p-value of less than 2.2e-16. The highly significant p-value leads to the rejection of the null hypothesis, which assumes no individual effects. This rejection has significant implications for the pooled OLS model, as it indicates that the model, which assumes that all banks share a common intercept, fails to capture important bank-specific factors influencing the P/TBV (Price-to-Tangible Book Value) of regional U.S. banks. The rejection of the null hypothesis suggests that unobserved heterogeneity across banks, such as differences in management quality, risk tolerance, or operational efficiency, significantly affects their P/TBV multiples. These individual-specific factors remain constant over time but vary across banks, making the fixed effects model a more appropriate choice for this analysis. By controlling for these unique characteristics, the fixed effects model provides more accurate and unbiased estimates, which is crucial in panel data analysis (Baltagi, 2005). This finding is consistent with existing research that applied fixed effects models in banking studies to control for firm-specific heterogeneity, ensuring more reliable results (Dietrich & Wanzenried, 2011; Baltagi, 2005).

Table 8. Summary of F-test results

F-statistic	df1	df2	p-value
16.59	100	1,905	$< 2.2e^{-16}$

4.1.4.3 Residual analysis

With the fixed effects model emerging as the model of choice for this study, residual analysis using residual diagnostic plots was performed as one of the methods to assess model fit. The residual diagnostic plots shown in Fig. 1. consist of Residual vs. Fitted, Q-Q Plot, Scale-Location Plot, and Residuals Histogram plots.

The residual diagnostic plots collectively indicate that the Fixed Effects (FE) model is well-fitted and satisfies critical assumptions. The Residuals vs Fitted plot shows no clear pattern, indicating that the model captures the relationship between the dependent and independent variables without significant bias or signs of non-linearity. Residuals are evenly spread around the horizontal line at zero, suggesting that the model is well-fitted, and no significant deviations or systematic patterns exist in the residuals. The Q-Q plot evaluates the normality of residuals, showing that they follow the 45-degree reference line, particularly in the center of the distribution. While there are some deviations at the tails, indicating outliers or heavy-tailed residuals, these deviations are relatively minor and do not significantly affect the model's overall fit. The Scale-Location plot checks for homoscedasticity (constant variance), and the lack of a clear fanning pattern confirms that the residuals exhibit consistent variance across different levels of fitted values. This suggests that heteroscedasticity is not a significant concern, however modified Wald test was conducted to quantitatively assess the impact of heteroscedasticity of the model. Finally, the Residuals Histogram displays a near-normal distribution, further validating the model's adequacy.

4.1.4.4 Addressing the impact of heteroscedasticity

The modified Wald test was conducted to detect groupwise heteroskedasticity in the fixed effects model (Greene, 2018). This test examines whether the variance of the residuals (ε_{it}) from the model differs across banks, indicating potential heteroskedasticity. To address the potential presence of heteroskedasticity, robust standard errors were employed in the fixed effects model, adjusting for any groupwise heteroskedasticity that may exist. This approach ensures the reliability of the coefficient estimates by accounting for any variance differences across banks. Table 9 presents the resulting coefficients of the fixed effects model with robust standard errors.

The results are generally consistent with the fixed effects model, with all the significant variables remaining so, except for the loan-to-deposit ratio (LDR). The p-value for LDR ($p > 0.1$) indicates that its coefficient is no longer statistically significant after adjusting for heteroskedasticity. Additionally, the significance level of LN_REV_STAFF decreased from 1% to 5% after accounting for heteroskedasticity. However, this does not negate the impact of LN_REV_STAFF on overall bank valuation.

4.2 Discussion

The fixed effect model emerged as the most fitted model when compared to the random effects and pooled OLS models. It offers a comprehensive understanding of the factors that drive bank valuations, reflecting broader industry practices, market expectations, and the findings of previous studies.

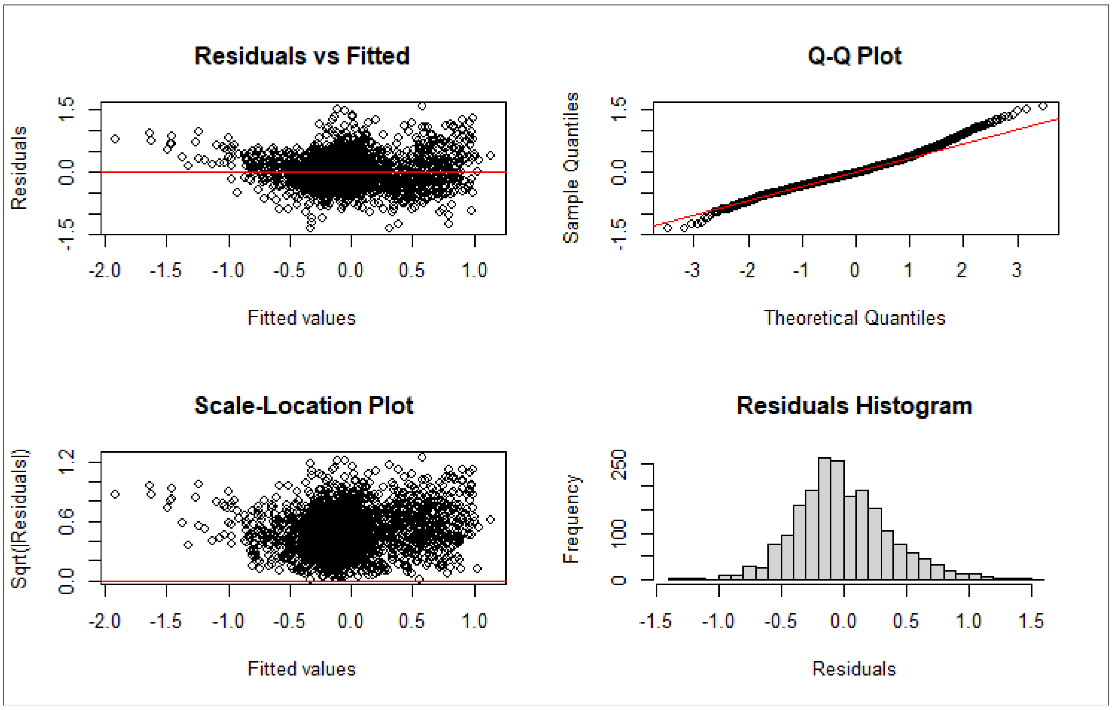

Fig. 1. Residual diagnostics for fixed effects model: Residuals vs fitted, Q-Q plot, scale-location, and histogram

Table 9. Fixed effects model estimates using robust standard errors

Variable	Estimate	Std. Error	t value	Pr(>|t|)
ROE	0.023	0.006	3.563	3.8e-04 ***
LDR	0.242	0.225	1.074	0.283
NPL	-0.100	0.016	-6.375	2.3e-10 ***
LEV	-0.065	0.017	-3.805	1.47e-04 ***
TCE_TA	-0.005	0.011	-0.465	0.642
LN_REV_STAFF	0.172	0.074	2.328	0.020*
DIV_YIELD	-0.165	0.016	-10.108	2.2e-16 ***
LN_ASSETS	-0.024	0.005	-5.211	2.1e-07 ***
as.factor(TIME)1	0.446	0.051	8.682	2.2e-16 ***

*Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

Profitability in the banking sector remains a fundamental driver of market valuation, as captured by the significant positive relationship between ROE and P/TBV. This aligns with the industry's long-standing focus on profitability as a critical performance measure. Investors tend to favor banks that efficiently convert shareholder equity into tangible returns, and this relationship is often used as a signal of management's ability to generate sustainable profits. The highly significant ROE results underscore this, as banks with consistently high profitability are more likely to be perceived as stable and capable of delivering long-term value. This finding is consistent with Athanasoglou et al. (2008), highlighting profitability's positive role in bank valuation.

Bank size, as measured by total assets, shows a negative and significant relationship with P/TBV multiple, indicating that smaller banks tend to have higher valuations than their larger counterparts. This is consistent with findings from studies such as Bogdanova et al. (2018); Minton et al. (2017), suggesting that larger banks were valued less than smaller ones before the financial crisis and pre-Dodd-Frank era, with the size effect diminished in later periods. Minton et al. (2017) highlight that larger banks often face lower valuations due to the complexities and higher costs associated with managing large institutions. These banks are subject to heightened regulatory scrutiny and operational inefficiencies, which can offset their advantages, such as economies of scale and the "too-big-to-fail" safety net. The market tends to penalize larger banks for these complexities, reflecting reduced financial performance and elevated risks, making them less appealing to investors compared to smaller banks. This valuation trend became especially pronounced after the financial crisis, as regulatory reforms imposed additional costs and challenges on larger institutions.

Credit risk is a significant concern for investors, as represented by NPL ratios. High NPL ratios indicate banks' high exposure to riskier loans, which can reduce profitability and undermine investor confidence in the bank's ability to manage credit risk effectively. In the banking industry, managing non-performing loans is critical to maintaining a healthy balance sheet, as high levels of bad debt can lead to capital shortfalls and regulatory intervention. The significant negative correlation between NPL and P/TBV reflects the market wariness of banks with poor loan performance, leading to lower profitability and shareholders' returns. This aligns with the findings by Berger & DeYoung (1997) on the negative impact of NPLs on profitability.

Moreover, the role of leverage in the model further reinforces the importance of financial stability. Leverage, while often used to amplify returns, increases a bank's credit risk profile. In the aftermath of the financial crisis, investors have grown more cautious about banks with high leverage, fearing that over-reliance on debt could lead to solvency issues. This is reflected in the significant negative relationship between leverage and valuation and in regulatory measures like Basel III, which seeks to limit leverage to ensure financial stability.

Interestingly, dividend policy, as reflected in the dividend yield variable, negatively affects bank valuations. This suggests that while dividend payments attract confident investors, the market may perceive higher dividend payouts as a sign of limited growth opportunities. Dividends are often viewed together with reinvestment; higher payouts can indicate that a bank lacks better avenues for deploying capital toward expansion or innovation. This finding aligns with studies by Arslan & Zaman (2014); Lyimo (2024) that noted the inverse relationship between dividend yield and share price. In competitive markets, particularly for banks looking to grow in an evolving regulatory and technological landscape, reinvestment in growth opportunities is often prioritized over short-term returns to shareholders. Therefore, the negative coefficient for dividend yield may reflect investor preference for banks that demonstrate a more substantial commitment to reinvestment and innovation.

The capital ratio, which measures the proportion of a bank's assets held as common equity to absorb losses, exhibits a negative and statistically insignificant relationship with P/TBV in the fixed effects model. This finding suggests a preference for banks that allocate more capital towards generating higher returns rather than banks that hold excess capital. Although greater capital levels improves a bank's ability to absorb shocks, they may also constrain lending capacity and profitability. This is further supported by the positive relationship between LDR and P/TBV, which, although not statistically significant in the fixed effects model with robust standard errors, provides insight into investor preferences for banks that engage in more lending activity.

The efficiency proxy, revenue per staff, demonstrates a significant positive effect, indicating that the market values operational efficiency in banks, rewarding those that generate higher revenue per employee. This suggests that investors place a premium on banks that can optimize their human capital, effectively managing costs while maintaining high productivity. By achieving greater efficiency with fewer resources, these banks are viewed as more capable of sustaining profitability and growth, leading to higher market valuations. This finding highlights the increasing importance of lean operations and resource optimization in driving investor confidence and bank valuation in a competitive financial environment.

The analysis of the time variable reveals that regional bank valuations were significantly higher during the pre-financial crisis period (as.factor(TIME)1) than in the post-crisis period (as.factor(TIME)2), as indicated by the positive and highly significant coefficient for the pre-crisis era. This outcome is consistent with the challenging post-crisis environment, marked by reduced profitability, more conservative business models, and stricter capital and liquidity requirements under the Basel Accords and the Dodd-Frank Act. Investor risk aversion, skepticism, and operational inefficiencies, especially among larger banks, further contributed to the decline in valuations compared to pre-crisis levels.

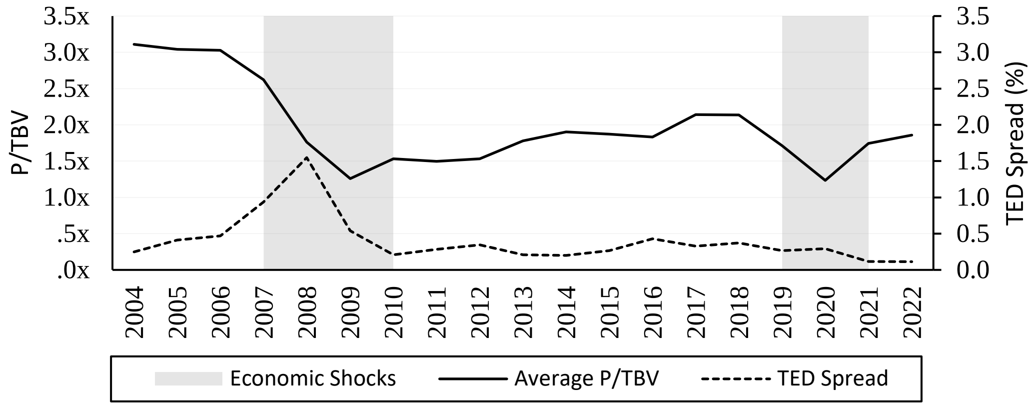

Fig. 2. Historical valuation levels of regional banks and the impact of economic shocks, highlighting higher valuations in the pre-financial crisis period

Source: S&P capital IQ and Federal Reserve Bank of St. Louis

Fig. 2 illustrates the changes in P/TBV multiple for regional banks over the past 19 years and the average TED Spread, a crucial indicator of credit risk in the U.S. economy. Spikes in the TED Spread indicate increased credit risk and decreased trust among banks, resulting in tighter credit conditions. Before 2004, regional banks traded at approximately 3x their tangible book value. However, the financial crisis of 2007-2009 and the economic impact of COVID-19 led to a significant decrease in valuation, accompanied by corresponding increases in the TED Spread.

The fixed effects model offers a deeper understanding of the factors influencing regional bank valuations, emphasizing the intricate balance between performance, stability, and market perceptions. It highlights how investor sentiment has shifted post-crisis, with a growing preference for banks that demonstrate resilience and adaptability in the face of evolving risks. The findings suggest that while traditional measures of success remain important, value creation also needs to be emphasized. This evolving perspective reflects broader trends in the financial industry, where stability, innovation, and efficient risk management are becoming vital to maintaining and enhancing value in an increasingly complex and regulated environment.

5. CONCLUSION

The findings of this study highlight the critical role of financial stability, profitability, capital adequacy, and asset quality in shaping the Price-to-Tangible Book Value multiple of regional banks. Key variables, including return on equity, operational efficiency, and a time-specific variable representing pre- and post-financial crisis periods, had significant positive effects on P/TBV, underscoring their importance in bank valuation. Conversely, factors such as asset size, non-performing loans, leverage, and dividend yield were negatively associated with valuations, signaling the need for banks to carefully manage these metrics. These insights offer practical guidance for bank managers and investors seeking to optimize valuation and pricing strategies, emphasizing the need for caution and attention in managing these financial and operational variables. By emphasizing profitability, maintaining robust asset quality, and exercising prudent capital allocation, banks can align their financial and operational efficiency with market expectations, thereby promoting sustainable growth and enhancing competitiveness.

While this study provides a comprehensive understanding of the internal financial determinants of bank valuations, there is a need to consider the impact of macroeconomic factors such as inflation, interest rates, and GDP growth rate, which are essential in shaping the broader market environment. These external variables could significantly influence the findings of this research. Future research should examine the interaction between these macroeconomic variables and bank-specific financial metrics to identify and quantify the overall influence on U.S. regional banks' valuation. Incorporating macroeconomic considerations would yield more profound insights into how regional banks can navigate evolving economic conditions, refining strategies for optimizing their market position in stable and volatile environments.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Authors hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that they have no known competing financial interests or non-financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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