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*Research article*

# The impact of diversification on risk and stability in Asian banks

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**Abstract:** This study employs system generalized method of moments (GMM) procedures to explore the impact of asset, income, and funding diversification on the stability and risk-taking of Asian banks, using data from 2000 to 2023. The findings showed that agency theory, portfolio theory, trade-off theory, and the resource-based view provide a basis for the relationships between diversification and banks' stability/risk-taking. The findings reveal that asset diversification enhances the stability of banks and decreases their risk; however, funding diversification decreases that stability and increases their risk in Asia. The results also highlight the benefits of income diversification for banks in Asia, as it enhances their stability and mitigates risk. The results reveal a significant variation in the impact of diversification on the stability and risk-taking of commercial, savings, and Islamic banks. In addition, the findings remain heterogeneous across the other attributes of banks, like capitalization, liquidity, size, and growth. The findings have implication for policymakers and regulators.

**Keywords:** diversification; bank risk; stability; Asia

**JEL Codes:** G01, G21, G28

## 1. Introduction

The banking systems in Asia, characterized by different economic structures and regulatory frameworks, provide a particular context for analyzing the relationship among diversification, risk-taking, and stability. Over the past 20 years, Asian banks have gradually diversified their revenue streams, moving from traditional interest-based revenue to noninterest revenue streams, including fees,

trading, commissions, insurance, and investment activities (Elsas et al., 2010; Sanya & Wolfe, 2011). This trend accelerated after the 2008 financial crisis as banks sought to reduce the risks associated with economic downturns (Adem, 2023). Diversifying income, assets, and financing is often associated with increased stability. However, the impact varies significantly across banking systems and is influenced by variables such as bank size, capitalization, liquidity, and governance (Nguyen & Nguyen, 2024). This study examines the complicated relationships among diversification, risk=taking, and stability and uses empirical evidence from Asian banks to elucidate the circumstances under which diversification improves or detracts from financial resilience (Shabir et al., 2024).

This study is driven by the increasing significance of diversity as a strategic method for enhancing banking stability, especially in light of global financial crises and economic instability. While several researchers have investigated the overall impact of diversity on banks' stability, the particular implications of diversification in Asian banks remain scarcely explored. The majority of the existing literature predominantly examines developed economies, leading to a considerable deficiency in comprehension about the distinct issues encountered by banks in emerging and transition economies in Asia (Sahputra & Adam, 2024). The issue at hand is that despite the increasing implementation of diversification strategies in Asian banks, evidence regarding their effects on risk-taking and stability remains inconclusive. Several studies have indicated that diversification can improve financial stability (Sanya & Wolfe, 2011), whereas others propose that it might elevate risk exposure, especially in volatile markets (Rashid & Jabeen, 2016). This study aimed to address this gap by examining the following research questions: How do assets, funding, and income diversification affect the risk-taking and stability of banks in Asia? Do the effects of diversification vary across commercial, savings, and Islamic banks in Asia? How do bank characteristics such as capitalization, size, liquidity, and growth shape the impact of diversification?

Diversification, bank risk-taking, and stability can be analyzed through several theoretical frameworks, such as modern portfolio theory (MPT) and the resource-based view (RBV). Modern portfolio theory posits that diversification mitigates unsystematic risk by distributing exposure among various income streams, asset classes, or funding sources, thus enhancing stability (Markowitz, 1952). Another viewpoint is offered by agency theory, which contends that by coordinating managerial incentives with the objective of long-term profitability, diversification can reduce conflicts of interest between bank managers and shareholders (Jensen & Meckling, 1979). Conversely, it demonstrates a potential ethical risk in which diversification may encourage excessive risk-taking as the management seeks high-return yet volatile activities, especially in environments with inadequate regulation. The RBV highlights the strategic significance of leveraging bank-specific resources, including expertise in asset management or structured finance, to attain a competitive advantage via diversification (Levine, 1997). The efficacy of diversification in achieving risk mitigation and stability is contingent upon internal characteristics such as size, capitalization, and liquidity, alongside external factors including regulatory frameworks and market conditions (Nguyen & Nguyen, 2024; Shabir et al., 2024). These theories jointly highlight the dependent character of the diversification-stability link, necessitating the contextualization of empirical data within the distinct economic and regulatory framework of Asian banks.

It is worth mentioning that the associations among banks' assets, funding, earning sources, and risk-taking have been explored in existing studies; however, this study enriches the existing banking literature with respect to their diversity in balance sheets and income statements. Primarily, this research focuses on banks located in the Asian region, which is significant due to its global connections, which have been neglected in prior studies in recent years. Therefore, these insights offer a deeper understanding of how

the diversity of assets, income, and funding impacts banks' risk-taking in the Asian banking industry. Second, this analysis contributes to highlighting the role of assets, income, and funding diversification in shaping the risk and stability of banks in Asia when risk is measured by the Z-score, nonperforming loans, and loan provisions. Third, this investigation explores how banks behave on the basis of their capitalization while diversifying their assets, income, and funding sources in Asia. Fourth, this empirical analysis of Asian banks contributes to exploring the impact of bank size, liquidity, and growth along with diversification on banks' risk-taking (Sahputra & Adam, 2024). Fifth, this research is significant for investigating and providing comparative insights for commercial, savings, and Islamic banks regarding the impact of bank diversification on bank risk, which is a gap in banking literature in the Asian context worth mentioning (Shabir et al., 2024). Lastly, the study expands the connection with relevant banking theories for various regulations required in Asia. The findings are very important for regulators, economists, and policymakers in Asia because this study used the generalized method of moments (GMM) approach to give strong results that address issues like overidentification, second-order serial correlation, and endogeneity (Octavianus & Fachrudin, 2022).

The subsequent sections of the study are structured as follows: Section 2 establishes the hypotheses regarding diversification and the risk and stability of banks; Section 3 explains the data and methodology; Section 4 articulates the empirical findings, along with their theoretical implications; and Section 5 expounds on the conclusions and policy recommendations derived from the analysis.

## 2. Review of relevant literature and development of the hypotheses

### *2.1. Income diversification and bank risk*

The current banking literature examines the correlation between income diversity and bank risk, frequently providing empirical findings with insufficient theoretical rationale. Although several studies have indicated both the good and negative effects of diversity, there is a lack of theoretical clarity on its impact on bank risk. For example, Berger & Ofek (1995) assert that income diversification decreases the probability of bankruptcy and alleviates risk by utilizing imperfect correlations between income sources. This supports Lewellen's (1971) assertion that sector diversification enhances operational stability. Diversification enables banks to utilize managerial expertise and achieve economies of scope, promoting operational synergies that reduce operational risk. Amihud & Lev (1981) emphasize that managerial expertise and economies of scope gained through diversification reduce operational risk. Laeven and Levine (2009) highlight the significance of diversification in establishing "financial supermarkets," which improves customer retention, expands the client base, and strengthens competitive resilience. The impact of income diversification on the risk and stability of Asian banks is complex, influenced by factors such as market maturity, regulatory frameworks, and economic diversity. Reducing reliance on interest income improves stability in mature markets (Elsas et al., 2010; Sanya & Wolfe, 2011) but may heighten volatility in less developed systems, particularly via trading and investment activities (Adem, 2023; Rashid & Jabeen, 2016). Following 2008, transitions to noninterest income and the COVID-19 pandemic underscored the necessity for effective risk management. Empirical evidence indicates that fee-based income contributes to the stability of banks; however, context-specific factors highlight the complexity of diversification's impacts, necessitating further exploration of Asia's varied banking environment (Sahputra & Adam, 2024). Wu et al. (2020) explored the impact of diversification on banks' risk-taking,

using 1000 commercial banks from 39 emerging economies. They concluded that diversification reduces the risk of commercial banks.

Income diversification has a substantial impact on banks' stability, with commercial banks experiencing greater advantages compared with savings and Islamic banks. Commercial banks participate in various activities such as fee-based income and trading, which diminish dependence on interest income and enhance stability during economic downturns (Sanya & Wolfe, 2011). Islamic banks encounter limitations imposed by Sharia law, which confines income generation to profit-sharing arrangements such as Mudarabah, thereby restricting the effects of diversification. Commercial banks in emerging markets experience enhanced diversification benefits owing to reduced dependence on interest income and increased global exposure (Nguyen & Nguyen, 2024). Islamic banks' reliance on noninterest income heightens their sensitivity to market fluctuations, which may compromise stability in adverse conditions (Shabir et al., 2024).

In contrast, banks with weaker liquidity often extend their operations into untested or less stable revenue sources, resulting in liquidity pressure and greater risk (Lepetit et al., 2008). The effect of income diversification on risk and stability is contingent upon factors such as capitalization, size, and liquidity. Large or well-capitalized banks effectively mitigate risks, whereas smaller or less liquid banks may encounter significant hazards in the absence of safeguards. The effect is contingent upon internal characteristics, as demonstrated in a study involving 32 banks, where diversification enhanced stability and cost efficiency (Octavianus & Fachrudin, 2022). The impact of income diversification is significantly influenced by bank size and ownership type, as larger banks exhibit distinct risk profiles in comparison with smaller banks (Kaur & Bansal, 2024). The influence of diversification varies with economic cycles: In contraction phases, it may diminish capital buffers while simultaneously lowering overall risk (Sahputra & Adam, 2024). The role of commercial banks is to help the customers with respect to their customer needs. Nowadays, many additional aspects have become part of commercial banking; for example, online payments, the use of credit and debit cards, the provision of guarantees on commission, and rapid changes in financial technologies have become some of the reasons that increase the wealth of banks. On the basis of the mixed evidence on income diversification, we were motivated to test the following hypotheses in the context of Asian banks.

*Hypothesis 1: Income diversification significantly impacts the risk and stability of banks in Asia.*

*Hypothesis 2: Income diversification is more beneficial for commercial banks than saving and Islamic banks to impact risk and stability in Asia.*

*Hypothesis 3: The impact of income diversification on the risk and stability of banks in Asia varies on the basis of capitalization, size, growth, and liquidity.*

### *2.2. Asset diversification and bank risk*

We start with the argument of Acharya et al. (2006) that diversifying banks' assets does not always result in higher returns or increased banks' stability, which runs counter to the assumptions of conventional portfolio and banking theories. Diversification of assets is an important strategy for risk management and stability in banks, especially in the Asian context, where economic environments can be volatile and banking systems often face substantial exposure to market and credit risks. Diversification allows banks to dissipate their risks across different asset types, such as loans, bonds, equities, and real estate, thus reducing the overall risk that would emanate from any one asset class. Indeed, Stiroh (2004) and Pasha and Lewaaelhamd (2024) suggest that diversification leads to a

diminution of the total risk of every asset type. The abovementioned studies suggested that in the context of Asia and given the existence of countries whose banking systems are limited in their resilience to crisis situations, asset portfolio diversification provided a kind of safety net that was necessary for banks by equipping them with alternatives that helped in responding to the adversities of the economy, such as sudden downturns in markets and the liquidity crisis (Trinh & Doan, 2018).

Research has documented that the greater the diversification of banks' asset bases, the more stable they are because of their lower exposure to risks in any single market or class of assets. Different studies on Asian banks have mentioned that diversification into strategies for reducing nonperforming loans, government bonds, and real estate would help banks cushion against external shocks. In the event of a sector-specific downturn, banks with diverse assets can rely on other income-generating assets to support their stability, enhancing their risk management capabilities (Sanya & Wolfe, 2011). However, diversified assets do not always reap their benefits. Smaller or less capitalized banks in Asia may not have easy access to more diversified asset classes or may not have the resources and expertise to manage the risks associated with a complex portfolio. It is also shown in research that less developed markets' banks might not be able to employ effective diversification techniques, which would put them at risk for further deteriorations if not managed properly (Lepetit et al., 2008). This stands in stark contrast to bigger, better-capitalized banks of advanced economies such as Japan and Singapore, which have been able to demonstrate risk reduction and heightened stability through their diversification across a wide asset class because these are better placed to monitor and absorb the risks of diversified investments. In particular, diversification strategies through nontraditional income sources have been found to minimize banks' risk-taking in Asian emerging economies (Hunjra et al., 2021). Abbas & Ali (2022) concluded that assets' diversity positively contributes to the stability of banks in the US. Saif-Alyousfi et al. (2023) investigated governance and concluded that it has a significant impact on diversification, while also highlighting the nonlinearity in this relationship. We used several measures for risk proxy to conclude the robust evidence, which is in line with suggestions (Saif-Alyousfi et al., 2020). On the basis of the mixed evidence on asset diversification, we were motivated to test the following hypotheses in the context of Asian banks:

*Hypothesis 4: Asset diversification significantly impacts the risk and stability of banks in Asia.*

*Hypothesis 5: Asset diversification is more beneficial for commercial banks than savings and Islamic banks to impact risk and stability.*

*Hypothesis 6: The impact of asset diversification on the risk and stability of banks varies according to capitalization, size, growth, and liquidity.*

### *2.3. Funding diversification and bank risk*

Banks with higher capitalization and larger size tend to be more resilient, as they can better absorb shocks and manage the risks associated with diversification. High liquidity levels correlate with improved stability, allowing banks to navigate crises more effectively. Banks experiencing growth may face increased risk-taking behavior, which can undermine stability if not balanced with effective risk management strategies (Adem, 2023). Funding diversification can exacerbate systemic risk, necessitating careful management of interconnectivity among banks (Fresno & Hanggraeni, 2020). Abbas & Ali (2022) explored US banks' behavior regarding diversification and risk-taking. They concluded that funding diversification is beneficial for US commercial banks; moreover, they argued that

funding diversification positively contributes to the stability of banks in the US. In another US study, Abbas et al. (2024) concluded that funding diversification significantly impacts banks' profitability and cost efficiency. Abuzayed et al. (2018) provided evidence regarding the diversification and financial stability of banks; they used unlisted bank data and found an inverse relationship between diversification and banks' stability. They highlight, in their empirical findings, that diversification has an adverse impact on conventional banks. Shabir et al. (2024) investigated the relationship between banks' stability and diversification in the Middle East and North Africa (MENA). They found that noninterest activities deteriorate the benefits of banks. They posited that the impact of diversity in assets, income, and financing varies in its influence on stability of banks according to size and market power. Shim (2019) explored the impact of loan diversity on the stability of financial institutions and concluded that diversity in lending is beneficial for the stability of banks. On the basis of the mixed evidence on funding diversification, we were motivated to test the following hypotheses in the context of Asian banks.

*Hypothesis 7: Funding diversification significantly impacts the risk and stability of banks in Asia.*

*Hypothesis 8: Funding diversification is more beneficial for commercial banks than savings and Islamic banks to impact risk and stability.*

*Hypothesis 9: The impact of funding diversification on the risk and stability of banks varies according to capitalization, size, growth, and liquidity.*

## 3. Data and methodology

The study explores the impact of assets, income, and funding diversification on banks' stability and bank risk. The study extracts unbalanced panel data of 5028 banks operating in Asian economies from the Bankscope database from 2000 to 2023, with 29,460 observations. The total number listed in the databases as provided by the data source is 5028. The data include 604 saving banks and 306 Islamic banks, and the rest of the banks are commercial banks. It is important to clarify that the data contain a longer period where most of the banks have missing data for different years; therefore, the number of observations varies with respect to their number and years. The countries include India, Pakistan, Nepal, Sri Lanka, Kuwait, Hong Kong, Saudi Arabia, China, Russia, Japan, Vietnam, Thailand, Bangladesh, Bahrain, Turkey, Iraq, Azerbaijan, Iran, Uzbekistan, Cyprus, Kazakhstan, Tajikistan, and the Philippines. The study retrieved macroeconomic data from the World Development Indicators database for the said period. For bank balance sheet and income statement data, we used the Bankscope database because it contains similar information across the reporting countries, which reduces the reported biases in the data.

### *3.1. Econometric model*

In this section, we provide the model used to check the relationship of stability and bank risk with diversification in income sources, assets, and financing channels in Asian banks over the recent period covering from 2000 to 2023. The following is the static form of our specification for the econometric model:

$$Bank\ stability_{i,j,t} = \omega_0 + \omega_1 diversification_{j,t} + \lambda m \sum_{m=1}^{n} X_{i,j,t} + \tau k \sum_{k=1}^{n} Z_{j,t} + \varepsilon_{i,j,t} \quad (1)$$

$$Bank\ ris_{i,j,t} = \omega_0 + \omega_1 diversification_{j,t} + \lambda m \sum_{m=1}^{n} X_{i,j,t} + \tau k \sum_{k=1}^{n} Z_{j,t} + \varepsilon_{i,j,t} \quad (2)$$

In this study we employed a two-step system GMM approach, which is a renowned econometric procedure for calculating consistent parameters in dynamic data settings introduced and revised by.

This research provides significant aspects that ensure the validity, relevance, and robustness of its empirical findings. For example, it discusses the notable issue of diversification and bank risk and stability, particularly in the Asian banking industries, which have had noteworthy evaluations in the recent past from both business and regulatory points of view. In addition, this study used the GMM approach to give strong results that address issues like overidentification, second-order serial correlation, and endogeneity (Octavianus & Fachrudin, 2022). Specifically, we used a two-step system GMM model, which is the best choice to deal with data with long cross-sections and a short time series. It is a useful procedure to adapt when the data contain the problems of endogeneity, heterogeneity, and unobserved fixed-effects biases. A similar approach was used by Saif-Alyousfi (2022), and Saif-Alyousfi and Saha (2021) while investigating the determinants of profitability and risk in Asian and Gulf Cooperation Council (GCC) banks. Here is the standard econometric model which we used to test our target hypotheses:

$$Bank\ stability_{i,j,t} = \phi_0 + \phi_1 bank\ stability_{i,j,t-1} + \phi_2 diversification_{j,t} + \lambda m \sum_{m=1}^{n} X_{i,j,t} + \tau k \sum_{k=1}^{n} Z_{j,t} + \varepsilon_{i,j,t} \quad (3)$$

$$Bank\ risk_{i,j,t} = \phi_0 + \phi_1 bank\ risk_{i,j,t-1} + \phi_2 diversification_{j,t} + \lambda m \sum_{m=1}^{n} X_{i,j,t} + \tau k \sum_{k=1}^{n} Z_{j,t} + \varepsilon_{i,j,t} \quad (4)$$

**Table 1.** Proxy measurements.

| Proxies | Description |
|---|---|
| Bank stability and risk | Dependent variables |
| Z-score | $\frac{ROAA+EQUITY\ RATIO}{\sigma ROAA}$ (Demirgüç-Kunt & Huizinga, 2010) |
| NPLGL | Ratio of nonperforming loans to gross loans (Ammar & Boughrara, 2019) |
| LLPTA | Ratio of loan loss provisions to total assets (Ammar & Boughrara, 2019) |
| Diversification | Independent variables |
| Asset diversification | $1 - \left(\frac{customer\ loans}{earnings\ assets}\right)^2 + \left(\frac{Interbank\ loans}{earnings\ assets}\right)^2 + \left(\frac{Ssecurities\ loans}{earnings\ assets}\right)^2 + \left(\frac{Other\ assets}{earnings\ assets}\right)^2$ (Abbas et al., 2024) |
| Funding diversification | $1 - \left(\frac{Equity}{Total\ funding}\right)^2 + \left(\frac{Sub-ordincate\ debt}{Total\ funding}\right)^2 + \left(\frac{Deposits}{Total\ funding}\right)^2 + \left(\frac{Short-term\ funds}{Total\ funding}\right)^2$ (Abbas et al., 2024) |
| Income diversification | $1 - \left(\frac{Interest\ income}{Total\ income}\right)^2 + \left(\frac{Non-interest\ income}{Total\ income}\right)^2$ (Abbas et al., 2024) |
| Control variables | Bank-specific variables |
| Capital ratio | Total equity to total assets ratio (Sawada, 2013) |
| Profitability | Net income to total assets ratio (Kaur & Bansal, 2024) |
| Asset growth | Annual growth in total assets (Demirgüç-Kunt & Huizinga, 2010) |
| Size | Log of total assets (Chen et al., 2018) |
| Operating efficiency | Noninterest expenses to total assets (Sawada, 2013) |
| | Macroeconomic variables |
| Economic growth | Annual growth rate of gross domestic product (Demirgüç-Kunt & Huizinga, 2010) |
| Inflation rate | Annual consumer price index (Demirgüç-Kunt & Huizinga, 2010) |

Similar to previous studies, we used several proxy measurements as a representation of banks' stability and risk-taking. We used the Z-score to gauge the insolvency of banks, which measures the

sum of return on assets (ROA) and the equity ratio divided by the standard deviation of ROA for each bank (Laeven & Levine, 2009). A higher Z-score represents higher stability of the bank. Second, the study used the nonperforming loans to gross loans ratio as an ex-post bank risk measure (Berger et al., 2010), where a higher ratio indicates the higher risk of the bank (Zheng et al., 2019). Third, the study used the ratio of loan loss provisions to total assets as an ex-ante bank risk in Asian banking (Berger et al., 2010). Fourth, the study used the ratio of risk weighted assets to total assets to observe bank risk in the Asian region in the current environment. The details of the proxies are listed in Table 1.

## 4. Empirical findings and discussion

### *4.1. Data description and correlation analysis*

Table 2 presents diverse financial and macroeconomic indicators, highlighting the trends and fluctuations among them. Financial stability, as evidenced by the Z-scores, demonstrates notable disparities among entities. Loan performance indicators indicate overall stability, characterized by typically low levels of nonperforming loans and provisions for loan losses. The levels of diversification in assets and funding are substantial, reflecting extensive risk management; however, income diversification exhibits more variability. Equity levels vary significantly, indicating differing capital robustness. Profitability and asset growth demonstrate significant variability, with certain companies incurring losses or experiencing declines. The magnitude of institutions, as denoted by their asset levels, exhibits moderate variations, although operational efficiency remains rather stable. Macroeconomic conditions, encompassing economic growth and inflation, show modest diversity, indicative of diverse economic contexts. The results demonstrate considerable variability in financial health, operational strategy, and external circumstances.

**Table 2.** Summary statistics.

| | Mean | SD | p10 | p25 | p75 | p90 |
|---|---|---|---|---|---|---|
| Z-score | 7.224 | 8.861 | 1.796 | 2.48 | 7.628 | 17.303 |
| NPLGL | 0.072 | 0.154 | 0.008 | 0.018 | 0.07 | 0.137 |
| LLPTA | 0.008 | 0.056 | −0.000 | 0 | 0.007 | 0.017 |
| Asset diversification | 0.751 | 0.179 | 0.501 | 0.579 | 0.925 | 0.976 |
| Funding diversification | 0.753 | 0.166 | 0.504 | 0.641 | 0.881 | 0.926 |
| Income diversification | 0.175 | 0.525 | −0.186 | 0.017 | 0.435 | 0.734 |
| Equity | 16.236 | 19.819 | 4.160 | 5.62 | 15.925 | 40.405 |
| Profitability | 0.768 | 7.218 | −0.020 | 0.16 | 1.39 | 2.79 |
| Asset growth | 11.208 | 35.013 | −5.000 | 0.71 | 15.26 | 31.34 |
| Log of assets | 15.941 | 3.975 | 11.133 | 13.446 | 18.204 | 22.73 |
| Operating efficiency | 0.087 | 2.4 | 0.008 | 0.01 | 0.034 | 0.076 |
| Economic growth | 2.733 | 3.468 | −0.240 | 0.736 | 5.514 | 7.113 |
| Inflation rate | 3.509 | 4.255 | −0.044 | 0.484 | 5.544 | 8.44 |

Source: Author's calculations based on the data retrieved for Asian banks from the Bankscope database for the period 2000 to 2023. The Z-score stands for stability; and NPLGL and LLPTA are banking risks.

**Table 3.** Pairwise correlations.

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Z-score | 1.000 | | | | | | | | | | | | |
| (2) NPLGL | 0.185* | 1.000 | | | | | | | | | | | |
| (3) LLPTA | −0.049* | 0.147* | 1.000 | | | | | | | | | | |
| (4) Asset diversification | 0.056* | −0.010 | 0.013* | 1.000 | | | | | | | | | |
| (5) Funding diversification | −0.109* | −0.048* | −0.023* | −0.009* | 1.000 | | | | | | | | |
| (6) Income diversification | 0.180* | −0.093* | −0.078* | −0.089* | −0.023* | 1.000 | | | | | | | |
| (7) Equity | 0.965* | 0.247* | 0.012* | 0.061* | −0.078* | 0.124* | 1.000 | | | | | | |
| (8) Profitability | 0.327* | −0.059* | −0.352* | 0.013* | −0.061* | 0.076* | 0.148* | 1.000 | | | | | |
| (9) Asset growth | 0.025* | −0.029* | −0.049* | 0.019* | −0.085* | 0.025* | −0.022* | 0.100* | 1.000 | | | | |
| (10) Log of assets | −0.327* | −0.243* | −0.065* | 0.007 | 0.131* | 0.071* | −0.335* | −0.015* | −0.081* | 1.000 | | | |
| (11) Operating efficiency | 0.047* | 0.000 | 0.017* | 0.020* | 0.008 | −0.004 | 0.056* | −0.005 | −0.017* | −0.041* | 1.000 | | |
| (12) Economic growth | 0.084* | −0.032* | −0.017* | −0.030* | −0.179* | 0.064* | 0.063* | 0.061* | 0.152* | −0.117* | 0.006 | 1.000 | |
| (13) Inflation rate | 0.176* | 0.178* | 0.099* | 0.013* | −0.328* | −0.017* | 0.166* | 0.037* | 0.147* | −0.404* | 0.033* | 0.129* | 1.000 |

A correlation matrix was created to analyze the correlations among the variables. The matrix represents pairwise correlation coefficients that indicate the magnitude and direction of linear relationships. *** p<0.01; **p<0.05; *p<0.1.

The pairwise correlations in Table 3 demonstrate significant relationships among the financial and macroeconomic variables. Z-scores exhibit a strong correlation with equity, highlighting the significance of capital strength in maintaining financial stability. Nonperforming loans show a positive correlation with inflation and a negative correlation with income diversification, indicating that institutions with better diversification encounter fewer issues related to loan performance. Loan loss provisions exhibit an inverse relationship with profitability and inflation, suggesting possible cost pressures. Diversification metrics display diverse dynamics: income diversification enhances financial health, whereas funding diversification demonstrates a negative correlation with inflation and Z-scores. Profitability highlights a positive correlation with stability and asset growth, while demonstrating a

negative correlation with loan issues. Larger institutions, as measured by the logarithm of assets, demonstrate reduced stability and equity, whereas economic growth enhances stability and asset expansion. Inflation is associated with diminished diversification, reduced equity, and increased loan challenges. The correlations illustrate the relationships among financial performance, diversification strategies, and external economic factors.

### *4.2. Full sample findings*

It is found that diversification in terms of assets, funding, and income sources has a meaningful and significant impact on the risk-taking behavior of all forms of organization, especially financial institutions. Here, our sample consists of banking organizations presently working in Asia. Table 4 shows that when banks invest in different assets, they remain stable. The simple justification for these empirical outcomes is diversification. Therefore, banks put their funds into different assets. The findings indicate a positive relationship between banks' risk-taking and diversification in assets (Markowitz, 1952). The hypothesis of diversification asserts that investing in a variety of assets can mitigate risk. The empirical results support the idea that choosing different asset classes in different industries and businesses causes a reduction in risk, other things held constant. For instance, the banks that maintain diverse loan portfolios exhibit greater stability compared with those with concentrated investments in a single portfolio. Acharya et al. (2006) empirically demonstrated that a highly diversified portfolio of bank assets results in reduced risk and improved stability. Despite the positive sentiments surrounding asset diversification, banks' stability, and risk, the opposing argument remains equally compelling. For example, Rajan (2006) proposed that overinvesting in various assets could raise the operational costs and complexity by posing new risks to banks and management.

In line with the previous discussion, the empirical results show that under the current conditions, banks which have diversified sources of revenue remain stable and consistent. The simple reason for the positive relationship between revenue diversification and risk is the development of new channels to exchange funds. The banks with a system to support the customers in the payment and receipt of their funds using advanced technology remain significant and secure more revenues which, of course, enhance the base for survival in competitive markets. Observations of income diversification reveal empirical evidence that indicates a positive relationship among stability, risk, and income diversification in Asia. The stability of Asian banks is enhanced by minimizing income volatility, as these institutions rely on alternative sources such as fee-based activities, insurance, and trading operations during challenging economic times (Stiroh, 2004). The argument holds that having multiple revenue sources reduces reliance on a single source of income. On a contrary note, Sanya & Wolfe (2011) showed that diversified sources can lead to an increase in banks' risk due to their limited rewards relative to returns. The findings highlight this challenge, indicating that while revenue diversity enhances banks' stability, it adversely affects asset quality, pointing to possible trade-offs between stability and loan advancement.

Funding diversification refers to the procurement of capital from many sources, including deposits, interbank loans, bonds, and other financial entities. These sources connect liquidity providers and liquidity customers, thereby enhancing stability and reducing funding risks for banks. The liquidity preference theory posits that an increased number of funding sources enhances flexibility and reduces reliance on volatile market sources. The empirical results indicate a negative correlation between funding diversification and the stability of banks in Asia. It posits

that the organization of many funding sources engenders operational and coordination challenges, as asserted by Demirgüç-Kunt and Huizinga (2010). However, it is noticed that funding diversification can increase the cost of funding if banks rely unduly on market-based funding rather than deposits, potentially diminishing profitability and stability. These theoretical claims are backed by empirical evidence. In one study, Acharya et al. (2006) found that banks with diversified portfolios had lower risks overall, while in another, Stiroh (2004) showed that diversified income sources were more stable in general but could lead to riskier investments. It is worth noting that funding diversification depends on institutional and market conditions, as demonstrated by Demirgüç-Kunt and Huizinga (2010), who also demonstrated that it has varied consequences.

**Table 4.** Full sample results.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| Variables | Z-score | Z-score | Z-score | NPLGL | NPLGL | NPLGL | LLPTA | LLPTA | LLPTA |
| Lagged risk | 0.123*** | 0.126*** | 0.109*** | 0.744*** | 0.745*** | 0.741*** | 0.623* | 0.618* | 0.093 |
| | (0.028) | (0.028) | (0.027) | (0.048) | (0.047) | (0.048) | (0.355) | (0.353) | (0.066) |
| Asset diversification | 0.256*** | | | −0.011*** | | | 0.007*** | | |
| | (0.074) | | | (0.004) | | | (0.002) | | |
| Funding diversification | | −0.544*** | | | 0.020** | | | −0.001 | |
| | | (0.180) | | | (0.008) | | | (0.006) | |
| Income diversification | | | 0.714*** | | | −0.011*** | | | −0.004*** |
| | | | (0.049) | | | (0.002) | | | (0.002) |
| Equity ratio | 0.390*** | 0.388*** | 0.396*** | 0.001*** | 0.001*** | 0.001*** | 0.000 | 0.000 | 0.000 |
| | (0.011) | (0.010) | (0.011) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Profitability | 0.245*** | 0.243*** | 0.217*** | −0.002 | −0.002 | −0.002 | −0.005** | −0.005** | −0.005** |
| | (0.055) | (0.055) | (0.057) | (0.001) | (0.001) | (0.001) | (0.002) | (0.002) | (0.002) |
| Asset growth | 0.002 | 0.002 | 0.003* | −0.000*** | −0.000*** | −0.000*** | −0.000** | −0.000** | −0.000* |
| | (0.001) | (0.001) | (0.002) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Size | 0.016** | 0.017** | 0.004 | −0.002*** | −0.002*** | −0.002*** | −0.000 | −0.000 | −0.001** |
| | (0.007) | (0.007) | (0.006) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Operating efficiency | −0.622** | −0.667** | −0.900*** | −0.005 | −0.001 | 0.009 | 0.007 | 0.008 | 0.013** |
| | (0.286) | (0.280) | (0.321) | (0.025) | (0.025) | (0.026) | (0.006) | (0.006) | (0.006) |
| Economic growth | 0.044*** | 0.041*** | 0.034*** | −0.001*** | −0.001*** | −0.000*** | 0.000** | 0.000* | 0.000* |
| | (0.005) | (0.004) | (0.004) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Inflation rate | 0.009** | 0.003 | 0.007** | 0.001*** | 0.001*** | 0.001*** | 0.001*** | 0.001*** | 0.001*** |
| | (0.003) | (0.004) | (0.003) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Constant | −0.496*** | 0.131 | −0.183 | 0.050*** | 0.025*** | 0.039*** | −0.000 | 0.006 | 0.015*** |
| | (0.158) | (0.140) | (0.134) | (0.009) | (0.009) | (0.007) | (0.006) | (0.007) | (0.005) |
| Observations | 29,460 | 29,498 | 28,349 | 27,755 | 27,756 | 27,413 | 29,837 | 29,861 | 29,265 |
| AR(2) | 0.476 | 0.358 | 0.842 | 0.495 | 0.491 | 0.311 | 0.850 | 0.845 | 0.626 |
| Hansen | 0.719 | 0.664 | 0.913 | 0.984 | 0.987 | 0.936 | 0.383 | 0.389 | 0.644 |

Table 4 presents the results of the system GMM approach, examining the effects of assets, funding, and income diversification on stability (Z-score) and bank risk (NPLGL, LLPTA) using data from Asian banks from 2000 to 2023. For the confirmation of model estimation, we employ Hensen, Sargan, AR (1), and AR (2) statistics. The post-estimation statistics confirm the validity and consistency of the parameters reported statistically. The significance level is as follows: *** p<0 represents 10%, ** p<0.05 represents 5%, and * p<0.1 is 10%.

### *4.3. Empirical findings based on bank type*

## Commercial banks' results

**Table 5.** Commercial banks' results.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| Variables | Z-score | Z-score | Z-score | NPLGL | NPLGL | NPLGL | LLPTA | LLPTA | LLPTA |
| Lagged risk | 0.275** | 0.259* | 0.201* | 0.856*** | 0.857*** | 0.846*** | 0.287 | 0.173** | 0.158** |
| | (0.132) | (0.133) | (0.122) | (0.040) | (0.040) | (0.041) | (0.206) | (0.074) | (0.077) |
| Asset diversification | −0.024 | | | −0.012** | | | 0.005*** | | |
| | (0.119) | | | (0.006) | | | (0.002) | | |
| Funding diversification | | −0.386** | | | 0.016 | | | −0.004 | |
| | | (0.173) | | | (0.010) | | | (0.004) | |
| Income diversification | | | 0.696*** | | | −0.011*** | | | −0.005*** |
| | | | (0.064) | | | (0.003) | | | (0.001) |
| Equity ratio | 0.320*** | 0.326*** | 0.354*** | 0.001*** | 0.001*** | 0.001*** | 0.000*** | 0.000** | 0.000*** |
| | (0.054) | (0.054) | (0.051) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Profitability | 0.375*** | 0.370*** | 0.344*** | −0.003*** | −0.003*** | −0.003*** | −0.006*** | −0.006*** | −0.006*** |
| | (0.066) | (0.065) | (0.067) | (0.001) | (0.001) | (0.001) | (0.001) | (0.000) | (0.000) |
| Asset growth | −0.003 | −0.003 | −0.001 | −0.000*** | −0.000*** | −0.000*** | −0.000** | −0.000 | −0.000 |
| | (0.003) | (0.004) | (0.004) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Size | 0.003 | 0.007 | 0.003 | −0.001*** | −0.001*** | −0.001*** | −0.001*** | −0.000*** | −0.000*** |
| | (0.005) | (0.005) | (0.006) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Operating efficiency | −0.127 | 0.083 | −0.794 | −0.011 | −0.010 | −0.008 | −0.039 | −0.035 | −0.034 |
| | (0.871) | (0.058) | (1.057) | (0.019) | (0.018) | (0.018) | (0.024) | (0.023) | (0.023) |
| Economic growth | 0.026*** | 0.027*** | 0.025*** | −0.001*** | −0.001** | −0.000** | 0.000 | 0.000 | 0.000* |
| | (0.009) | (0.009) | (0.008) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Inflation rate | −0.008 | −0.009 | −0.001 | 0.001*** | 0.001*** | 0.001*** | 0.001*** | 0.001*** | 0.001*** |
| | (0.006) | (0.006) | (0.006) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Constant | −0.052 | 0.181 | −0.178 | 0.035*** | 0.017 | 0.029*** | 0.012*** | 0.018*** | 0.015*** |
| | (0.127) | (0.185) | (0.141) | (0.008) | (0.011) | (0.008) | (0.004) | (0.005) | (0.003) |
| Observations | 16,701 | 16,706 | 16,252 | 16,106 | 16,107 | 15,926 | 18,354 | 18,371 | 17,904 |
| AR(2) | 0.921 | 0.921 | 0.821 | 0.532 | 0.535 | 0.785 | 0.324 | 0.267 | 0.350 |
| Hansen | 0.253 | 0.259 | 0.231 | 0.802 | 0.790 | 0.873 | 0.734 | 0.443 | 0.298 |

Table 5 presents the results of the system GMM approach, examining the effects of assets, funding, and income diversification on stability (Z-score) and bank risk (NPLGL, LLPTA) using data from Asian banks from 2000 to 2023. For the confirmation of the model's estimation, we employ Hensen, Sargan, AR (1), and AR (2) statistics. The post-estimation statistics confirm the validity and consistency of the parameters reported statistically. The significance level is as follows: *** p<0 represents 10%, ** p<0.05 represents 5%, and * p<0.1 is 10%.

The findings presented in Table 5 establish the connections among assets, income, and funding diversification, alongside the risk and stability of commercial banks, as assessed by the Z-score, NPLGL (ratio of nonperforming loan growth to loans), and LLPTA (ratio of loan loss provisions to total assets). Asset diversification, although theoretically suggested to mitigate risk by engaging with various asset classes (Markowitz, 1952) presents mixed results in this context, revealing a negative but statistically insignificant effect on Z-score, alongside a significant yet minor positive effect on LLPTA. This suggests a constrained advantage for stability but highlights possible compromises in provisioning needs. The relationship between income diversification and Z-score is positive, aligning with the findings of Stiroh (2004), which underscores its role in stabilization through the creation of alternative revenue streams. However, the negative correlation with asset quality indicators (NPLGL, LLPTA) indicates a rise in risk-taking behavior, consistent with the conclusions drawn by Sanya and Wolfe (2011). The relationship between funding diversification and Z-score is negative, indicating that the intricacies involved in managing various funding sources could potentially compromise stability, in line with the findings of Demirgüç-Kunt and Huizinga (2010). The equity ratio and profitability consistently reinforce the stability across various metrics, while economic growth positively influences the Z-score, highlighting the significant impact of external macroeconomic conditions. The results highlight the complex nature of diversification, indicating that its potential advantages are contingent upon the quality of implementation, the dynamics of the market, and the level of regulatory oversight. The results correspond with the trade-off theory of Jensen and Meckling (1979) and indicate that although diversification may offer theoretical advantages, it requires careful management to reduce unforeseen risks.

**Savings banks**

The results indicate that diversification and various bank-specific attributes have a substantial impact on risk and performance in savings banks. Asset diversification positively influences stability, as indicated by the Z-score, underscoring its importance in improving financial resilience. This finding aligns with previous research that highlights the advantages of risk-spreading strategies. In contrast, income diversification seems to adversely affect stability and nonperforming loans (NPLGL), supporting the notion that an over-reliance on noninterest income can elevate risk exposure (DeYoung & Roland, 2001). The equity ratio and profitability consistently improve stability, supporting previous research indicating that well-capitalized and profitable banks are less prone to failure in economic downturns (Athanasoglou et al., 2008). Additionally, lagged risk demonstrates considerable persistence across all models, underscoring the impact of prior risk-taking behavior on current financial outcomes (Altunbas et al., 2007). Macroeconomic conditions play a significant role, as economic growth typically enhances banks' stability, whereas inflation exhibits mixed effects, underscoring its intricate relationship with asset quality and provisioning (Bikker & Hu, 2002). The findings underscore the significance of effective management strategies and macroeconomic stability in preserving the viability of savings banks.

**Table 6.** Savings banks.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| Variables | Z-score | Z-score | Z-score | NPLGL | NPLGL | NPLGL | LLPTA | LLPTA | LLPTA |
| Lagged risk | 0.002*** | −0.001*** | −0.001*** | 0.799*** | 0.815*** | 0.353** | −0.116* | 0.283*** | 0.290*** |
| | (0.000) | (0.000) | (0.000) | (0.203) | (0.204) | (0.245) | (0.058) | (0.063) | (0.074) |
| Asset diversification | 0.009 | | | 0.004 | | | 0.005 | | |
| | (0.000) | | | (0.048) | | | (0.004) | | |
| Funding diversification | | 0.004 | | | −0.024 | | | −0.009 | |
| | | (0.000) | | | (0.070) | | | (0.010) | |
| Income diversification | | | −0.008** | | | −0.082** | | | −0.007*** |
| | | | (0.000) | | | (0.034) | | | (0.002) |
| Equity ratio | 0.410*** | 0.410*** | 0.410*** | −0.002* | −0.002* | 0.002 | 0.001 | −0.001 | −0.001* |
| | (0.000) | (0.000) | (0.000) | (0.001) | (0.001) | (0.001) | (0.000) | (0.000) | (0.000) |
| Profitability | 1.000*** | 1.000*** | 1.000*** | −0.008 | −0.008 | 0.006 | −0.003*** | −0.003*** | −0.001 |
| | (0.000) | (0.000) | (0.000) | (0.005) | (0.005) | (0.004) | (0.001) | (0.000) | (0.000) |
| Asset growth | −0.001 | 0.001** | 0.001** | −0.001 | −0.001 | −0.001 | −0.001 | −0.001 | 0.001* |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Size | −0.005 | −0.004** | −0.002** | −0.005 | −0.005 | −0.005 | 0.001** | 0.002 | 0.003* |
| | (0.000) | (0.000) | (0.000) | (0.005) | (0.005) | (0.006) | (0.001) | (0.000) | (0.000) |
| Operating efficiency | 0.011*** | 0.076** | 0.008*** | −0.264 | −0.278* | −0.078* | 0.127* | 0.063 | 0.113** |
| | (0.000) | (0.000) | (0.000) | (0.298) | (0.280) | (0.708) | (0.121) | (0.097) | (0.093) |
| Economic growth | 0.003*** | −0.001 | −0.001 | −0.003 | −0.003 | −0.003** | −0.001*** | −0.001*** | −0.001** |
| | (0.000) | (0.000) | (0.000) | (0.002) | (0.002) | (0.002) | (0.000) | (0.000) | (0.000) |
| Inflation rate | −0.007** | −0.002 | −0.002 | 0.011 | 0.091** | −0.011** | 0.001** | 0.005*** | 0.009*** |
| | (0.000) | (0.000) | (0.000) | (0.001) | (0.001) | (0.001) | (0.000) | (0.000) | (0.000) |
| Constant | −0.066** | 0.010* | 0.001* | 0.145 | 0.166* | 0.141 | −0.016* | 0.010** | −0.002*** |
| | (0.000) | (0.000) | (0.000) | (0.129) | (0.081) | (0.120) | (0.012) | (0.014) | (0.007) |
| Observations | 168 | 168 | 155 | 128 | 128 | 118 | 210 | 210 | 187 |
| AR(2) | 0.677 | 0.448 | 0.0300 | 0.244 | 0.247 | 0.220 | 0.060 | 0.561 | 0.023 |
| Hansen | 0.860 | 0.182 | 0.130 | 0.276 | 0.314 | 0.140 | 0.440 | 0.0982 | 0.103 |

Table 6 presents the results of the system GMM approach, examining the effects of assets, funding, and income diversification on stability (Z-score) and bank risk (NPLGL, LLPTA) using data from Asian banks from 2000 to 2023. For the confirmation of the model's estimation, we employ Hensen, Sargan, AR (1), and AR (2) statistics. The post-estimation statistics confirm the validity and consistency of the parameters reported statistically. The significance level is as follows: *** p<0 represents 10%, ** p<0.05 represents 5%, and * p<0.1 is 10%.

## Islamic banks

The examination of Islamic banks reveals the complex influence of risk, diversification, and macroeconomic factors on their stability and performance. Lagged risk demonstrates considerable persistence across all models, significantly influencing the Z-score, nonperforming loans (NPLGL), and loan loss provisioning (LLPTA). This supports the conclusion that Islamic banks are susceptible to the impacts of prior risk exposure (Beck et al., 2010). Asset diversification has a detrimental impact on stability and asset quality, indicating that excessive diversification may undermine Islamic banks' adherence to their fundamental principles and operations (Farooq & Zaheer, 2015). Conversely, income diversification has a positive effect on stability, supporting the notion that varied income sources can reduce risks (Chong & Liu, 2009). The equity ratio and profitability enhance stability,

indicating that capital strength and financial performance are essential factors in determining resilience (Pappas et al., 2017). Macroeconomic factors, including economic growth, contribute positively to stability, whereas inflation shows a limited and mixed effect, highlighting the significance of stable economic environments for Islamic banks (Čihák & Hesse, 2010). The findings indicate that although Islamic banks show certain risk dynamics similar to conventional banks, their distinct operating models necessitate customized management strategies.

**Table 7.** Islamic banks.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| Variables | Z-score | Z-score | Z-score | NPLGL | NPLGL | NPLGL | LLPTA | LLPTA | LLPTA |
| Lagged risk | 0.280** | 0.276** | 0.259** | 0.653*** | 0.725*** | 1.239*** | 1.239*** | −1.397*** | −1.411*** |
| | (0.117) | (0.126) | (0.120) | (0.189) | (0.195) | (0.372) | (0.372) | (0.169) | (0.179) |
| Asset diversification | −0.443*** | | | −0.009*** | | | −0.018*** | | |
| | (0.646) | | | (0.042) | | | (0.042) | | |
| Funding diversification | | −0.305* | | | −0.001* | | | −0.020* | |
| | | (0.632) | | | (0.057) | | | (0.016) | |
| Income diversification | | | 0.313*** | | | 0.018 | 0.018 | | 0.001 |
| | | | (0.100) | | | (0.013) | (0.013) | | (0.001) |
| Equity ratio | 0.310*** | 0.312*** | 0.316*** | 0.001* | 0.001 | −0.008 | −0.011 | 0.011 | 0.006* |
| | (0.047) | (0.051) | (0.049) | (0.001) | (0.001) | (0.001) | (0.001) | (0.000) | (0.000) |
| Profitability | 0.479*** | 0.477*** | 0.472*** | −0.015*** | −0.016*** | −0.017*** | −0.012*** | −0.003*** | −0.003*** |
| | (0.055) | (0.056) | (0.055) | (0.002) | (0.002) | (0.003) | (0.003) | (0.001) | (0.001) |
| Asset growth | −0.007 | −0.007 | −0.007 | −0.006* | −0.004** | −0.005* | −0.001* | −0.001 | 0.001 |
| | (0.007) | (0.007) | (0.007) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Size | 0.140** | 0.151** | 0.135* | −0.001 | 0.002 | 0.016 | 0.012 | 0.001 | 0.002 |
| | (0.067) | (0.069) | (0.070) | (0.007) | (0.006) | (0.012) | (0.012) | (0.001) | (0.001) |
| Operating efficiency | 1.760 | 1.749** | 1.633*** | 0.091 | 0.086** | 0.174*** | 0.104*** | 0.022*** | 0.013*** |
| | (1.961) | (1.952) | (1.853) | (0.106) | (0.098) | (0.119) | (0.110) | (0.028) | (0.031) |
| Economic growth | 0.016*** | 0.014*** | 0.003*** | 0.001 | 0.001 | 0.002* | 0.002* | −0.001 | −0.001 |
| | (0.010) | (0.010) | (0.010) | (0.001) | (0.001) | (0.001) | (0.001) | (0.000) | (0.000) |
| Inflation rate | −0.007 | −0.007 | −0.002 | 0.001 | 0.001 | 0.003 | 0.003 | 0.001 | 0.001* |
| | (0.014) | (0.010) | (0.016) | (0.002) | (0.001) | (0.002) | (0.002) | (0.000) | (0.000) |
| Constant | −1.865 | −2.158* | −2.160* | 0.047 | −0.010 | −0.269 | −0.269 | 0.008 | −0.017 |
| | (1.188) | (1.282) | (1.160) | (0.143) | (0.086) | (0.223) | (0.223) | (0.021) | (0.023) |
| Observations | 1,069 | 1,072 | 1,046 | 738 | 738 | 731 | 731 | 864 | 856 |
| AR(2) | 0.257 | 0.266 | 0.323 | 0.241 | 0.233 | 0.185 | 0.115 | 0.107 | 0.992 |
| Hansen | 0.846 | 0.828 | 0.819 | 0.195 | 0.136 | 0.172 | 0.172 | 0.142 | 0.083 |

Table 7 presents the results of the system GMM approach, examining the effects of assets, funding, and income diversification on stability (Z-score) and bank risk (NPLGL, LLPTA) using data from Asian banks from 2000 to 2023. For the confirmation of the model's estimation, we employ Hensen, Sargan, AR (1), and AR (2) statistics. The post-estimation statistics confirm the validity and consistency of the parameters reported statistically. The significance level is as follows: *** p<0 represents 10%, ** p<0.05 represents 5%, and * p<0.1 is 10%.

### *4.4. Empirical findings based on bank capitalization*

Well-capitalized banks demonstrate enhanced financial stability relative to undercapitalized banks, as evidenced by the elevated Z-scores and the significant role of asset and income diversification, profitability, and equity ratios in risk mitigation and the reduction in problem loans. Well-capitalized banks derive substantial advantages from income diversification, which bolsters their resilience to financial shocks. Additionally, profitability plays a crucial role in reducing nonperforming loans (NPLGL) and loan loss provisions (LLPTA). Conversely, undercapitalized banks demonstrate increased sensitivity to delayed risk and macroeconomic variables, including economic growth and inflation. Income diversification and profitability contribute to the stabilization of undercapitalized banks; however, their effects are comparatively weaker, underscoring the advantage of stronger capital buffers. The findings are consistent with previous research that highlights the importance of capitalization and diversification in enhancing financial stability (Berger & Bouwman, 2013; Čihák et al., 2012). The study demonstrates that banks with stronger capital positions have more effective risk management systems, rendering them less susceptible to negative economic circumstances (Allen et al., 2011; Vazquez & Federico, 2015).

**Table 8.** Impact of diversification on risk and stability.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| Variables | Z-score | Z-score | Z-score | NPLGL | NPLGL | NPLGL | LLPTA | LLPTA | LLPTA |
| **Well-capitalized banks** | | | | | | | | | |
| Lagged risk | 0.057** | 0.059** | 0.052** | 0.635*** | 0.635*** | 0.631*** | 0.273 | 0.276 | 0.149** |
| | (0.023) | (0.023) | (0.021) | (0.072) | (0.072) | (0.073) | (0.204) | (0.207) | (0.061) |
| Asset diversification | 0.901*** | | | −0.046** | | | 0.019*** | | |
| | (0.242) | | | (0.020) | | | (0.005) | | |
| Funding diversification | | 0.268 | | | 0.017 | | | 0.005 | |
| | | (0.206) | | | (0.021) | | | (0.006) | |
| Income diversification | | | 0.795*** | | | −0.015** | | | −0.012*** |
| | | | (0.085) | | | (0.007) | | | (0.002) |
| **Undercapitalized banks** | | | | | | | | | |
| Asset diversification | −0.078 | | | −0.010* | | | 0.011*** | | |
| | (0.107) | | | (0.006) | | | (0.004) | | |
| Funding diversification | | −0.201 | | | −0.010 | | | 0.001 | |
| | | (0.180) | | | (0.010) | | | (0.007) | |
| Income diversification | | | 0.661*** | | | −0.009*** | | | 0.001 |
| | | | (0.045) | | | (0.002) | | | (0.002) |
| Constant | −0.527*** | −0.131 | −0.140 | 0.071*** | 0.039* | 0.051*** | −0.009* | 0.000 | 0.004 |
| | (0.198) | (0.215) | (0.168) | (0.022) | (0.021) | (0.019) | (0.005) | (0.006) | (0.004) |
| Observations | 5,285 | 5,323 | 4,670 | 3,651 | 3,652 | 3,565 | 5,052 | 5,077 | 5,323 |
| AR(2) | 0.708 | 0.692 | 0.829 | 0.0865 | 0.0976 | 0.121 | 0.396 | 0.382 | 0.290 |
| Hansen | 0.267 | 0.122 | 0.580 | 0.351 | 0.369 | 0.330 | 0.668 | 0.660 | 0.473 |

Table 8 presents the results of the system GMM approach, examining the effects of assets, funding, and income diversification on stability (Z-score) and bank risk (NPLGL, LLPTA) using data from Asian banks from 2000 to 2023. For the confirmation of the model's estimation, we employ Hensen, Sargan, AR (1), and AR (2) statistics. The post-estimation statistics confirm the validity and consistency of the parameters reported statistically. The significance level is as follows: *** p<0 represents 10%, ** p<0.05 represents 5%, and * p<0.1 is 10%.

### *4.5. Empirical findings based on bank size*

The findings indicate significant disparities in risk mitigation strategies and financial stability factors between large and small banks. Income diversification in large banks positively influences the Z-score, an indicator of financial stability, while markedly decreasing nonperforming loans (NPLGL) and loan loss provisions (LLPTA) (Table 9, Columns 3, 6, and 9). Conversely, small banks experience greater advantages from asset diversification, leading to a notable enhancement in their Z-score and a reduction in NPLGL (Table 9, Columns 1 and 4). The equity ratio and profitability serve as reliable predictors of stability in both large and small banks, with a more significant impact observed in large banks (Table 9, Columns 1–3). Macroeconomic factors, including economic growth and inflation, have a substantial impact on the stability metrics of small banks, whereas large banks exhibit reduced sensitivity to these external variables (Tables 9, Columns 7–9). The findings indicate that diversification strategies are essential for small banks, whereas large banks depend more on capitalization and income diversification to improve stability.

**Table 9.** Impact of diversification on risk and stability.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| Variables | Z-score | Z-score | Z-score | NPLGL | NPLGL | NPLGL | LLPTA | LLPTA | LLPTA |
| **Large banks** | | | | | | | | | |
| Lagged risk | 0.086 | 0.105 | −0.012 | 0.723*** | 0.719*** | 0.695*** | 0.216** | 0.215** | 0.168* |
| | (0.290) | (0.081) | (0.018) | (0.022) | (0.023) | (0.061) | (0.105) | (0.101) | (0.095) |
| Asset diversification | 0.024 | | | −0.002 | | | 0.001** | | |
| | (0.038) | | | (0.001) | | | (0.000) | | |
| Funding diversification | | −0.010 | | | 0.007** | | | −0.003* | |
| | | (0.090) | | | (0.003) | | | (0.002) | |
| Income diversification | | | 0.031** | | | −0.008*** | | | −0.004*** |
| | | | (0.013) | | | (0.001) | | | (0.000) |
| **Small banks** | | | | | | | | | |
| Asset diversification | 0.506*** | | | −0.010 | | | 0.011** | | |
| | (0.191) | | | (0.008) | | | (0.005) | | |
| Funding diversification | | −0.517** | | | 0.023** | | | 0.008 | |
| | | (0.229) | | | (0.010) | | | (0.007) | |
| Income diversification | | | 0.888*** | | | −0.010*** | | | −0.001 |
| | | | (0.077) | | | (0.003) | | | (0.002) |
| Constant | −0.033 | −0.033 | 0.095* | 0.033*** | 0.027*** | 0.031*** | 0.006*** | 0.009*** | 0.003** |
| | (0.340) | (0.165) | (0.051) | (0.004) | (0.004) | (0.008) | (0.001) | (0.002) | (0.001) |
| Observations | 7,368 | 7,380 | 7,000 | 7,111 | 7,111 | 6,982 | 7,079 | 7,083 | 6,922 |
| AR(2) | 0.789 | 0.396 | 0.502 | 0.611 | 0.612 | 0.606 | 0.948 | 0.986 | 0.808 |
| Hansen | 0.573 | 0.965 | 0.470 | 0.882 | 0.867 | 0.654 | 0.380 | 0.111 | 0.454 |

Table 9 presents the results of the system GMM approach, examining the effects of assets, funding, and income diversification on stability (Z-score) and bank risk (NPLGL, LLPTA) using data from Asian banks from 2000 to 2023. For the confirmation of the model's estimation, we employ Hensen, Sargan, AR (1), and AR (2) statistics. The post-estimation statistics confirm the validity and consistency of the parameters reported statistically. The significance level is as follows: *** p<0 represents 10%, ** p<0.05 represents 5%, and * p<0.1 is 10%.

### *4.6. Empirical findings based on bank liquidity*

The findings for highly liquid banks, as shown in Table 10, indicate several key factors affecting their financial stability and risk management. Lagged risk exhibits a notable positive correlation with the Z-score at the 1% significance level, suggesting continuity in financial stability across time periods. Lagged risk exhibits a significant positive correlation with NPLGL, indicating the persistence of previous risk patterns (Altman, 1968). Diversification has a nuanced impact on highly liquid banks. Asset diversification exhibits a positive yet statistically insignificant effect on the Z-score, with mixed outcomes for NPLGL and LLPTA, indicating its constrained advantages. Income diversification significantly enhances the Z-score while reducing both NPLGL and LLPTA, highlighting its importance in improving stability and mitigating credit risk (Berger & Bouwman, 2009). The relationship between funding diversification and Z-score, as well as risk metrics, is negative and statistically insignificant, indicating a negligible effect on the financial stability of highly liquid banks. The equity ratio and profitability are consistently significant factors contributing to stability and risk mitigation in highly liquid banks. The two variables positively affect the Z-Score while decreasing NPLGL and LLPTA, highlighting the significance of a strong capital foundation and consistent profitability for sustaining financial health (Altman, 1968). Macroeconomic factors play a significant role. Economic growth enhances the Z-score, suggesting that macroeconomic expansion contributes to financial stability (Levine, 1997). Inflation is positively correlated with the Z-score but exerts a mixed effect on the risk metrics, underscoring the vulnerability of highly liquid banks to inflationary trends (Boyd et al., 2001).

The analysis reveals specific characteristics regarding stability and risk factors for banks with low liquidity, as illustrated in Table 10. Like highly liquid banks, lagged risk has a significant impact on the Z-score and NPLGL, indicating the persistence of financial risk and stability trends. Diversification has a greater impact on banks with low liquidity. Asset diversification demonstrates a robust positive correlation with the Z-score and markedly decreases LLPTA, highlighting its essential function in stability. Income diversification enhances the Z-score and decreases NPLGL, though its impact on LLPTA is negligible (Berger & Bouwman, 2009). Funding diversification exhibits a negative yet statistically insignificant effect, suggesting minimal advantages for low-liquidity banks in this domain.

Similar to highly liquid banks, the equity ratio and profitability significantly enhance the Z-score while concurrently decreasing NPLGL and LLPTA. This consistency highlights the critical significance of a robust capital structure and dependable earnings for both categories of banks (Altman, 1968). Macroeconomic factors, especially economic growth, positively influence Z-score and risk metrics, thereby reinforcing their stabilizing effect (Levine, 1997). Inflation exhibits a weaker and statistically insignificant effect relative to highly liquid banks, indicating that low-liquidity banks demonstrate reduced sensitivity to inflationary pressures (Boyd et al., 2001). Furthermore, the size and efficiency variables demonstrate mixed effects on financial stability, with certain weakly significant results suggesting their secondary importance for banks with low liquidity.

The findings indicate that banks with high and low liquidity employ distinct risk management strategies. Highly liquid banks benefit substantially from income diversification, equity ratios, and macroeconomic stability. Conversely, asset diversification is more critical for banks with low liquidity, in addition to profitability and economic growth. These insights highlight the necessity of customized risk management and diversification strategies that consider the liquidity levels of banks.

**Table 10.** Impact of diversification on risk and stability.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| Variables | Z-score | Z-score | Z-score | NPLGL | NPLGL | NPLGL | LLPTA | LLPTA | LLPTA |
| **Highly liquid banks** | | | | | | | | | |
| Lagged risk | 0.087*** | 0.138 | 0.071** | 0.767*** | 0.768*** | 0.767*** | 0.064 | 0.067 | 0.060 |
| | (0.033) | (0.127) | (0.036) | (0.067) | (0.067) | (0.059) | (0.097) | (0.097) | (0.094) |
| Asset diversification | 0.078 | | | −0.012 | | | −0.007* | | |
| | (0.139) | | | (0.010) | | | (0.004) | | |
| Funding diversification | | −0.260 | | | 0.011 | | | −0.005 | |
| | | (0.211) | | | (0.012) | | | (0.007) | |
| Income diversification | | | 0.745*** | | | −0.008** | | | −0.004* |
| | | | (0.073) | | | (0.004) | | | (0.002) |
| **Low-liquidity banks** | | | | | | | | | |
| Asset diversification | 0.669*** | | | 0.011 | | | 0.019** | | |
| | (0.226) | | | (0.008) | | | (0.009) | | |
| Funding diversification | | −0.464 | | | −0.004 | | | −0.009 | |
| | | (0.383) | | | (0.009) | | | (0.008) | |
| Income diversification | | | 0.587*** | | | −0.010*** | | | 0.003 |
| | | | (0.080) | | | (0.003) | | | (0.002) |
| Constant | −0.524*** | −0.249 | −0.219 | 0.065*** | 0.046*** | 0.055*** | 0.015*** | 0.013* | 0.010*** |
| | (0.178) | (0.192) | (0.170) | (0.016) | (0.016) | (0.011) | (0.005) | (0.007) | (0.004) |
| Observations | 10,191 | 10,231 | 9,573 | 9,037 | 9,038 | 8,855 | 9,509 | 9,522 | 9,284 |
| AR(2) | 0.584 | 0.721 | 0.646 | 0.656 | 0.653 | 0.679 | 0.390 | 0.394 | 0.399 |
| Hansen | 0.878 | 0.680 | 0.281 | 0.599 | 0.582 | 0.586 | 0.316 | 0.395 | 0.323 |

Table 10 presents the results of the system GMM approach, examining the effects of assets, funding, and income diversification on stability (Z-score) and bank risk (NPLGL, LLPTA) using data from Asian banks from 2000 to 2023. For the confirmation of the model's estimation, we employ Hensen, Sargan, AR (1), and AR (2) statistics. The post-estimation statistics confirm the validity and consistency of the parameters reported statistically. The significance level is as follows: *** p<0 represents 10%, ** p<0.05 represents 5%, and * p<0.1 is 10%.

### *4.7. Empirical findings based on bank growth*

The findings from high-growth banks (Table 11) and low-growth banks (Table 11) illustrate the differing impacts of financial and macroeconomic variables on their stability and risk metrics. In high-growth banks, lagged risk demonstrates a consistently significant positive correlation with the Z-score and NPLGL, suggesting that historical risks have a substantial impact on current financial stability and credit risk (Altman, 1968). Asset diversification is a crucial strategy that enhances the Z-score and decreases the ratio of loan loss provisions to total assets (LLPTA), underscoring its significance for financial stability. Income diversification positively impacts the Z-score and decreases NPLGL and LLPTA, thereby affirming its benefits in risk reduction. In contrast, funding diversification exhibits a minimal or negative effect on the Z-score and LLPTA, while it significantly reduces NPLGL, indicating that its risk mitigation advantages are confined to particular risk metrics (Berger & Bouwman, 2009). Key financial indicators, such as the equity ratio and profitability, enhance financial stability, evidenced by their strong positive correlation with the Z-score and notable decreases in risk metrics. The findings highlight the necessity of sustaining robust capital buffers and profitability in high-growth banks (Boyd et al., 2001). Economic

growth has a positive effect on the Z-score, whereas inflation shows mixed effects; it slightly decreases the Z-score while simultaneously increasing the risk metrics. This highlights the susceptibility of high-growth banks to inflationary pressures (Levine, 1997). Low-growth banks exhibit specific characteristics, as illustrated in Table 15. Lagged risk significantly influences all stability and risk metrics, indicating the greater persistence of financial risk in comparison with high-growth banks. Diversification strategies are significant, as income diversification markedly enhances the Z-score and decreases NPLGL. Funding diversification demonstrates a negative correlation with the Z-score, suggesting potential disadvantages for stability in banks experiencing low growth. Asset diversification has a limited effect on the Z-score but leads to a decrease in LLPTA, indicating a more specific advantage (Berger & Bouwman, 2009). Financial indicators such as the equity ratio and profitability are crucial determinants of stability, positively affecting the Z-score and reducing the risk metrics. Nonetheless, their effects seem to be less pronounced in comparison with high-growth banks, likely attributable to the diminished growth dynamics of these institutions (Altman, 1968). Macroeconomic factors, such as economic growth and inflation, exhibit diminished effects on low-growth banks, indicating that these institutions are less responsive to macroeconomic fluctuations (Boyd et al., 2001). The findings indicate that high-growth banks derive greater advantages from diversification and robust financial indicators, whereas low-growth banks depend more on targeted diversification strategies and encounter ongoing risk. The differing dynamics emphasize the need for customized financial and risk management strategies aligned with growth characteristics.

**Table 11.** Impact of diversification on risk and stability.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| Variables | Z-score | Z-score | Z-score | NPLGL | NPLGL | NPLGL | LLPTA | LLPTA | LLPTA |
| **High-growth banks** | | | | | | | | | |
| Lagged risk | 0.169*** | 0.166*** | 0.098** | 0.619*** | 0.618*** | 0.615*** | 0.106 | 0.103 | 0.098 |
| | (0.043) | (0.044) | (0.045) | (0.083) | (0.082) | (0.089) | (0.065) | (0.063) | (0.060) |
| Asset diversification | 0.364*** | | | 0.003 | | | 0.009*** | | |
| | (0.121) | | | (0.010) | | | (0.003) | | |
| Funding diversification | | −0.014 | | | 0.029** | | | −0.002 | |
| | | (0.165) | | | (0.012) | | | (0.003) | |
| Income diversification | | | 0.442*** | | | −0.011** | | | −0.006*** |
| | | | (0.064) | | | (0.005) | | | (0.001) |
| **Low-growth banks** | | | | | | | | | |
| Asset diversification | 0.108 | | | −0.003 | | | 0.019* | | |
| | (0.213) | | | (0.011) | | | (0.010) | | |
| Funding diversification | | −0.909** | | | 0.030** | | | 0.034* | |
| | | (0.448) | | | (0.015) | | | (0.020) | |
| Income diversification | | | 0.862*** | | | −0.012*** | | | −0.002 |
| | | | (0.075) | | | (0.003) | | | (0.002) |
| | (0.120) | (0.209) | (0.155) | (0.017) | (0.017) | (0.017) | (0.004) | (0.004) | (0.003) |
| Observations | 7,233 | 7,268 | 6,827 | 5,917 | 5,917 | 5,821 | 7,824 | 7,830 | 7,500 |
| AR(2) | 0.230 | 0.175 | 0.257 | 0.200 | 0.197 | 0.191 | 0.177 | 0.163 | 0.136 |
| Hansen | 0.794 | 0.706 | 0.108 | 0.771 | 0.766 | 0.849 | 0.516 | 0.700 | 0.638 |

Table 11 presents the results of the system GMM approach, examining the effects of assets, funding, and income diversification on stability (Z-score) and bank risk (NPLGL, LLPTA) using data from Asian banks from 2000 to 2023. For the confirmation of the model's estimation, we employ Hensen, Sargan, AR (1), and AR (2) statistics. The post-estimation statistics confirm the validity and consistency of the parameters reported statistically. The significance level is as follows: *** p<0 represents 10%, ** p<0.05 represents 5%, and * p<0.1 is 10%.

## 5. Conclusions and implications

The aim of this study was to examine the potential impact of diversification of assets, financing, and returns on stability and banking risk metrics in the Asian region. The findings reveal notable variations in how assets, funding, and income diversification impact the stability and risk of banks throughout Asia, shaped by factors including capitalization, liquidity, bank type, asset growth, and size. Asset diversification typically enhances stability and mitigates risk; however, it can adversely affect stability and elevate risk for commercial banks. Diversification of funding adversely affects stability and risk in all banking categories, providing minimal advantages, especially for commercial banks. Minimizing nonperforming loans enhances profitability and stability while reducing risk through income diversification. Savings banks prioritize stability and risk management, whereas commercial banks significantly benefit from income diversification. Well-capitalized banks are more capable of withstanding shocks and utilizing diversification strategies, making capitalization critically important. Conversely, undercapitalized banks exhibit increased vulnerability and derive minimal advantages from diversification. Liquidity is crucial: Banks with low liquidity require enhanced risk management strategies, whereas banks with high liquidity exhibit greater stability and reduced reliance on debt financing. The size of banks significantly influences their risk profile, as large institutions leverage economies of scale and diversification opportunities while simultaneously generating systemic risks that necessitate stringent regulation. Conversely, smaller banks experience reduced benefits from diversification and exhibit greater susceptibility to economic shocks. Moreover, stability and risk influence growth dynamics. Low-growth banks face ongoing risks and necessitate structural modifications to enhance resilience, whereas high-growth banks gain from diversification and profitability, yet exhibit greater sensitivity to macroeconomic shocks. Various banks exhibit distinct responses to diversification strategies. The intricacy of their business processes and market exposure renders commercial banks highly sensitive. Savings banks, while upholding conservative risk profiles, primarily emphasize income diversification. Islamic banks, which comply with Sharia principles, are notably affected by asset diversification and exhibit reduced sensitivity to macroeconomic fluctuations.

The results contain several implications for regulators, economists, and bankers for the formulation of new guidelines in light of the current empirical analysis. Primarily, the empirical evidence highlights the requirement for banks to revise their assets, funding, and revenue diversification plan according to their market model instead of using general patterns for it. For example, commercial banks may avoid excessive diversification in their asset portfolios along with excessive funding. Saving banks should use revenue diversification instead of assets and funding sources. Islamic banks use asset diversification, which leads to reduced risk and enhanced stability. Similarly, our study highlights that banks should consider their size, liquidity, capitalization, and growth when using diversification in assets, funding, and incomes.

## Author contributions

**Mr. Mutee-Ur-Rehman** contributes to the introduction, literature review, and methodology. Data analysis, interpretations of empirical findings, and conclusions are all aided by **Dr. Faisal Abbas.**

## Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in creating this article.

## Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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