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The Effect of Cash Holding and Financial Regulation on Bankruptcy Risk: Evidence from Cross-Country Banking Industry

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Abstract

This paper studies the determinants of bank financial distress using a 2012–2018 multi-country panel (73,124 bank-year observations; 10,562 banks; 32 countries). Fixed-effects estimates show that higher capital (Tier-1/RWA) and better asset quality (lower NPL) are associated with higher Z-scores (lower distress). Intangible intensity is positively related to distress. Cash-holding proxies load negatively in the Z-score equation, indicating that larger cash balances coincide with lower Z-scores in this sample. One interpretation is that excess cash reflects under-deployment or precautionary hoarding during adverse conditions, which does not translate into stronger stability. Results are robust to alternative specifications. Policy implications highlight calibrating core capital, strengthening credit risk management, and optimizing not hoarding liquidity.

Keywords: *Cash Holding, Financial Distress, Global Banking, Intangible Asset, and Capital Adequacy Ratio*

JEL Classifications: *G21, G28, and G33.*

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Introduction

Financial distress is an early indicator of bankruptcy that can affect both services (Smith & Graves, 2005) and manufacturing companies (Smith & Liou, 2007). Companies indicated to be in financial distress experience business disruptions and a weakening financial position (Bulot et al., 2014), leading to increased costs. Financial literature discusses the costs of financial difficulties concerning capital structure decisions (Al-Dhamari et al., 2023).

Companies undergoing financial distress adopt different policies compared to liquid companies. Financially constrained companies need help securing external funding (Quintiliani, 2017). Furthermore, companies experiencing financial distress tend to have more lenient investment policies to pursue corporate growth (Gupta & Mahakud, 2022). Loans and maturing interest further pressurise companies in financial distress, potentially leading to bankruptcy in severe cases (Hadjaat et al., 2021). Obtaining trust from creditors becomes increasingly challenging for these companies due to their reputation for struggling to repay previous loans (ElBannan, 2021).

Previous research indicates that a high level of cash ownership can reduce the incidence of financial distress in companies (Han & Qiu, 2007; Nier & Baumann, 2006). Additionally, studies by Alanis and Quijano (2019), Chen and Duchin (2022), and Fahlenbrach et al. (2021) highlight the role of intangible asset value in influencing a company's financial risk. Investments generating high future cash flows are recognised as factors that can mitigate banks' financial distress risk. In this context, effective risk management becomes crucial to help banks absorb potential losses and reduce the risk of failure (Berger & Bouwman, 2013).

Awareness of environmental sustainability is also becoming a primary concern for entrepreneurs and companies. Research by Berger and Bouwman (2013) explores the role of financial regulation in bank stability, emphasising the importance of adequate capital and liquidity in reducing the risk of bank bankruptcy during crises and maintaining overall financial system stability (Lee & Hsieh, 2013). These findings provide a robust foundation for regulatory and supervisory approaches that can help mitigate financial risk in the banking sector.

Following the global financial crisis, bank failures have become a focal point of attention for academics, practitioners, and regulators. The vital role of banks in the economy, especially in developing countries, makes their business sustainability a primary concern. A study by Mutarindwa et al. (2020) indicates that banks with adequate capital tend to be more stable and less prone to taking risks during crises. High funding liquidity is also linked to stability and low bankruptcy risk. Anginer et al. (2018) found that high capital levels in banks can reduce systemic risk, especially for countries with low supervision and information. Bui et al. (2017) highlight the role of bank capital in enhancing the financial system's resilience in Australia, where high buffer capital can absorb potential losses at the bank level and mitigate overall financial system instability. However, the buffer capital increase may also negatively impact credit growth and regulatory capital ratios.

Bank failures in the banking sector are triggered by the moral hazard of bank managers (Acharya & Naqvi, 2012). Excessive bank liquidity encourages managers to be more expansive in extending credit (Thornton & Tommaso, 2019), thereby increasing credit risk and disrupting bank stability (Khan et al., 2017). Conversely, unfavourable conditions in the interbank money market infrastructure and high information asymmetry make it challenging for banks to manage liquidity, which, in turn, disrupts intermediation functions (Rokhim & Min, 2020). Therefore, the relationship between liquidity and risk-taking behaviour remains to be determined.

Both theoretically and empirically, regulatory capital can influence bank failures. The risk absorption view argues that high capital adequacy is used to absorb potential losses (Kim & Sohn, 2017), reducing the likelihood of bank failure (Bui et al., 2017; Ovi et al., 2020; Zheng et al., 2019). However, excessive capital levels may only be utilised as a guarantee to meet the minimum capital requirements set by

regulators or market discipline motives (Guidara et al., 2013). On the other hand, the financial crowding-out view suggests that high capital levels reduce the potential for bank failure due to pressure from shareholders (Distinguin et al., 2013). Therefore, a high level of capital can have a positive impact (Shim, 2013) or a negative impact (Khan et al., 2017) on the probability of bank failure.

This study examines determinants of bank financial distress with emphasis on cash holdings and intangible assets. Measuring intangible value remains difficult, yet investment in technology-intensive banking can raise capital costs while strengthening future cash-flow capacity and lowering distress risk. The analysis clarifies how cash, intangibles, and prudential factors operate jointly in shaping stability.

Financial distress in banks is a central policy issue under Basel III, which prioritizes strong capital and high-quality liquidity. Cross-country evidence on how cash and asset composition interact with prudential buffers remains inconclusive. Prior work shows that precautionary cash can reduce bankruptcy risk, whereas persistent accumulation may signal under-deployment, inefficiency, or adverse selection in funding costs. Evidence on intangibles is likewise mixed: they enhance franchise value and earnings but offer weak collateral and may raise loss severity, and many studies are single-country or crisis-episode, limiting generalization.

This study addresses these gaps using a harmonized bank-level panel covering 32 countries over 2012–2018 with ratio-based indicators for comparability. The empirical design estimates fixed effects and two-step System-GMM to handle persistence, heterogeneity, and reverse causality, with Arellano–Bond and Hansen diagnostics. Results indicate that cash does not mechanically improve stability and may reflect hoarding or under-investment under certain constraints, while the resilience contribution of intangibles is context dependent. The findings inform liquidity calibration, capital planning, and asset-quality supervision.

Literature Review

Review Theory

Bank stability is understood as the capacity of the intermediation system to keep extending credit and providing payment services during shocks amid the buildup of vulnerabilities (Haddou & Mkhinini, 2023; Moudud-Ul-Huq et al., 2022). Financial distress is measured by the bank Z-score where higher values indicate lower insolvency risk and a greater distance to default, consistent with the safety-first logic and banking applications (Cerutti et al., 2017; Laeven & Levine, 2009). Within this framework, Basel III capital and liquidity buffers are designed to strengthen resilience; post-implementation evaluations indicate greater loss-absorption, although buffer usability is often constrained by market stigma, automatic distribution restrictions, and interactions with leverage and resolution requirements, so only part of the buffer is effectively drawn during stress (Ding et al., 2023). Operating efficiency, for example a lower cost-to-income ratio, supports sustainable profitability, enlarges loss-absorption capacity, and thereby stability (Berger & Bouwman, 2013; Busch & Kick, 2015). Two empirical implications follow, stronger capital and liquidity positions tend to raise the Z-score, and higher operating efficiency also raises the Z-score, with effects that may weaken during high-uncertainty episodes when buffer-usability frictions bind (Anarfo et al., 2020; Gupta & Mahakud, 2022).

The conceptual foundation rests on modern credit-risk and capital-structure theory. The structural approach to default treats equity as an option on assets and links distress to asset value dynamics and leverage (Miller & Scholes, 1978); failure to manage long-term cash flows also heightens distress risk (Diaw, 2021; Lei et al., 2021). Trade-off theory states that debt increases firm value up to an optimum through the exchange between tax benefits and expected distress costs (Modigliani & Miller, 1963), whereas pecking-order theory predicts a preference for internal funds then debt before equity when information asymmetry is present (Myers & Majluf, 1984). Recent evidence shows that well-calibrated external financing policies reduce the probability of distress and that expected distress costs shape financing choices (Farooq et al., 2023).

Cash Holding and Financial Distress

Financial distress increases the likelihood of missed debt service and weakens intermediation capacity. Trade-off theory views cash as a precautionary buffer that smooths cash-flow volatility, lowers external-financing frictions, and reduces expected distress costs. Empirical studies report that larger cash reserves are associated with lower default risk and stronger resilience around funding shocks (Acharya et al., 2012; Kim, 2020; Lei et al., 2021; Sayed & Khalil, 2022; Shan et al., 2023) Within a Z-score framework, higher readily available cash should raise the Z-score, which corresponds to lower distress. Based on this discussion, the first hypothesis of this study is as follows:

H_1: Higher cash holding reduces financial distress.

Intangible Asset and Financial Distress

Companies with higher investments in intangible assets may offer services or products at higher costs (Bulot et al., 2014). Intangible assets, including patents, expertise, trademarks, brand names, and after-sales services (Farooq et al., 2021), can enhance the quality of products or services, thereby retaining and expanding the customer base. Increasingly loyal customers boost sales, reducing the financial difficulties of the company. Previous research results demonstrate that higher ownership of intangible assets can help avoid financial distress (Bulot et al., 2014; Cater & Cater, 2009; Farooq et al., 2021; Mselmi et al., 2017; Surroca et al., 2010). The second hypothesis is as follows:

H_2: Higher intangible asset ownership reduces financial distress.

Capital Adequacy Ratio and Financial Distress

Banks with a higher capital adequacy ratio demonstrate better resilience to financial shocks, as they rely less on external parties. The minimum capital requirements set by regulations serve as a beneficial buffer for banks in maintaining liquidity and financial health. Capital buffers can support losses from non-performing loans and mitigate the potential decline in credit growth during economic downturns or crises (Oliveira & Raposo, 2020). This viewpoint is supported by Harahap (2015), Lei et al. (2021), and Oliveira and Raposo (2020), suggesting that a higher Capital Adequacy Ratio (CAR) can suppress financial distress. The third hypothesis is formulated as follows:

H_3: A higher capital adequacy ratio reduces financial distress.

Non-performance Loan and Financial Distress

The increase in non-performing loans (NPLs) results in higher losses for banks due to bearing the cost of unrecoverable loan losses and increasing the cost of provisioning for productive assets. Non-performing loans contribute to a decline in credit quality; thus, a high NPL ratio positively affects the potential occurrence of financial distress. The provision of loans by banks to delinquent borrowers worsens the bank's balance sheet. Moreover, banks need more incoming cash flows, leading to difficulties in meeting their obligations. Previous research has supported this view, indicating that a higher NPL ratio contributes to financial distress (Abbas & Frihatni, 2023; Dalwai & Salehi, 2021; Farooq et al., 2021; Habib & Kayani, 2022; Li et al., 2008; Papadaki & Pavlopoulou-Lelaki, 2022; Zaki et al., 2011). The fourth hypothesis is as follows:

H_4: Lower non-performing loans reduce financial distress.

Net Interest Margin and Financial Distress

Net Interest Margin (NIM) reflects the productive asset's ability of a bank to generate net interest income. A higher NIM ratio represents the bank's efficiency in managing productive assets. Increased productivity can be achieved by providing high-quality, non-delinquent loans and enhancing interest income. The allocation of managed funds to low-risk, high-quality loans can reduce the risk of financial distress. This research is consistent with findings from studies (Bhusan et al., 2023; Guizani & Abdalkrim, 2023; Hao et al., 2023; Harahap, 2015; Shahwan, 2015), indicating a negative correlation between bank interest income and financial distress. The fifth hypothesis is as follows:

H_5: A higher net interest margin reduces financial distress.

Cost-to-Income Ratio and Financial Distress

A higher Cost to Income (CTI) ratio indicates inefficient overhead costs for the bank, eroding its profitability. Therefore, an increasing CTI brings the bank closer to financial distress. A low CTI represents efficient management, resulting in more optimal profits. A decrease in CTI signifies that the bank is more operationally efficient. Profitability improves by minimising costs, thereby avoiding financial distress issues. Studies align with this perspective (Bulot et al., 2014; Farooq et al., 2021; Li et al., 2008; Manlagñit, 2011; Quintiliani, 2017; Zaki et al., 2011), suggesting that a higher CTI leads to an increase in financial distress. The sixth hypothesis is as follows:

H_6: A lower cost to income (CTI) ratio reduces financial distress.

Method

Research Methodology

The research sample consists of banks from various countries from 2012 to 2018. Bank-related data were obtained from the Refinitiv database, while macroeconomic

data were sourced from the World Bank database. The sample comprises 10.562 banks from 32 countries, with 73.124 observations. Outlier data were removed to mitigate the risk of bias. Standard errors were clustered at the bank level to relax the assumptions of heteroskedasticity and autocorrelation (Petersen, 2009; Wooldridge, 2018).

Table 1. Variable Measurement

Variable name	Abbreviation	Measurement	References
Dependent variable			
Financial distress	Distress	Z-score (The higher the Z-score, the lower the probability of financial distress)	Guizani and Abdalkrim (2023)
Independent variables			
Cash holdings	CNet	The ratio of total cash and equivalents divided by (total assets–total cash and equivalents)	Alnori et al. (2022)
Cash holdings	CTA	The ratio of cash and equivalents to total assets	Alnori et al. (2022)
Intangible	INT	(Total market value/book value of assets) * 100	(Farooq et al., 2021)
Capital adequacy ratio	TR1	Tier 1 capital, net of deductions, divided by total risk-weighted assets	(Le et al., 2020)
Non-performance loan	NPL	The ratio of non-performing (impaired loans) loans to total loans	Moudud-Ul-Huq et al. (2022); Oliveira and Raposo (2020)
Net interest margin	NIM	Net interest income over total earning assets	Aslan (2022)
Cost-to-income ratio	CTI	The ratio of fixed costs operational to gross profit	Oliveira and Raposo (2020)
GDP per capita growth	GDP	Annual growth rate of GDP per capita	Saif-Alyousfi et al. (2018)
Inflation	INF	Inflation rate	Le et al. (2020)

The analysis examines the relationship between cash holding and prudence factors of banks with financial distress. In this study, cash holding employs two distinct measurements to test the consistency of results. The analysis employs a dynamic panel model, referencing Thornton and Tommaso (2020), Khan et al. (2017), and Dahir et al. (2018). We aim to analyse the impact of cash holding on financial distress from different perspectives, resulting in two econometric models as follows:

$$Distress_{ict} = \beta_0 + \beta_1 Distress_{ict-1} + \beta_2 Cnet_{ict} + \beta_3 TA_{ict} + \beta_4 TR1_{ict} + \beta_5 NPL_{ict} + \beta_6 NIM_{ict} + \beta_7 CTI_{ict} + \beta_8 GDP_{ct} + \beta_9 INF_{ct} + \varepsilon_{ict} \quad (1)$$

$$Distress_{ict} = \beta_0 + \beta_1 Distress_{ict-1} + \beta_2 CTA_{ict} + \beta_3 TA_{ict} + \beta_4 TR1_{ict} + \beta_5 NPL_{ict} + \beta_6 NIM_{ict} + \beta_7 CTI_{ict} + \beta_8 GDP_{ct} + \beta_9 INF_{ct} + \varepsilon_{ict} \quad (2)$$

Distress measures financial distress using the Z-score for bank i, country c at time t. The original Z-score model was introduced by Altman (1968) as a reliable predictor of bankruptcy, and the score can be computed as follows:

$$\text{Z-score} = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 1.0X_5 \quad (3)$$

where X_1 is working capital/total assets, X_2 is retained earnings/total assets, X_3 is earnings before interest and taxes/total assets, X_4 is market value equity/book value of total debt, and X_5 is sales/total assets.

Cnet represents the net cash ratio obtained by dividing total cash and equivalents by (total assets – total cash and equivalents). At the same time, CTA is the cash-asset ratio calculated by dividing cash and equivalents by total assets. T.A. stands for intangible asset, computed as the total market value divided by the book value of assets. TR1 regulatory capital is the capital adequacy ratio approximated by Tier 1 capital, net of deductions, divided by total risk-weighted assets. NPL refers to non-performance loans formulated as the ratio of non-performing (impaired) loans to total loans. NIM is the net interest margin calculated by dividing net interest income by total earning assets. CTI is the cost-to-income ratio, representing the ratio of fixed operational costs to gross profit. GDP signifies GDP per capita growth, indicating the annual growth rate of GDP per capita. INF represents inflation, denoting the inflation rate in each respective country.

Results and Discussion

Descriptive Statistics

Descriptive statistics for the research data are presented in Table 2. An unbalanced panel is employed due to variable-specific data availability. Several constructions (e.g., Z-score and volatility measures) require multi-year windows and lags, mechanically reducing early-period observations. Extreme values are winsorized, and records failing basic accounting consistency checks are removed. Corporate events (e.g., mergers) create temporary reporting gaps for specific entities. Consequently, the number of observations differs across variables and tables. Estimations rely on listwise deletion per equation, whereas descriptive statistics use pairwise availability, yielding varying N. Inferences remain robust under re-estimation on the common sample (untabulated), with qualitatively similar signs and significance.

The average net cash ownership rate reaches 6.8% of total cash and cash equivalents. Banks also report a ratio of cash and cash equivalents to total assets of 8.4%, a figure higher than the net asset ratio. Our banking sample indicates an average market value for intangible assets at 640% compared to book value, even though the minimum value is negative. The growth in the market value of intangible assets reflects customer confidence in the bank's performance. Capital Adequacy Ratio (TR1) is crucial for banks as regulatory rules are stringent, with an average sample value of 18%. A high Tier1 can strengthen a bank's finances during a crisis and expand operations with low capital costs. Banks with a high Tier1 risk obtaining lower returns by limiting credit disbursement. The average Non-Performing Loan (NPL) ratio is 3%, and a lower value indicates higher-quality credit assets and high compliance with the regulations of their respective home countries.

Moreover, banks may apply a high internal risk tolerance, forcing management to maintain a low NPL ratio. The average Net Interest Margin (NIM) is 3%; a higher ratio indicates increased profitability and risk-bearing capacity, signalling favourable to investors. Conversely, a high NIM affects borrowers, who bear the burden of high-interest costs that can reduce borrowing. Furthermore, the average Cost-to-Income (CTI) ratio is 94%, with a high ratio indicating increasing inefficiency in the bank. Inefficient banks are at risk of offering high interest rates during credit disbursement,

potentially reducing the number of borrowers. The average GDP per capita growth is below the annual inflation rate. Higher inflation impacts slower credit growth and increased credit risk, as the increase in borrower income is more minor than inflation.

Table 2. Descriptive Statistics

Variable	Obs	Mean	Std. dev.	Min	Max
Distress	71661	4.3304	1.2856	1.2268	8.6006
Cnet	71979	0.0681	0.0672	0	0.3523
CTA	72212	0.0844	0.0849	0	0.4686
INT	73124	6.4304	2.1051	-0.6311	15.212
TR1	72754	0.1809	0.0693	0.0003	0.6315
NPL	72287	0.0307	0.0425	0	0.2686
NIM	71717	0.0345	0.0126	0.0075	0.1168
CTI	72718	0.9433	0.3611	0.0328	3.8117
GDP	73124	1.5638	1.4242	-10.016	23.999
INF	73124	1.9879	2.1481	-3.7491	48.699

This table displays descriptive statistics. Bank-level variables (Distress, Cnet, CTA, lnta, CAR, NPL, NIM, and CTI) were treated with winsorising, using a cut-off at the 1st percentile for the lower bound and the 99th percentile for the upper bound.

Table 3 presents the results of the Pearson correlation to ensure that there is no multicollinearity among variables. Farooq et al. (2023) say there is no multicollinearity issue if the result is < 0.70. The test results show that all variables are accessible from multicollinearity issues except for the variables Cnet and CTA, both of which represent cash holding. As a solution, we separated these variables into different analytical models.

Table 3. Matrix of Correlation

Variable	Distress	Cnet	CTA	INT	TR1	NPL	NIM	CTI	GDP	INF
Distress	1									
Cnet	-1.197	1								
CTA	-0.1216	0.9776	1							
INT	0.0709	0.1813	-1.332	1						
TR1	0.1182	0.1189	0.1483	-0.2044	1					
NPL	-0.1598	-0.0304	-0.0161	0.1084	-0.0171	1				
NIM	-0.1919	0.1907	0.1922	-0.1982	-0.0831	-0.0173	1			
CTI	-0.1242	0.0354	0.0658	0.1683	-0.0333	0.2246	-0.1366	1		
GDP	0.0048	0.1288	0.1289	0.1304	-0.0227	-0.1546	0.1088	0.0492	1	
INF	-0.1218	0.1004	0.1311	0.1275	-0.0166	0.1173	0.3581	0.2927	0.0498	1

The Influence of Cash Holding on Financial Distress

Table 4 reports fixed-effects estimates, with diagnostics indicating no heteroskedasticity or autocorrelation. Both cash-holding proxies, Cnet and CTA, load negatively and significantly in the Z-score equation ($p < 0.01$). Given that higher Z-scores indicate lower distress, these signs imply that larger cash balances coincide with lower Z-scores and thus higher distress; H1 is rejected. Two mechanisms can explain this result. First, under-deployment: excess cash may signal weak investment opportunities or overly cautious asset allocation, compressing profitability and eroding loss-absorbing capacity, which reduces measured stability. Second, precautionary hoarding: in adverse states, banks may accumulate cash defensively without

improvements in asset quality or earnings power, so raw liquidity increases while the Z-score does not, particularly when margins soften and expected credit losses rise. System-GMM checks yield the same sign pattern for cash proxies. Prior studies report context-dependent cash–risk links that can turn adverse when cash reflects weak opportunities or stress conditions (e.g., Kim, 2020; Lei et al., 2021; Shan et al., 2023). Policy guidance points to liquidity optimization that balances precaution with prudent, low-risk income-generating placements rather than simple accumulation of idle cash.

The Influence of Intangible Asset on Financial Distress

The coefficient on intangibles is positive and significant ($p < 0.01$), implying higher measured distress as intangible intensity increases, thereby rejecting H2. A potential mechanism is that technology-related intangibles demand continuous investment and maintenance, raising operating leverage and execution risk; dependence on proprietary platforms or brands can also expose banks to contract expiry or disruption risk. This interpretation contrasts with studies reporting a stabilising role of intangibles but highlights that not all intangible accumulation translates into robust, cash-flow-backed franchise value. The result differs from some prior studies but is consistent with the view that well-managed intangibles can strengthen resilience in Islamic banks. Intangible assets such as trademarks, patents, and goodwill unexpectedly increase the potential for financial distress. This result contradicts previous researchers (Bulot et al., 2014; Cater & Cater, 2009; Farooq et al., 2021; Mselmi et al., 2017; Surroca et al., 2010). The researchers speculate that banks are susceptible to the risks of technological change, requiring substantial investments and maintenance costs. Banks must adapt to cutting-edge technology to retain customers, leading to financial distress. Some banks might rely on specific trademarks, and any disruption, such as the expiration of contractual agreements, could pose financial risks.

The Influence of Tier1 on Financial Distress

Estimates indicate a positive and statistically significant association between Tier-1 and the Z-score ($p < 0.01$), implying lower distress at higher capital levels. Hypothesis 3, which posits that capital adequacy is negatively related to financial distress, is supported. The economic rationale views capital as a loss-absorbing buffer and a credible market signal that strengthens confidence, sustains intermediation under stress, and reduces the probability of failure. This finding is consistent with previous evidence on the role of capital buffers in enhancing bank resilience and reducing the likelihood of distress (e.g., Beck et al., 2013; Berger & Bouwman, 2013; Oliveira & Raposo, 2020). A note of caution is warranted when improvements in capital ratios are achieved through credit contraction or asset sales under stressed conditions, since such channels can erode short-term profitability. Nonetheless, the core estimation results consistently demonstrate a net stabilizing effect of stronger capital.

The Influence of NPL on Financial Distress

The estimates show a negative and statistically significant coefficient on NPL ($p < 0.01$), meaning higher problem financing lowers the Z-score and thus raises the probability of financial distress. The mechanism is that asset-quality deterioration cuts effective interest income and fee flows, forces higher loan-loss provisioning/expected

credit losses that erode capital headroom, and strains liquidity through weaker cash collections and costlier funding, which together elevate distress risk. Consistent with this channel, prior studies document that rising NPLs are associated with weaker profitability and capitalization, heightened liquidity risk, and a greater likelihood of bank distress or failure (e.g., Abbas & Frihatni, 2023; Dalwai & Salehi, 2021; Farooq et al., 2021; Li et al., 2008; Papadaki & Pavlopoulou-Lelaki, 2022).

Table 4. Baseline Hypothesis Testing using Panel (Fixed Effect)

Variable	Model (1)	Model (2)
Zscore	0.521***	0.521***
	(53.816)	(53.542)
Cnet	-0.452***	
	(-5.911)	
CTA		-0.355***
		(-5.777)
INT	0.018***	0.018***
	(4.728)	(4.801)
TR1	0.866***	0.892***
	(9.763)	(10.034)
NPL	-1.192***	-1.189***
	(-6.689)	(-6.683)
NIM	-5.832***	-5.825***
	(-10.227)	(-10.196)
CTI	-0.188***	-0.191***
	(-7.995)	(-8.093)
GDP	0.005	0.004
	(0.789)	(0.731)
INF	-0.007	-0.007
	(-1.582)	(-1.512)
Cons	2.247***	2.245***
	(26.290)	(26.231)
Country F.E.	Yes	Yes
Year F.E.	Yes	Yes
Included U.S. banks	Yes	Yes
N	56.517	56.747
Banks	10.555	10.562
Adj. R2	0.415	0.414

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Standard errors are clustered within the bank to address heteroscedastic and autocorrelation issues.

The Influence of NIM on Financial Distress

The results of the fifth hypothesis testing indicate that NIM is significantly negatively related to financial distress ($p < 0.01$). Thus, H5 is accepted. A higher NIM for the bank suggests higher income, enabling it to cover operational costs and accumulate reserve funds to face future losses. The research findings support previous studies (Bhusan et al., 2023; Guizani & Abdalkrim, 2023; Hao et al., 2023; Harahap, 2015; Shahwan, 2015). An increase in NIM tends to reduce credit risk, meaning the bank can avoid problematic loans that trigger financial distress. A high NIM represents the bank's ability to obtain low-cost funding, thereby increasing the interest margin when extending credit. The ability to generate a high margin is attractive to investors expecting high returns, and banks leverage this to attract more capital. On the other

hand, a high NIM may result from the bank taking excessive risks, leading to a riskier asset portfolio and increasing financial distress.

The Influence of CTI on Financial Distress

The final hypothesis posits a positive relationship between CTI and financial distress, but the results show the opposite. This finding indicates that the CTI significantly negatively impacts financial distress ($p < 0.01$), leading to the rejection of H6. This outcome contradicts previous research findings (Bulot et al., 2014; Farooq et al., 2021; Li et al., 2008; Manlagñit, 2011; Quintiliani, 2017; Zaki et al., 2011). Researchers speculate that high CTI incentivises management to enhance operational cost efficiency through tightened risk management. Banks focus on reducing the risk of financial distress by diversifying portfolios, controlling credit risks, and managing liquidity. Accounting analysis shows banks setting aside higher loss provisions, increasing operational costs. These provisions are beneficial for addressing short-term and long-term financial challenges, such as crises or the COVID-19 pandemic. Therefore, banks must further analyse the causes of operational inefficiencies to increase sustainable revenue.

Conclusion

The analysis shows that larger cash positions are associated with lower Z-scores (greater distress risk), whereas stronger regulatory capital (Tier-1/CAR) and better asset quality (lower NPL) coincide with higher Z-scores (lower distress). Intangible intensity is positively related to distress, suggesting execution and maintenance risks around technology and brand-dependent assets. Operating efficiency and pricing capacity also matter, higher NIM is linked to lower distress, while the estimated CTI effect points to efficiency adjustments that can mitigate risk. Mechanistically, these patterns reflect the roles of capital as a loss-absorbing buffer and signal of resilience, asset quality as a driver of earnings and provisioning needs, liquidity policy as a balance between precaution and productive deployment, and efficiency as a foundation for sustainable profitability.

Managerial and policy implications follow. First, reinforce core capital and tighten credit underwriting, monitoring, and recovery to contain NPLs. Second, optimize not hoard liquidity by aligning cash and near-cash with liability maturities and low-risk income generation. Third, diagnose the sources of operating inefficiency to safeguard margins without elevating risk, and treat intangible investment with disciplined governance, linking spend to verifiable cash-flow gains. Future research should refine market- versus accounting-based proxies for franchise value and trace transmission channels from liquidity management, funding structure, and intangibles to the Z-score over the cycle.

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