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HOW DOES BANKING INNOVATION IMPACT BANKING STABILITY IN INDONESIA? THE MODERATING ROLE OF GENDER DIVERSITY

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ABSTRACT

This study aims to examine the impact of banking innovation on banking stability in Indonesia. Using financial data from 46 banks listed on the Indonesia Stock Exchange from 2004 to 2022 with 637 observations, this study applies the Ordinary Least Squares (OLS) method for its analysis. The results of this study show that banking innovation exerts a significant positive influence on banking stability in Indonesia. However, a surprising finding emerges from the moderation of gender diversity which turns out to have a negative effect on the relationship between banking innovation and banking stability, contrary to the literature that often shows a positive effect of gender diversity on firm performance. Additional analysis suggests that despite innovations, SOEs with strict structures and regulations may not be able to fully capitalise on the efficacy of such innovations due to bureaucratic barriers and strict government policies. In contrast, non-SOE firms are more agile and able to implement innovations with higher effectiveness, which contributes to their financial stability. The study also analyses various financial quadrants, showing that the effect of innovation on banking stability varies based on asset characteristics and firm age.

Keywords :
Banking Innovation, Banking Stability, Gender Diversity

JEL Classification : G21, O31, P34

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I. Introduction

Innovation is a critical element that strengthens the foundation of any business, including the banking sector. It is a driver of progress and an essential tool for maintaining relevance and competitiveness in a dynamic market (Coccia, 2017; Lütjen et al., 2019; Sáez-Martínez et al., 2016). Through innovation, banks can develop products and services that meet current market needs while improving operational efficiency and reducing costs (Akhisar et al., 2015; Lee et al., 2021). In banking, innovation's role in determining service quality and customer satisfaction is strategically essential (F. Li et al., 2021; Mahmoud et al., 2018; YuSheng & Ibrahim, 2019). To illustrate, digital technologies, including mobile and internet banking, have transformed how customers access financial services, leading to substantial enhancements in transactional efficiency and security (Broby, 2021; Gomber et al., 2018; Hakizimana et al., 2023). Moreover, big data and analytics innovations facilitate more precise data-driven decision-making, reducing credit and operational risks (Hasan et al., 2023; Malhotra & Malhotra, 2023). As Amjad et al. (2023) asserted, implementing financial innovation strategies in conjunction with robust risk management practices is pivotal to enhancing a bank's financial stability. This is because financial innovation, exemplified by the utilisation of sophisticated algorithms for risk prediction and service personalisation, can optimise efficiency and effectiveness in bank operations (Addy et al., 2024; Douglas, 2024). Conversely, robust risk management guarantees that innovations are implemented within a secure framework, preventing financial losses that could prove catastrophic.

The role of financial innovation in financial institutions in strengthening stability and predictability in financial markets is of significant importance. As Forrer & Forrer (2015) posited, deploying innovative financial instruments can garner greater public interest and offer more predictable returns for shareholders. This, in turn, reinforces investor confidence and contributes to economic stability. The findings of Jungo et al. (2023) substantiated the assertion that financial sector innovation is a pivotal driver of enhanced financial inclusion. This bolsters the competitive edge of banking institutions and mitigates financial risks.

These innovations assist financial institutions in reaching a broader market segment and provide safer and more efficient services, reinforcing the bedrock of financial stability. Nampewo & Opolot (2016) elucidated how financial innovation can impact the stability of money's velocity, including its effects on interest rates and real income. These shifts in the demand for money and the stock of money frequently give rise to substantial economic fluctuations, necessitating more adaptive and innovative monetary policies to maintain stability.

Santos-Arteaga et al. (2020) highlighted the significance of financial stability in promoting innovation, particularly during periods of economic turbulence. A resilient innovation system can bolster a country's economic and financial resilience, underscoring the symbiotic relationship between stability and innovation. In the ongoing pandemic, Shafiya et al. (2022) have highlighted the crucial role of financial innovation, particularly within the Islamic finance sector. The digitisation of processes and the utilisation of innovative financial technologies facilitate broader financial inclusion and assist in maintaining financial stability in the context of volatile market conditions. Pürhani et al. (2023) employed a regression analysis to ascertain the impact of capital investment in innovation on financial stability. Their findings suggest that sustained and measured innovation can generate long-term benefits for financial sector stability. Ujunwa et al. (2022) demonstrated how financial innovation can accelerate the velocity of money circulation, thereby enhancing the stability of money demand within the economy. This indicates that financial innovation affects the market structure and the broader macroeconomic mechanism. Degl'Innocenti et al. (2018) emphasized that the conjunction of financial centers' competitiveness and stability can enhance the banking industry's capacity for innovation, mainly when business conditions are favorable. This, in turn, can confer benefits across the entire financial system. However, Kuehnhausen (2014) warned that high levels of innovation can also harm firm stability, introducing vulnerabilities that must be carefully managed. This highlights the necessity for robust regulation in addressing the accelerated pace of financial innovation.

In addition to its association with banking stability, innovations in financial technology (FinTech) have significantly impacted risk management in banking. The advent of new technologies, including artificial intelligence and big data analytics, has enabled banking institutions to enhance their capacity to identify, quantify, and manage risk more efficiently (Fethi & Pasiouras, 2010; Giudici, 2018; Vassakis et al., 2018). Using sophisticated algorithms and predictive models enables the expedient identification of potential warning signs of credit and operational risks, facilitating prompt intervention to prevent lossess (Addy et al., 2024; Johnson, 2019; Yao, 2024). Furthermore, FinTech innovations have contributed to a reduction in information asymmetry among market participants (Ediagbonya & Tioluwani, 2023; Gomber et al., 2018; Lai et al., 2023). The advent of FinTech innovations has also given rise to the diversification of products and services. The advent of new financial products, such as peer-to-peer lending and digital payment services, has enabled banks to enter new markets and offer more personalised services (Alt & Puschmann, 2012; Glushchenko et al., 2019). This diversification generates new revenue streams and mitigates risk, enhancing banks' resilience to fluctuations in one market segment.

The extant literature has identified the impact of banking innovations on banking stability. However, significant research gaps still need to be addressed, particularly in the context of firm-level analyses. The majority of studies, including those by Khan et al. (2023), Li et al. (2022), and Kuehnhausen (2014), tended to adopt a macro-level perspective, examining the impact of FinTech and other financial innovations on banks' stability and risk behaviour in aggregate. For instance, Khan et al. (2023) findings indicated that the advent of FinTech tends to diminish the stability of banks in GCC countries. However, large and well-capitalised banks demonstrate greater resilience to the adverse effects of FinTech adoption. Conversely, Li et al. (2022) posited that FinTech innovations may diminish banks' risk appetite, with a more pronounced decline observed in large and state-owned banks. This underscores the necessity for more comprehensive investigations at the firm level to elucidate the interplay between these intrinsic factors and financial innovation in shaping stability and risk-taking outcomes.

Furthermore, while certain studies, such as those conducted by González et al. (2016) and Lee et al. (2021), have explored specific aspects such as securitisation, the use of credit derivatives, and the effect of fintech industry development on cost efficiency, there is still a paucity of data that elucidates the impact of specific technology or product innovations on risk and stability parameters that are unique to individual banks. The necessity for more detailed data and more targeted analyses on operational and risk management aspects at the bank level is becoming increasingly paramount. Furthermore, while some studies, such as those conducted by González et al. (2016) and Lee et al. (2021), have explored specific aspects, including securitisation, the use of credit derivatives, and the impact of fintech industry development on cost efficiency, there is still a paucity of data elucidating how particular technological or product innovations influence risk and stability parameters specific to individual banks. The necessity for more detailed data and more concentrated analyses of operational and risk management aspects at the bank level is becoming increasingly apparent. In conclusion, the impact of the global pandemic, as illustrated by Sapulette et al. (2021) in the Indonesian context, also demonstrates the variability of responses to FinTech innovations during the crisis. This introduces another dimension to the analysis of the effect of banking innovations on stability and risk. Consequently, future research must further investigate how external and internal bank crisis factors interact in the context of financial innovation to provide a more comprehensive picture and deeper nuances on this topic.

This study aims to examine the impact of banking innovation on the banking stability in Indonesia. This research will undertake a more detailed examination at the level of individual banking institutions, diverging from the approach of previous studies, which have typically concentrated on the FinTech aspect alone. Furthermore, this study seeks to incorporate the moderating influence of gender diversity in board decision-making. Prior research has demonstrated that gender diversity on corporate boards can facilitate a broader range of perspectives and analytical thinking, thereby enhancing the comprehensiveness of decision-making processes (Ahmed, 2024; Anggraini, 2024; Carter et al., 2010; Keller, 2024; Khaw & Liao, 2018; Oradi & Izadi, 2019; Sholichah, 2022; Sitohang, 2023; Vacca et al., 2020;

Yousry et al., 2022; Yuliana, 2019). This diversity is anticipated to influence how banks manage risk and innovation. In particular, this study will assess the impact of gender diversity on banks' propensity to take risks and its effect on banks' financial stability.

This research offers significant theoretical and practical benefits in the context of the impact of banking innovation on banking stability. Theoretically, this study contributes to the finance literature by expanding the understanding of the interaction between banking innovation and financial stability. It facilitates the development of novel models that more precisely analyse and predict the impact of innovation on banking stability. Furthermore, integrating variables such as gender diversity in decision-making provide new insights into the influence of non-financial factors on financial decisions within the banking context. From a practical standpoint, the results of this study are of significant utility to banking practitioners and policymakers. For practitioners, a deeper understanding of how innovation affects financial stability can assist in the design of more effective strategies for risk management and product innovation. Banks may use these findings to reinforce their risk-taking framework, enhancing operational safety and efficiency. Meanwhile, for policymakers, this research provides empirical evidence that can inform the adjustment of financial regulations to accommodate the latest developments in banking innovation, ensuring that such developments do not increase systemic risk but add stability to the banking sector.

II. Literature Review

A. Banking Innovation

Research examining innovation's impact on the banking industry has witnessed a notable expansion in recent years. Tashtamirov (2023) has identified financial innovation and digital technology as the primary catalysts for transformation in the banking industry. As Al-Sahlani (2023) asserts, innovation exerts a considerable influence on the performance of banks over time. Implementing novel ideas and technologies can influence both the efficacy of operations and banks' long-term viability. Chipeta & Muthinja (2018) specifically identified a correlation between the

implementation of financial advancements, including mobile banking, internet banking, and automated teller machines, and enhanced bank performance. Okenabirhie (2021) presents evidence indicating that the competitiveness of commercial banking services has been enhanced through technological improvements, including Internet and mobile banking.

Additionally, Aboramadan et al. (2019) identified that organisational culture and marketing innovation significantly contribute to the positive performance of banks. This finding aligns with the proposition put forth by Anielak (2018) that innovation plays a pivotal role in enhancing the effectiveness of bank operations. Tran et al. (2022) demonstrated that innovation exerts a mitigating influence on liquidity risk in commercial banks from a risk management perspective. Shao et al. (2020) emphasised the importance of evaluating and developing banks' capacity to innovate products for sustained growth. Meanwhile, Liu et al. (2023) demonstrated that the deployment of innovative technology solutions and the active participation of consumers in banking channels positively impact banking efficiency. Furthermore, Khudolii (2023) posited that the advent of fintech innovations, including open banking and hyper-personalisation, has profoundly impacted the banking sector. Li (2024) notes that developments in fintech have led to improvements in operational efficiency and total factor productivity in banks. Ajide (2016) also highlights how technological innovation has enhanced the efficiency of banks in gathering savings and directing them towards productive sectors of the economy. These observations illustrate ongoing innovation's significant role in enhancing the banking sector's sustainability and competitiveness.

B. Banking Stability

The banking industry, often considered the central component of the financial system, plays a crucial role in preserving economic stability (Acharya & Ryan, 2016; Prochniak & Wasiak, 2017). The banking system's stability is crucial, as banks play a vital role in facilitating the efficient distribution of resources, providing loans, and managing risk (Choudhry, 2018; Naili & Lahrichi, 2022). These functions are fundamental to the

economy's operation on a significant level. Furthermore, the banking sector's stability is a crucial measure of a nation's economic viability. When banks function in a stable state, they can furnish the essential financial means to bolster economic expansion through investment and consumption (Choudhry, 2018; Naili & Lahrichi, 2022). Lack of stability can lead to distrust from investors and customers, decreasing economic liquidity. The banking system's stability relies on the absence of stressors that could endanger the national economy. This requires the financial authorities to establish effective supervisory and regulatory measures, while banking institutions must adopt strong risk management policies. A robust banking system creates a favourable environment for economic expansion by reducing the likelihood of systemic hazards that could affect numerous companies and individuals (Choudhry, 2018; Naili & Lahrichi, 2022).

In empirical studies, Berger et al. (2009) observed that the Z-score frequently measures individual banks' stability concerning bank-specific financial data. The Z-score represents an efficacious methodology for evaluating financial stability in banking institutions, integrating key elements such as capital adequacy, profitability, and risk. The Z-score is an indicator designed to identify instances of bank fragility by measuring the probability of bankruptcy. The Z-score combines vital financial variables, including the capital adequacy ratio, earnings volatility, and return on assets, to provide a comprehensive picture of a bank's financial stability (Hafeez et al., 2022; Neto, 2021; Onumah & Duho, 2019). In particular, a high Z-score indicates robust financial stability and a low-risk profile (Saif-Alyousfi et al., 2020). A high score indicates that the bank can absorb potential losses and has adequate financial buffers to protect against unexpected market fluctuations. This is a positive indicator for investors, supervisors, and other stakeholders regarding the bank's financial health. Conversely, a low Z-score indicates that the bank is in a more fragile state and has low stability. This usually reflects a riskier financial structure with insufficient capital to cover potential losses, which may increase the likelihood of insolvency or the need for regulatory intervention.

C. The Impact of Banking Innovation on Banking Stability

Recent research has demonstrated that financial innovation is a pivotal determinant of the banking industry's stability. Babenko (2021) posited that implementing financial technology and other innovations can engender the creation of novel business models, procedures, and products that profoundly influence financial markets and institutions. Verma & Chakarwarty (2023) additionally posited that interbank competition positively influences financial stability, thereby enabling banks to enhance their financial resilience. Kolodiziev et al. (2016) highlighted the significance of selecting an appropriate financial innovation, considering the stage of development and financial stability of the bank in question. Moreover, research conducted by Ahamed & Mallick (2019) indicated that financial inclusion can enhance bank stability by underscoring the significance of financial development at the local level. Degl'Innocenti et al. (2018) highlighted the complex impact on innovation levels in their study of the relationship between banks' competitiveness, financial stability, and innovation capabilities during the Global Financial Crisis. Трусова et al. (2021) demonstrated that the promotion of banking innovation is associated with the financial stability of banking institutions, where digital technology plays a vital role in harnessing the potential of innovation in the financial industry.

However, Dovha & Boychenko (2017) cautioned that the potential risks associated with financial progress must be considered, as intense competition in the banking sector may intensify the adverse effects on stability. Khalifaturofi'ah (2020) acknowledged the efficiency-enhancing benefits of financial innovation, while Liu (2022) demonstrated that financial innovation has a considerable impact on banks' financial performance. Moreover, the specific attributes of each firm have significant consequences in determining the present financial performance of the bank. Lu (2018) posited that financial product innovation is associated with increased revenue, superior risk management, and more robust market restrictions for commercial banks. This, in turn, leads to a broader spectrum of financial risks and enhanced risk management capabilities. Jote (2023) underscored the significance of

implementing efficacious strategies to advance the utilisation of financial innovations, thereby enhancing the efficiency and effectiveness of banking services. The extant literature indicates that financial innovation offers numerous advantages, but a judicious and strategic approach is imperative to mitigate potential risks and optimise benefits for bank stability. In light of the preceding literature, the research hypothesis is formulated as follows:

H_1: Banking innovation has a significant positive impact on banking stability.

D. The Moderating Gender Diversity Impact of Banking Innovation on Banking Stability

The intensified emphasis on gender diversity in corporate governance is driven by its capacity to mitigate risk and enhance corporate stability. The findings of the research conducted by Özdemir & Erkmen (2022) indicate that the inclusion of gender diversity in senior management teams can enhance monitoring and control processes, mitigating business risks. Ibiamke (2023) underscored the significance of gender diversity in risk management committees, underscoring its contribution to enhanced risk assessment and reduced financial distress in the banking industry. Rodriguez (2023) and Hesniati (2024) proposed that diverse genders on the board of directors can improve the group's functioning, resulting in lower risk perception, higher attractiveness for investors, and potentially greater financial returns for the organisation. Moreover, Muhammad et al. (2022) indicated that gender-diverse boards may diminish systematic risk and facilitate the implementation of more conservative financial and investment strategies compared to boards with limited gender representation. Achour (2022) posited that including individuals of different genders on the board of directors can mitigate risk fluctuations within the firm. The agency, upper-echelon, and human capital theories support this argument. Teodósio et al. (2023) presented findings suggesting that gender diversity impacts decisions regarding capital structure, favoring short-term debt over bank loans as a risk management strategy. This finding indicates that gender diversity is pivotal in formulating risk management strategies within the business sector. Based

on the findings of the literature review, it can be concluded that the presence of diverse genders in the context of corporate governance can assist in reducing risk and enhancing stability. This is achieved by reinforcing monitoring processes, improving control mechanisms, and influencing strategic decision-making in favor of adopting less risky policies. Organisations can derive significant benefits from the promotion of gender diversity in leadership roles, including the mitigation of risk, the increase in investor confidence, and the improvement of overall performance. In light of the preceding literature, the research hypothesis is formulated as follows:

H_{1a}: Gender diversity moderates the positive effect of banking innovation on banking stability.

III. Data and Method

A. Data and Samples

The data employed in this study comprises financial data from banks listed on the Indonesia Stock Exchange from 2004 to 2022. In particular, 46 banks have been selected as samples, with 637 observations. Of these, 72 observations relate to state-owned banks, and 565 to non-state-owned banks. The primary data utilised in this study were procured from the companies' annual reports and financial statements, accessible via their respective corporate websites and the Indonesia Stock Exchange website. The sampling process was conducted through the purposive sampling method, with specific criteria: 1) Banking companies listed on the official website of the Indonesia Stock Exchange during the period from 2004 to 2021, 2) Companies in the banking sector that publish audited financial statements and annual reports for 2004 to 2022, and 3) Banking companies selected as samples have the complete data required for research available.

B. Operationalisation of Research Variables

The operationalisation of the variables in this study is presented below (Table 1).

Table 1. Operationalisation of Variables

Variable	Operationalisation
Moderating Variables	
Female Director (**FEMDIR**)	Female Director (FEMDIR) is a dummy variable that indicates the presence of female directors on the company's board of directors. This variable takes the value 0 if there is no female director on the board and 1 if there is at least one female director (Saleh et al., 2023; El-Deeb & Mohamed, 2024; Gull et al., 2018; Ye et al., 2019).
Percentage of Female Directors (**PERC_FEMDIR**)	Percentage of Female Directors (PERC_FEMDIR) measures the proportion of female directors on a company's board of directors. This variable is calculated by dividing the number of female directors by the total number of directors on the board, then multiplying by 100 to get the percentage (Saleh et al., 2023; El-Deeb & Mohamed, 2024; Gull et al., 2018; Ye et al., 2019).
Female Commissionaire (**FEMCOM**)	Female Commission**aire** (FEMCOM) is also a dummy variable used to mark the presence of female commissionaire**s** on the company's board of commissionaires. This variable will be 0 if there is no female commissionaire, and 1 if there is at least one female commissionaire (Saleh et al., 2023; El-Deeb & Mohamed, 2024; Gull et al., 2018; Ye et al., 2019).
Percentage of Female Commissionaire (**PERC_FEMCOM**)	Percentage of Female Commissionaires (PERC_FEMCOM) is calculated in a similar way to PERC_FEMDIR, by taking the number of female commissionaires, dividing by the total number of commissionaires, and multiplying the result by 100 to get the percentage (Saleh et al., 2023; El-Deeb & Mohamed, 2024; Gull et al., 2018; Ye et al., 2019).
Female Audit Committee (**FEMAUDITCOM**)	Female Audit Committee (FEMAUDITCOM) is a dummy variable that indicates whether there are female members on the audit committee. This variable will take a value of 0 if there is no female member on the audit committee, and 1 if there is at least one female member (Saleh et al., 2023; El-Deeb & Mohamed, 2024; Gull et al., 2018; Ye et al., 2019).
Percentage of Female Audit Committee (**PERC_FEMAUDITCOM**)	Percentage of Female Audit Committee (PERC_FEMAUDITCOM) is calculated by taking the number of female members in the audit committee, divided by the total audit committee members, then the result is multiplied by 100 to get the percentage (Saleh et al., 2023; El-Deeb & Mohamed, 2024; Gull et al., 2018; Ye et al., 2019).
Independent Variables	
First Proxy of Banking Innovation (**LNINOV**)	**LNINOV** is the natural logarithm of the current value of intangible assets. The use of the natural logarithm helps in reducing the skewness of the distribution of intangible assets, which is usually very skewed because most companies have very small amounts or even no intangible

Variable	Operationalisation
	assets (Bresciani et al., 2016; Duodu & Rowlinson, 2019; Sukumar et al., 2020).
Second Proxy of Banking Innovation (**LNINOV^2**)	**LNINOV^2** is the square of **LNINOV**. This variable is used to test the non-linear effect of intangible assets on the dependent variable (Bresciani et al., 2016; Duodu & Rowlinson, 2019; Sukumar et al., 2020).
Third Proxy of Banking Innovation (**LNINOV$_{T-1}$**)	**LNINOV$_{T-1}$** is the natural logarithm of the value of intangible assets for the previous year (Bresciani et al., 2016; Duodu & Rowlinson, 2019; Sukumar et al., 2020).
Fourth Proxy of Banking Innovation ((**LNINOV$_{T-1}$)^2**)	**(LNINOV$_{T-1}$)^2** is the square of **LNINOV$_{T-1}$**. Just like **LNINOV^2**, this variable is used to assess the non-linear relationship between the previous year's intangible asset value and the dependent variable in the model (Bresciani et al., 2016; Duodu & Rowlinson, 2019; Sukumar et al., 2020).
Dependent Variables	
First Proxy of Banking Stability (**ZSCORE**)	The fisrt proxy of banking stability is Altman Z-score . Altman Z-score is one of the earliest and well-known methods for predicting corporate bankruptcy. The advantage of Altman Z-score over Z-score using ROA (Return on Assets) and ROE (Return on Equity) lies in its more comprehensive composition. The Altman Z-score combines several different financial ratios, including operating efficiency, profitability, leverage, liquidity, and sales activity, providing a more holistic and accurate picture of a company's financial stability. Compared to using only ROA or ROE, the Altman Z-score can provide analyses that are more resistant to financial statement manipulation and offer stronger predictions of the risk of financial failure (Almamy et al., 2016; Badea & Matei, 2016; Zhu et al., 2021). $$Altman\ ZScore = \left(\left(1.2 \times \frac{Working\ Capital}{Total\ Assets}\right) + \left(1.4 \times \frac{Retained\ Earnings}{Total\ Assets}\right) + \left(3.3 \times \frac{Earnings\ Before\ Interest\ dan\ Tax}{Total\ Assets}\right) + \left(1.6 \times \frac{Total\ Equity\ Market\ Value}{Total\ Assets}\right) + \left(0.999 \times \frac{Total\ Sales}{Total\ Assets}\right)\right)$$
Second Proxy of Banking Stability (**CZSCORE**)	The second proxy of banking stability is the World Bank's Bank Z-score, which is an alternative to the traditional Z-score that is specific to the banking industry at the country level (Almamy et al., 2016; Badea & Matei, 2016; Zhu et al., 2021).
Firm Level – Control Variable	
Firm Size (**FSIZE**)	Firm size is measured using the natural logarithm of the firm's total assets.

Variable	Operationalisation
Firm Age (**FAGE**)	Firm age is measured as the natural logarithm of the number of years since the firm was founded.
Price-to-Book Value Ratio (**PBV**)	The price to book value ratio is calculated by dividing the stock price by the equity per share. This ratio is an important indicator used by investors to assess the valuation level of a company's stock, where higher values may indicate that the stock may be overvalued, and lower values may indicate that the stock is considered undervalued by the market.
Debt to Equity Ratio (**DER**)	The debt-to-equity ratio is calculated by dividing total debt by total equity. This ratio is an important indicator of a company's capital structure and is used to assess the company's level of financial leverage. A higher ratio may indicate higher risk, but it could also indicate the aggressiveness of the company in financing growth through debt.
Country Level – Control Variable	
Inflation Consumer Price (**INFCP**)	Consumer price inflation is measured as an annual percentage change and is obtained from World Bank data. Consumer inflation reflects changes in the prices of goods and services purchased by households and is commonly used as a leading indicator of the inflation rate in a country.
Inflation (**INFGDP**)	Inflation using the GDP deflator measured also as annual percentage change, provided by the World Bank. It differs from consumer price inflation in that it measures changes in the prices of all goods and services produced in the economy, not just those consumed by households.
GDP Growth (**GDPGR**)	GDP (Gross Domestic Product) growth is measured as a percentage of annual growth and is available through the World Bank database. GDP growth is a key indicator that shows how fast a country's economy is expanding and is often used to measure overall economic health.
Tax Revenue (**TR**)	Tax revenue, measured as a percentage of GDP, is a critical indicator of the government's ability to generate revenue from internal economic activities. This data is also obtained from the World Bank and is useful for analysing fiscal policy as well as the government's ability to publicly finance.
Trade (**TRADE**)	Trade, measured as a percentage of GDP, indicates the degree of openness of a country's economy to international trade. This data, provided by the World Bank, includes the total value of exports and imports compared to the overall size of the economy, offering insight into how integrated the economy is with global markets.

C. Econometric Model

The approach used in this study is Ordinary Least Squares (OLS). The following is the regression model used to determine the impact of banking innovation on the banking stability with gender diversity moderated:

$$f(BANKING\ STABILITY_{i,d}) = f\begin{pmatrix} BANK\ INNOVATION_{i,d} \\ GENDER\ DIVERSITY_{i,d} \\ BANK\ INNOVATION_{i,d} * GENDER\ DIVERSITY_{i,d} \end{pmatrix} + \varphi_{i,d} \quad (1)$$

The dependent variables in this study are Banking Stability (with the proxies ZSCORE and CZSCORE in the operationalisation of variables). While the independent variable is banking innovation with four measurement proxies, namely: LNINOV, $LNINOV^2$, $(LNINOV_{T-1})$, and $(LNINOV_{T-1})^2$. The moderating variables in this study are gender diversity with six measurement proxies, namely: FEMDIR, PERC_FEMDIR, FEMCOM, PERC_FEMCOM, FEMAUDITCOM, and PERC_FEMAUDITCOM. The variable $\varphi_{i,d}$ is a control variable consisting of Firm Size (FSIZE), Firm Age (FAGE), Price-to-Book Value Ratio (PBV), Debt to Equity Ratio (DER), Inflation Consumer Price (INFCP), Inflation (INFGDP), GDP Growth (GDPGR), Tax Revenue (TR), and Trade (TRADE).

IV. Result and Discussion

A. Descriptive Statistics and Correlation Coefficient

In the descriptive statistical analysis, several variables stand out regarding their variability and distribution (Table 2). The ZSCORE variable, as an indicator of banking stability, shows a mean of 34.321 with a very high standard deviation of 257.922, indicating significant variability in financial stability across banks. This is evident from the wide range of values from -2.15 to 2912.71. On the other hand, CZSCORE, which also measures stability, has a more stable mean value of 4.716 and a lower standard deviation (0.609), indicating a more concentrated distribution between 3 and 5.5.

Table 2. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
ZSCORE	637	34.321	257.922	-2.15	2912.71
CZSCORE	637	4.716	.609	3	5.5
LNINOV	637	14.615	12.33	0	30.69
$LNINOV^2$	637	365.394	318.329	0	942.08
$LNINOV_{T-1}$	637	14.571	12.331	0	30.69
$(LNINOV_{T-1})^2$	637	364.147	318.201	0	942.08
FEMDIR	637	.746	.436	0	1
PERC FEMDIR	637	.167	.15	0	.75
FEMCOM	637	.465	.499	0	1
PERC FEMCOM	637	.117	.145	0	.667
FEMAUDITCOM	637	.509	.5	0	1
PERC FEMAUDITCOM	637	.192	.219	0	.75
FSIZE	637	30.987	1.823	25.221	35.114
FAGE	637	3.736	.528	1.946	4.844
PBV	637	1969.358	37747.679	-209808.92	909011.75
DER	637	31.516	52.669	-55.62	571.86
INFCP	637	4.791	2.456	1.56	13.109
INFGDP	637	6.271	4.68	-.402	18.15
GDPGR	637	4.726	2	-2.066	6.345
TR	637	10.691	1.251	8.31	13.311
TRADE	637	44.571	6.886	32.972	63.988

FEMDIR, a dummy variable for the presence of female directors, shows an average of 0.746, meaning approximately 74.6% of the banks in the sample have at least one female director. Furthermore, PERC_FEMDIR, which measures the percentage of female directors to total directors, has an average value of only 0.167 or 16.7%. This indicates that while women may be present on boards, they must still be proportionally represented. The FEMCOM variable averages 0.465 for commissioner positions, meaning 46.5% of banks have at least one female commissioner. As for PERC_FEMCOM, which shows the percentage of female commissioners, the average is only 11.7%, confirming that while women are represented, their numbers still need to be improved. In the context of audit committees, FEMAUDITCOM shows an average of 0.509, which means

about 50.9% of banks have women on their audit committees. However, the percentage of women on audit committees (PERC_FEMAUDITCOM) is still low, with an average of only 19.2%.

In this study, the multicollinearity test was conducted to ensure that the variables in the model did not show a high correlation, which could interfere with the accuracy of the model estimation (Table 3). This test uses the Variance Inflation Factor (VIF) indicator, where a VIF value of less than ten indicates the absence of significant multicollinearity. Based on the results recorded across all panels, the Mean VIF value for each variable in each panel ranges between 2.96 and 2.97, well below the threshold of 10. This indicates no significant multicollinearity problem among the variables tested in this model. Each panel shows consistency in low VIF values, indicating that the independent variables have an independent relationship in influencing the dependent variable tested. This confirms that the model used in this study is robust, with the independent variables providing valid and reliable explanations of the dependent variable without significant statistical distortion due to multicollinearity. In conclusion, with VIF values below 10, the model is suitable for further analysis to test the research hypotheses regarding the impact of banking innovation on stability in the banking sector.

In this study, correlation analysis between variables using Pearson coefficients provides an in-depth understanding of the prevailing relationship between banking stability and banking innovation. The results of the correlation test are displayed in Table 4. The correlation between CZSCORE values show a very weak and insignificant relationship with ZSCORE (-0.010, p=0.794). In the context of innovation, LNINOV has a significant positive correlation with CZSCORE (0.360, p<0.000), indicating that an increase in innovation is significantly associated with an increase in one form of bank stability measured. In particular, $LNINOV^2$ and $(LNINOV_{T-1})^2$, which represent the squared value of the most recent and previous year's innovations, show very high correlations with each other (0.990, p<0.000) and with LNINOV (0.990, p<0.000). The analysis also includes the variable $LNINOV_{T-1}$, which has a significant positive correlation with stability as measured by CZSCORE (0.285, p<0.000), illustrating how

innovations in the previous year still have a significant effect on the following year.

Table 3. Variance Inflation Factor

Panel 1: The Impact of Banking Innovation on Banking Stability (Dependent Variables - ZSCORE)							
Variable	VIF	Variable	VIF	Variable	VIF	Variable	VIF
TR	7.76	TR	7.78	TR	7.76	TR	7.78
TRADE	6.99	TRADE	6.97	TRADE	6.99	TRADE	6.97
INFCP	4.1	INFCP	4.10	INFCP	4.10	INFCP	4.1
INFGDP	2.7	INFGDP	2.69	INFGDP	2.70	INFGDP	2.69
GDPGR	2.08	GDPGR	2.08	GDPGR	2.08	GDPGR	2.08
FSIZE	1.42	FSIZE	1.41	FSIZE	1.44	FSIZE	1.43
FAGE	1.31	FAGE	1.31	FAGE	1.31	FAGE	1.31
DER	1.2	DER	1.20	DER	1.20	DER	1.2
LNINOV	1.12	$LNINOV_{T-1}$	1.06	$LNINOV^2$	1.14	$(LNINOV_{T-1})^2$	1.07
PBV	1.01	PBV	1.01	PBV	1.01	FEMDIR	1.01
Mean VIF	2.97	Mean VIF	2.96	Mean VIF	2.97	Mean VIF	2.96
Panel 2: The Impact of Banking Innovation on Banking Stability (Dependent Variables - CZSCORE)							
Variable	VIF	Variable	VIF	Variable	VIF	Variable	VIF
TR	7.76	TR	7.76	TR	7.78	TR	7.78
TRADE	6.99	TRADE	6.99	TRADE	6.97	TRADE	6.97
INFCP	4.1	INFCP	4.1	INFCP	4.1	INFCP	4.1
INFGDP	2.7	INFGDP	2.7	INFGDP	2.69	INFGDP	2.69
GDPGR	2.08	GDPGR	2.08	GDPGR	2.08	GDPGR	2.08
FSIZE	1.42	FSIZE	1.44	FSIZE	1.41	FSIZE	1.43
FAGE	1.31	FAGE	1.31	FAGE	1.31	FAGE	1.31
DER	1.2	DER	1.2	DER	1.2	DER	1.2
LNINOV	1.12	$LNINOV^2$	1.14	$LNINOV_{T-1}$	1.06	$(LNINOV_{T-1})^2$	1.07
PBV	1.01	PBV	1.01	PBV	1.01	FEMDIR	1.01
Mean VIF	2.97	Mean VIF	2.97	Mean VIF	2.96	Mean VIF	2.96

Table 4. Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) ZSCORE	1.000														
(2) CZSCORE	-0.010	1.000													
	(0.794)														
(3) LNINOV	0.103*	0.360*	1.000												
	(0.009)	(0.000)													
(4) $LNINOV^2$	0.092*	0.358*	0.990*	1.000											
	(0.020)	(0.000)	(0.000)												
(5) $LNINOV_{T-1}$	0.067	0.285*	0.842*	0.840*	1.000										
	(0.090)	(0.000)	(0.000)	(0.000)											
(6) $(LNINOV_{T-1})^2$	0.058	0.280*	0.835*	0.848*	0.990*	1.000									
	(0.144)	(0.000)	(0.000)	(0.000)	(0.000)										
(7) FSIZE	-0.056	0.088*	0.062	0.144*	0.050	0.123*	1.000								
	(0.157)	(0.026)	(0.121)	(0.000)	(0.209)	(0.002)									
(8) FAGE	-0.132*	0.072	0.015	0.056	0.001	0.038	0.477*	1.000							
	(0.001)	(0.070)	(0.702)	(0.158)	(0.974)	(0.342)	(0.000)								
(9) PBV	0.400*	0.023	0.041	0.036	0.032	0.028	-0.019	-0.046	1.000						
	(0.000)	(0.568)	(0.307)	(0.363)	(0.415)	(0.475)	(0.631)	(0.246)							
(10) DER	-0.004	-0.167*	-0.091*	-0.062	-0.058	-0.035	0.341*	0.222*	0.008	1.000					
	(0.924)	(0.000)	(0.022)	(0.120)	(0.141)	(0.379)	(0.000)	(0.000)	(0.833)						
(11) INFCP	-0.005	-0.749*	-0.280*	-0.278*	-0.183*	-0.179*	-0.037	-0.040	-0.025	0.167*	1.000				
	(0.897)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.354)	(0.317)	(0.522)	(0.000)					
(12) INFGDP	-0.014	-0.714*	-0.299*	-0.293*	-0.218*	-0.211*	-0.039	-0.033	-0.029	0.155*	0.681*	1.000			
	(0.716)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.330)	(0.403)	(0.469)	(0.000)	(0.000)				
(13) GDPGR	0.035	-0.267*	-0.157*	-0.159*	-0.148*	-0.148*	-0.043	-0.050	0.008	0.033	0.462*	0.509*	1.000		
	(0.376)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.283)	(0.207)	(0.839)	(0.403)	(0.000)	(0.000)			
(14) TR	-0.006	-0.703*	-0.277*	-0.275*	-0.211*	-0.207*	-0.033	-0.040	-0.016	0.158*	0.839*	0.736*	0.683*	1.000	
	(0.878)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.411)	(0.310)	(0.690)	(0.000)	(0.000)	(0.000)	(0.000)		
(15) TRADE	-0.008	-0.788*	-0.300*	-0.298*	-0.209*	-0.203*	-0.031	-0.042	-0.044	0.177*	0.827*	0.788*	0.620*	0.900*	1.000
	(0.839)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.441)	(0.292)	(0.268)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	

Table 4 presents the Pearson correlation coefficients between the variables used for hypothesis testing (p-values are in parentheses).

B. Multivariate Statistical Analysis

The Impact of Banking Innovation on Banking Stability

The following are the regression results to determine the impact of Banking Innovation on Banking Stability (regression results are presented in Table 5). Of the four models tested, LNINOV in model (a) shows a highly significant effect on ZSCORE with a coefficient of 2.055 and a t-statistic value of 3.10, indicating that direct innovation in the same period has a significant positive impact on banking stability at the 1% significance level ($p<0.01$). Model (b) examines the effect of the previous year's innovation ($LNINOV_{T-1}$) on the ZSCORE and shows a coefficient of 1.195 with a significance level of 10% ($p<0.1$), indicating that the effect of the previous year's innovation still persists and has a positive impact on banking stability, although with a lower strength than direct innovation. In model (c), the square of direct innovation ($LNINOV^2$) exerts a positive effect with a coefficient of 0.0764 and a significance level of 1% ($p<0.01$), indicating that increased innovation quadratically increases stability. Finally, model (d), which examines the square of the previous year's innovation ($(LNINOV_{T-1})^2$), yields a coefficient of 0.0435 with a significance level of 10% ($p<0.1$), providing evidence that the effect of the previous year's innovation on stability is significant in a quadratic way, although weaker than the direct effect. Each model has an adjusted R^2 value close to 0.17, indicating that about 17% of the variability in banking stability can be explained by the variables included in the model. The F-statistic in each model is close to 1.83 with a probability greater than 0.05, indicating that the model as a whole is significant.

Table 5 presents the results of a robust Ordinary Least Squares (OLS) regression analysis investigating the impact of banking innovation on banking stability. The analytical model employed in this study is an OLS regression model: $ZSCORE_{i,d} = \beta_0 + \beta_1 LNINOV_{i,d} + \beta_2 \varphi_{i,d} + \epsilon$, $ZSCORE_{i,d} = \beta_0 + \beta_1 LNINOV_{i,d}^2 + \beta_2 \varphi_{i,d} + \epsilon$, $ZSCORE_{i,d} = \beta_0 + \beta_1 (LNINOV_{t-1})_{i,d} + \beta_2 \varphi_{i,d} + \epsilon$, and $ZSCORE_{i,d} = \beta_0 + \beta_1 (LNINOV_{t-1})_{i,d}^2 + \beta_2 \varphi_{i,d} + \epsilon$. The variable $\varphi_{i,d}$ is a control variable consisting of Firm Size (FSIZE), Firm Age (FAGE), Price-to-Book

Value Ratio (PBV), Debt to Equity Ratio (DER), Inflation Consumer Price (INFCP), Inflation (INFGDP), GDP Growth (GDPGR), Tax Revenue (TR), and Trade (TRADE) The table includes regression coefficients and t-statistics $\left(\frac{b}{t_{stat}}\right)$. Robust regressions have been presented to account for heteroscedasticity and autocorrelation. The significance levels are denoted by ***, **, and *, corresponding to levels of 1%, 5%, and 10% respectively.

Table 5. Ordinary Least Squares (OLS) regression of the impact of banking innovation on banking stability (ZScore)

	Model (a) ZSCORE	Model (b) ZSCORE	Model (c) ZSCORE	Model (d) ZSCORE
LNINOV	2.055*** (3.10)			
$LNINOV_{T-1}$		1.195* (1.75)		
$LNINOV^2$			0.0764*** (3.10)	
$(LNINOV_{T-1})^2$				0.0435* (1.75)
FSIZE	-1.047 (-0.58)	-0.501 (-0.29)	-2.094 (-1.11)	-1.029 (-0.60)
FAGE	-56.50*** (-2.92)	-56.63*** (-2.90)	-56.63*** (-2.92)	-56.74*** (-2.90)
PBV	0.00267*** (2.92)	0.00268*** (2.90)	0.00268*** (2.92)	0.00268*** (2.90)
DER	0.142 (1.30)	0.126 (1.18)	0.141 (1.30)	0.126 (1.18)
INFCP	3.889 (0.59)	3.050 (0.47)	3.849 (0.58)	3.075 (0.47)
INFGDP	-0.664 (-0.18)	-1.088 (-0.30)	-0.768 (-0.21)	-1.145 (-0.31)
GDPGR	7.730* (1.70)	8.315* (1.79)	7.788* (1.71)	8.349* (1.79)
TR	-20.02 (-1.32)	-18.85 (-1.28)	-20.03 (-1.32)	-18.95 (-1.29)
TRADE	2.154 (0.76)	1.701 (0.60)	2.151 (0.76)	1.690 (0.60)
_CONS	305.1* (1.82)	313.4* (1.87)	341.0* (1.96)	333.3* (1.93)
N	637	637	637	637
R^2-Adj	0.171	0.166	0.170	0.165
F-Statistics	1.825	1.840	1.821	1.833
Prob > F	0.0533	0.0509	0.0539	0.0519

In this study, a regression analysis is employed to assess the effect of banking innovation on banking stability, with CZSCORE serving as a proxy variable. CZSCORE, which is an alternative to the traditional Z-score provided by the World Bank, is a more general and global measure of banking stability. The four analytical models demonstrate robust statistical significance in forecasting banking stability based on innovations occurring in the current period and the previous year. The initial model (a) demonstrates that direct banking innovation (LNINOV) exerts a markedly positive influence on CZSCORE, with a coefficient of 0.00479 and a t-statistic of 4.44, and a statistical significance level below 0.01. This indicates that banking innovation can directly and significantly enhance banking stability. The model demonstrates an R2-Adj value of 0.755, which indicates that it is able to explain approximately 75.5% of the observed variability in banking stability. The second model (b) demonstrates that banking innovation from the previous year ($LNINOV_{T-1}$) also exerts a positive and significant influence on CZSCORE, with a coefficient of 0.00565 and a t-statistic of 5.47. This corroborates the notion that the impact of sustained innovation on banking stability is both substantial and enduring. The third model (c) demonstrates that the square of current banking innovation ($LNINOV^2$) exerts a positive influence, albeit with a smaller coefficient of 0.000182. Nevertheless, the influence remains significant, as evidenced by a t-statistic of 4.35. The fourth model (d) examines the impact of the preceding year's banking innovation $(LNINOV_{T-1})^2$. This yields a coefficient of 0.000212 with a t-statistic of 5.30, thereby confirming that the cumulative effect of the previous year's innovation on banking stability continues to grow quadratically.

Table 6 presents the results of a robust Ordinary Least Squares (OLS) regression analysis investigating the impact of banking innovation on banking stability. The analytical model employed in this study is an OLS regression model: $CZSCORE_{i,d} = \beta_0 + \beta_1 LNINOV_{i,d} + \beta_2 \varphi_{i,d} + \epsilon$, $CZSCORE_{i,d} = \beta_0 + \beta_1 LNINOV_{i,d}^2 + \beta_2 \varphi_{i,d} + \epsilon$, $CZSCORE_{i,d} = \beta_0 + \beta_1 (LNINOV_{t-1})_{i,d} + \beta_2 \varphi_{i,d} + \epsilon$, and $CZSCORE_{i,d} = \beta_0 + \beta_1 (LNINOV_{t-1})_{i,d}^2 + \beta_2 \varphi_{i,d} + \epsilon$. The variable $\varphi_{i,d}$ is a control variable consisting of Firm Size (FSIZE), Firm Age (FAGE), Price-to-Book Value Ratio (PBV), Debt to Equity Ratio (DER), Inflation Consumer Price (INFCP), Inflation (INFGDP), GDP Growth (GDPGR), Tax Revenue (TR),

and Trade (TRADE) The table includes regression coefficients and t-statistics $\left(\frac{b}{t_{stat}}\right)$. Robust regressions have been presented to account for heteroscedasticity and autocorrelation. The significance levels are denoted by ***, **, and *, corresponding to levels of 1%, 5%, and 10% respectively."

Table 6. Ordinary Least Squares (OLS) regression of the impact of banking innovation on banking stability (CZScore)

	Model (a) CZSCORE	Model (b) CZSCORE	Model (c) CZSCORE	Model (d) CZSCORE
LNINOV	0.00479*** (4.44)			
$LNINOV_{T-1}$		0.00565*** (5.47)		
$LNINOV^2$			0.000182*** (4.35)	
$(LNINOV_{T-1})^2$				0.000212*** (5.30)
FSIZE	0.0186** (2.27)	0.0185** (2.25)	0.0160* (1.93)	0.0158* (1.89)
FAGE	0.0253 (0.92)	0.0271 (1.00)	0.0251 (0.91)	0.0267 (0.99)
PBV	-0.000000322*** (-2.60)	-0.000000327*** (-2.99)	-0.000000318** (-2.58)	-0.000000322*** (-2.94)
DER	-0.000155 (-0.68)	-0.000165 (-0.73)	-0.000155 (-0.68)	-0.000161 (-0.71)
INFCP	-0.0484*** (-4.08)	-0.0506*** (-4.28)	-0.0484*** (-4.08)	-0.0505*** (-4.27)
INFGDP	-0.0295*** (-6.72)	-0.0295*** (-6.94)	-0.0297*** (-6.79)	-0.0298*** (-7.00)
GDPGR	0.111*** (17.56)	0.112*** (17.91)	0.111*** (17.54)	0.112*** (17.88)
TR	-0.0343 (-0.97)	-0.0284 (-0.82)	-0.0343 (-0.97)	-0.0287 (-0.83)
TRADE	-0.0510*** (-12.82)	-0.0520*** (-13.47)	-0.0510*** (-12.82)	-0.0521*** (-13.46)
_CONS	6.515*** (20.67)	6.486*** (20.74)	6.599*** (20.94)	6.580*** (20.97)
N	637	637	637	637
R^2-Adj	0.755	0.759	0.754	0.758
F-Statistics	383.5	414.7	384.4	414.2
Prob > F	0.000	0.000	0.000	0.000

The Role of Gender Diversity

In order to evaluate the impact of gender diversity on the bank stability of banking institutions, the regression results demonstrate a number of significant findings (see Table 7). Firstly, the proportion of female directors (PERC_FEMDIR) has a positive effect on CZSCORE, indicating that the presence of more women on boards of directors correlates with increased banking stability. This could imply that female directors contribute a distinctive perspective that can reinforce strategic decision-making, mitigate risks, and advance superior governance practices.

Table 7 summarises the regression results presented in Appendices 1 to 6. Appendices 1-6 are summarised in Model (1) and Model (2). Model (1) and Model (2) are regressions that investigate the direct effect of gender diversity on banking stability.

Table 7. Summary of the OLS Regression of the direct effect of gender diversity on banking stability

	Model (1) ZSCORE	Model (2) CZSCORE
FEMDIR	No Sig (+/-)	No Sig (+/-)
PERC_FEMDIR	No Sig (+/-)	Sig (+)
FEMCOM	No Sig (-)	No Sig (+)
PERC_FEMCOM	No Sig (-)	No Sig (+)
FEMAUDITCOM	No Sig (-)	No Sig (+/-)
PERC_FEMAUDITCOM	No Sig (+/-)	No Sig (-)

Description: Sig = regression results are statistically significant, No Sig = regression results are not statistically significant, (+) = the direction of the relationship between the independent and dependent variables is positive, while (-) = the direction of the relationship between the independent and dependent variables is negative.

The application of regression analysis to the investigation of the moderating effect of gender diversity on the relationship between banking innovation and banking stability provides valuable insights into firms'

internal dynamics and policies. There is a negative relationship between banking innovation and stability when the ZSCORE proxy is used (see Table 10). This is because of the gender diversity variables that were looked at: Female Director (FEMDIR), Percentage of Female Directors (PERC_FEMDIR); Female Commissionaire (FEMCOM); Percentage of Female Commissionaire (PERC_FEMCOM); Female Audit Committee (FEMAUDITCOM); and Percentage of Female Audit Committee (PERC_FEMAUDITCOM). This negative effect indicates that the presence of gender diversity in key positions may introduce different perspectives or approaches to managing innovation, which may impede the adoption or integration of such innovations in day-to-day banking operations. This may be indicative of the influence of potential discrepancies in risk tolerance between genders, or alternatively, the impact of evolving group dynamics resulting from increased diversity, which could subsequently influence strategic decision-making and policy implementation. In the context of banking stability as measured by the CZSCORE proxy, the moderation of Female Director (FEMDIR) is the only variable that significantly weakens the relationship between banking innovation and banking stability. The presence of female directors on boards may engender a more conservative or disparate approach to risk-taking, which could constrain the manner in which banking innovation is leveraged to enhance stability. This indicates that the presence of female directors, in particular, exerts a more pronounced influence in this moderation, whereas the effects of other proxies for gender diversity do not demonstrate the same degree of significance.

Table 8 presents a summary of the regression results presented in Appendices 1 to 6. Models (1) and (2) in the aforementioned table evaluates the effect of banking innovation on banking stability by considering the moderation of gender diversity. These models demonstrate the significant impact of gender diversity in decision-making and innovation strategies on the financial stability of banks.

Table 8. Summary of the regression of the effect of banking innovation on banking stability by considering the moderation of gender diversity

	Model (1) ZSCORE	Model (2) CZSCORE
LNINOV×FEMDIR	Sig (-)	Sig (-)
$LNINOV_{T-1}$×FEMDIR	Sig (-)	Sig (-)
$LNINOV^2$×FEMDIR	Sig (-)	Sig (-)
$(LNINOV_{T-1})^2$×FEMDIR	Sig (-)	Sig (-)
LNINOV×PERC_FEMDIR	Sig (-)	No Sig (-)
$LNINOV_{T-1}$× PERC_FEMDIR	Sig (-)	No Sig (-)
$LNINOV^2$× PERC_FEMDIR	Sig (-)	No Sig (-)
$(LNINOV_{T-1})^2$× PERC_FEMDIR	Sig (-)	No Sig (-)
LNINOV×FEMCOM	Sig (-)	No Sig (-)
$LNINOV_{T-1}$×FEMCOM	No Sig (-)	No Sig (-)
$LNINOV^2$×FEMCOM	Sig (-)	No Sig (-)
$(LNINOV_{T-1})^2$×FEMCOM	No Sig (-)	No Sig (-)
LNINOV×PERC_FEMCOM	Sig (-)	No Sig (-)
$LNINOV_{T-1}$×PERC_FEMCOM	No Sig (-)	No Sig (-)
$LNINOV^2$×PERC_FEMCOM	Sig (-)	No Sig (-)
$(LNINOV_{T-1})^2$×PERC_FEMCOM	No Sig (-)	No Sig (-)
LNINOV×FEMAUDITCOM	Sig (-)	No Sig (-)
$LNINOV_{T-1}$×FEMAUDITCOM	Sig (-)	No Sig (-)
$LNINOV^2$×FEMAUDITCOM	Sig (-)	No Sig (-)
$(LNINOV_{T-1})^2$×FEMAUDITCOM	Sig (-)	No Sig (-)
LNINOV×PERC_FEMAUDITCOM	Sig (-)	No Sig (+)
$LNINOV_{T-1}$×PERC_FEMAUDITCOM	Sig (-)	No Sig (+)
$LNINOV^2$×PERC_FEMAUDITCOM	Sig (-)	No Sig (-)
$(LNINOV_{T-1})^2$×PERC_FEMAUDITCOM	Sig (-)	No Sig (-)

Description: Sig = regression results are statistically significant, No Sig = regression results are not statistically significant, (+) = the direction of the relationship between the independent and dependent variables is positive, while (-) = the direction of the relationship between the independent and dependent variables is negative.

Discussion and Additional Analysis

The regression analysis results show that all proxies of banking innovation, including LNINOV, $LNINOV_{T-1}$, $LNINOV^2$, and $(LNINOV_{T-1})^2$, have a positive influence on banking stability, as measured using ZSCORE and CZSCORE proxies. This positive effect indicates that innovations in the banking sector, which often involve the introduction of new technologies and processes, contribute to improving banks' financial performance and resilience. The success of these innovations in improving banking stability can be seen as a reflection of better operational efficiency and more effective risk management. As Babenko (2021) asserts, financial innovation facilitates the development of novel business models, procedures, and products that exert a profound influence on financial markets and institutions. This is consistent with the findings of Verma & Chakarwarty (2023), who determined that interbank competition has a positive impact on financial stability, enabling banks to enhance their financial resilience. This research suggests that the implementation of appropriately selected innovations, which take into account the development stage and financial stability of the bank, as emphasised by Kolodiziev et al. (2016), can provide significant benefits. Furthermore, Lu (2018) posited that financial product innovation is associated with increased revenue, better risk management, and stronger market constraints for commercial banks. This, in turn, brings a wider spectrum of financial risks and enhanced risk management capabilities.

The finding that gender diversity negatively moderates the impact of banking innovation on banking stability raises some important questions. This differs significantly from previous literature that often shows a positive effect of gender diversity on firm performance. For example, many studies have indicated that gender diversity at the board level can improve the quality of decision making by broadening perspectives and enhancing creative problem solving which in turn can strengthen firm stability and performance (Boukattaya & Omri, 2018; Duppati et al., 2020; Sanan, 2016). However, this finding implies that in the context of banking innovation, increased gender diversity may not necessarily result in more stable decisions. Factors that could explain this contradiction include differences

in the types of innovations implemented or in the market dynamics in which the bank operates. Perhaps, in some cases, gender diversity can introduce different perspectives which, while enriching the discussion, can also slow down decision-making or result in less cohesive decisions in the short term. Gender diversity can be more effective in stable environments where time to formulate decisions is not so critical, compared to highly dynamic and competitive environments such as innovation banking. In addition, the negative effect of gender diversity on banking stability may suggest that there are problems in the effective integration of female board members in managing innovation and its associated risks. This may reflect the need for better training and support to utilise the full potential of gender diversity in strategic decision-making.

Additional analyses in this study adopt a segmentation approach to gain a more detailed understanding of the effect of banking innovation on banking stability. This is achieved by utilising variables such as ownership (state-owned enterprise (SOE) vs non-SOE) and firm size and age. This approach generates four quadrants based on a combination of asset size and firm age, as measured by the natural logarithm of asset value and age (see Figure 1). The first quadrant comprises companies with substantial assets and a mature age, indicating long-established organisations with considerable assets. The quadrant includes 17 companies that may demonstrate stability and resilience in the context of market fluctuations due to their extensive experience and resources. In contrast, Quadrant 2, which comprises companies with substantial assets but a relatively young age, includes only two companies. This group may exhibit different dynamics, potentially due to the combination of large assets and the relative youth of the company, which may not yet have fully developed risk management policies. Quadrant 3 contains companies with small assets and young age, totalling 19 companies, indicating these companies may be more vulnerable to instability due to lack of resources and experience. Finally, Quadrant 4 involves companies with large assets and young age, totalling 8 companies.

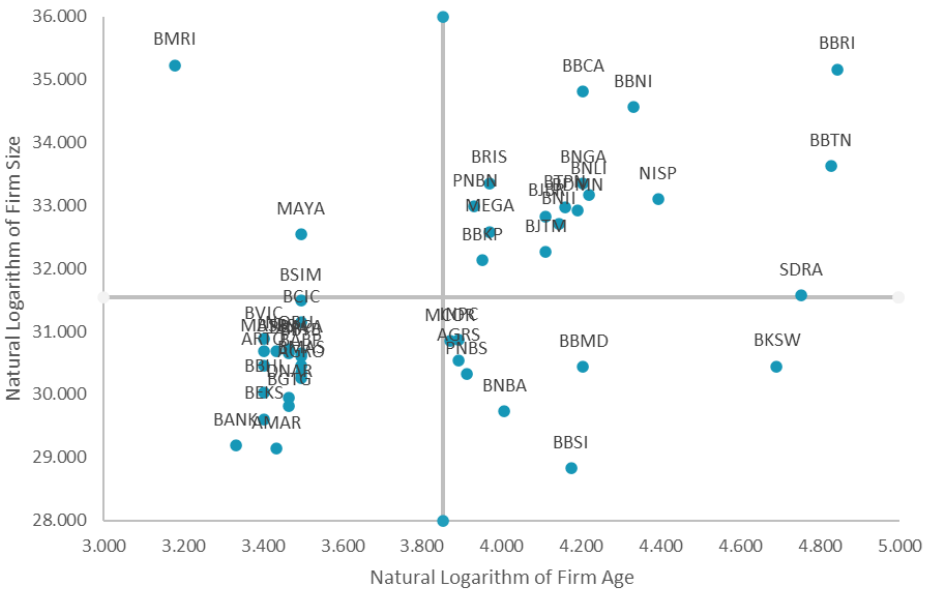

Figure 1. Quadrants for Firm Age and Firm Size

The additional analysis revealed that the impact of banking innovation on banking stability differs between SOEs and non-SOEs, highlighting the intricate dynamics within the banking sector. As evidenced by the regression results presented in Table 9, there is no statistically significant correlation between banking innovation and banking stability in SOE firms. It may be inferred that, despite innovations, SOE firms may have more stringent structures and regulations that may restrict the full efficacy of such innovations. Furthermore, these firms may encounter bureaucratic impediments or be required to adhere to more stringent government policies, which could diminish their agility and responsiveness to innovation. In contrast, the results in Table 10 demonstrate that innovation has a positive impact on banking stability in non-state-owned enterprises. This indicates that non-SOE firms may be more agile and capable of adopting and implementing innovations with greater efficacy. They may have fewer regulatory and structural constraints, allowing them to be more responsive in utilising new technologies to enhance operational efficiency and financial stability.

Table 9 presents the results of a robust Ordinary Least Squares (OLS) regression analysis investigating the impact of banking innovation on banking stability in State-Owned Banking Companies. The analytical model employed in this study is an OLS regression model: $\mathrm{ZSCORE}_{i,d} = \beta_0 +$

Table 9. Ordinary Least Squares (OLS) regression analysis of the impact of banking innovation on banking stability in State-Owned Banking Companies

	(1) ZSCORE	(2) ZSCORE	(3) ZSCORE	(4) ZSCORE	(5) CZSCORE	(6) CZSCORE	(7) CZSCORE	(8) CZSCORE
LNINOV	-0.000797				-0.000805			
	(-0.54)				(-0.23)			
$LNINOV_{T-1}$		-0.00191				-0.0000750		
		(-1.23)				(-0.02)		
$LNINOV^2$			-0.0000246				-0.0000250	
			(-0.48)				(-0.21)	
$(LNINOV_{T-1})^2$				-0.0000603				0.000000901
				(-1.11)				(0.01)
FSIZE	0.210***	0.220***	0.210***	0.219***	0.281***	0.275***	0.280***	0.274***
	(4.06)	(4.19)	(4.04)	(4.13)	(4.25)	(3.72)	(4.20)	(3.65)
FAGE	0.0304*	0.0300	0.0307*	0.0305*	0.121**	0.123***	0.121**	0.123***
	(1.70)	(1.66)	(1.73)	(1.70)	(2.54)	(2.66)	(2.58)	(2.67)
PBV	0.0561***	0.0495***	0.0564***	0.0505***	-0.0343	-0.0308	-0.0339	-0.0303
	(3.17)	(2.74)	(3.17)	(2.80)	(-1.15)	(-1.01)	(-1.13)	(-0.97)
DER	-0.000701**	-0.000738**	-0.000697**	-0.000733**	0.000677	0.000707	0.000680	0.000710
	(-2.35)	(-2.58)	(-2.33)	(-2.54)	(1.32)	(1.42)	(1.33)	(1.42)
INFCP	0.00728	0.0100	0.00720	0.00949	0.0220	0.0212	0.0219	0.0211
	(0.59)	(0.77)	(0.59)	(0.73)	(0.84)	(0.80)	(0.84)	(0.80)
INFGDP	0.00391	0.00263	0.00398	0.00296	-0.0367***	-0.0363***	-0.0366***	-0.0362***
	(0.68)	(0.43)	(0.69)	(0.49)	(-3.26)	(-3.15)	(-3.26)	(-3.18)
GDPGR	0.0154	0.0158	0.0153	0.0155	0.121***	0.121***	0.121***	0.121***
	(1.61)	(1.62)	(1.60)	(1.60)	(6.50)	(6.49)	(6.51)	(6.50)
TR	-0.00320	-0.0159	-0.00313	-0.0135	-0.132*	-0.132*	-0.132*	-0.132*
	(-0.09)	(-0.47)	(-0.09)	(-0.40)	(-1.92)	(-1.76)	(-1.92)	(-1.78)
TRADE	0.00536	0.00772	0.00535	0.00724	-0.0356***	-0.0355***	-0.0356***	-0.0356***
	(0.98)	(1.32)	(0.98)	(1.24)	(-4.28)	(-3.41)	(-4.28)	(-3.56)
_CONS	-7.191***	-7.470***	-7.173***	-7.437***	-2.665	-2.506	-2.648	-2.482
	(-3.80)	(-3.90)	(-3.78)	(-3.85)	(-1.06)	(-0.91)	(-1.04)	(-0.89)
N	72	72	72	72	72	72	72	72
R^2-Adj	0.781	0.784	0.780	0.783	0.828	0.828	0.828	0.828
F-Statistics	15.09	15.65	15.09	15.44	95.21	99.28	95.78	97.60
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

$\beta_1 \mathrm{LNINOV}_{i,d} + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d}^2 + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d} + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d}^2 + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{CZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d} + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{CZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d}^2 + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{CZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d} + \beta_2 \varphi_{i,d} + \epsilon$,and $\mathrm{ZCSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d}^2 + \beta_2 \varphi_{i,d} + \epsilon$. The variable $\varphi_{i,d}$ is a control variable consisting of Firm Size (FSIZE), Firm Age (FAGE), Price-to-Book Value Ratio (PBV), Debt to Equity Ratio (DER), Inflation Consumer Price (INFCP), Inflation (INFGDP), GDP Growth (GDPGR), Tax Revenue (TR), and Trade (TRADE) The table includes regression coefficients and t-statistics $\left(\frac{b}{t_{stat}}\right)$. Robust regressions have been presented to account for heteroscedasticity and autocorrelation. The significance levels are denoted by ***, **, and *, corresponding to levels of 1%, 5%, and 10% respectively.

Table 10 presents the results of a robust Ordinary Least Squares (OLS) regression analysis investigating the impact of banking innovation on banking stability in Non State-Owned Banking Companies. The analytical model employed in this study is an OLS regression model: $\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d} + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d}^2 + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d} + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d}^2 + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{CZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d} + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{CZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d}^2 + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{CZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d} + \beta_2 \varphi_{i,d} + \epsilon$,and $\mathrm{ZCSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d}^2 + \beta_2 \varphi_{i,d} + \epsilon$. The variable $\varphi_{i,d}$ is a control variable consisting of Firm Size (FSIZE), Firm Age (FAGE), Price-to-Book Value Ratio (PBV), Debt to Equity Ratio (DER), Inflation Consumer Price (INFCP), Inflation (INFGDP), GDP Growth (GDPGR), Tax Revenue (TR), and Trade (TRADE) The table includes regression coefficients and t-statistics $\left(\frac{b}{t_{stat}}\right)$. Robust regressions have been presented to account for heteroscedasticity and autocorrelation. The significance levels are denoted by ***, **, and *, corresponding to levels of 1%, 5%, and 10% respectively.

Table 10. Ordinary Least Squares (OLS) regression analysis of the impact of banking innovation on banking stability in Non State-Owned Banking Companies

	(1) ZSCORE	(2) ZSCORE	(3) ZSCORE	(4) ZSCORE	(5) CZSCORE	(6) CZSCORE	(7) CZSCORE	(8) CZSCORE
LNINOV	2.679***				0.00485***			
	(3.08)				(4.10)			
$LNINOV_{T-1}$		1.612*				0.00560***		
		(1.91)				(4.98)		
$LNINOV^2$			0.104***				0.000190***	
			(3.08)				(4.03)	
$(LNINOV_{T-1})^2$				0.0613*				0.000215***
				(1.93)				(4.84)
FSIZE	6.817**	6.820**	5.540*	6.184*	0.0297***	0.0295***	0.0273***	0.0273**
	(1.97)	(1.99)	(1.74)	(1.88)	(2.87)	(2.80)	(2.63)	(2.57)
FAGE	-110.0***	-105.2***	-110.7***	-105.5***	0.0137	0.0159	0.0123	0.0146
	(-3.05)	(-3.05)	(-3.05)	(-3.05)	(0.38)	(0.44)	(0.34)	(0.41)
PBV	0.00264***	0.00265***	0.00264***	0.00265***	-0.000000329***	-0.000000326***	-0.000000326***	-0.000000322***
	(2.93)	(2.90)	(2.93)	(2.90)	(-2.61)	(-2.92)	(-2.60)	(-2.88)
DER	0.253	0.287	0.244	0.283	-0.000733*	-0.000775*	-0.000750*	-0.000790*
	(1.11)	(1.23)	(1.08)	(1.22)	(-1.68)	(-1.79)	(-1.71)	(-1.82)
INFCP	5.138	4.119	5.144	4.139	-0.0575***	-0.0591***	-0.0575***	-0.0590***
	(0.67)	(0.54)	(0.67)	(0.54)	(-4.40)	(-4.55)	(-4.40)	(-4.53)
INFGDP	-0.487	-1.081	-0.604	-1.139	-0.0289***	-0.0293***	-0.0291***	-0.0295***
	(-0.12)	(-0.26)	(-0.15)	(-0.28)	(-6.27)	(-6.50)	(-6.34)	(-6.56)
GDPGR	8.117	8.921*	8.169	8.974*	0.111***	0.112***	0.111***	0.112***
	(1.61)	(1.73)	(1.61)	(1.73)	(16.60)	(16.92)	(16.60)	(16.90)
TR	-22.98	-23.00	-22.96	-23.01	-0.0185	-0.0186	-0.0185	-0.0187
	(-1.28)	(-1.28)	(-1.28)	(-1.28)	(-0.48)	(-0.49)	(-0.48)	(-0.49)
TRADE	2.497	2.218	2.505	2.184	-0.0517***	-0.0516***	-0.0517***	-0.0517***
	(0.74)	(0.65)	(0.74)	(0.64)	(-11.74)	(-11.93)	(-11.74)	(-11.95)
_CONS	257.1	272.1	300.6	296.1	6.138***	6.125***	6.217***	6.208***
	(1.35)	(1.44)	(1.54)	(1.53)	(17.04)	(17.14)	(17.31)	(17.35)
N	565	565	565	565	565	565	565	565
R^2-*Adj*	0.181	0.173	0.180	0.173	0.749	0.753	0.749	0.752
F-Statistics	1.874	1.873	1.871	1.869	290.9	306.6	292.0	307.1
Prob > F	0.0462	0.0463	0.0467	0.0469	0.000	0.000	0.000	0.000

Additional analyses aimed at assessing the effect of innovation on banking stability in different financial quadrants provide deeper insights into the internal and external dynamics affecting the banking sector. Results from Quadrant 1, which includes banking firms with large assets and mature age, show that innovation has a significant positive influence on banking stability at the national level as measured through the CZSCORE proxy. However, there is no significant effect on the ZSCORE proxy that measures stability at the firm level, as noted in Table 11. This could be because large firms with mature structures may be more integrated in the national financial system, so the innovations they implement have a wider impact. In Quadrant 2, which consists of banking firms with large assets but young age, it is found that innovation plays an important role in improving banking stability at the firm level, as seen from the positive significance on the ZSCORE proxy. Meanwhile, the effect is not significant at the national level (CZSCORE), as reported in Table 12. This suggests that young firms with large assets may be more dynamic and able to implement innovations that directly affect their internal operations without unduly affecting the wider external environment. Quadrant 3 includes banking companies with small assets and young age, and the results show that innovation has a significant positive impact on their stability, as noted in Table 13. This could indicate that small and young companies are more aggressive in adopting new technologies and innovative processes to enhance their stability in the face of market competition. Finally, Quadrant 4, which involves banking firms with large assets and young age, shows that innovation has a significant positive influence on banking stability at the national level (CZSCORE), but not at the firm level (ZSCORE), as noted in Table 14. This indicates that while innovation in these firms affects banking stability at a broader level, they may not have fully translated the benefits into their internal operations or financial performance directly.

Table 11 presents the results of a robust Ordinary Least Squares (OLS) regression analysis investigating the impact of banking innovations on banking stability in large asset and mature Banking Firms (Quadrant 1). The analytical model employed in this study is an OLS regression model: $\mathrm{ZSCORE}_{\mathrm{i,d}} = \beta_0 + \beta_1 \mathrm{LNINOV}_{\mathrm{i,d}} + \beta_2 \varphi_{\mathrm{i,d}} + \epsilon$, $\mathrm{ZSCORE}_{\mathrm{i,d}} = \beta_0 + \beta_1 \mathrm{LNINOV}^2_{\mathrm{i,d}} + \beta_2 \varphi_{\mathrm{i,d}} + \epsilon$,

$ZSCORE_{i,d} = \beta_0 + \beta_1(LNINOV_{t-1})_{i,d} + \beta_2\varphi_{i,d} + \epsilon$, $ZSCORE_{i,d} = \beta_0 + \beta_1(LNINOV_{t-1})^2_{i,d} + \beta_2\varphi_{i,d} + \epsilon$, $CZSCORE_{i,d} = \beta_0 + \beta_1 LNINOV_{i,d} + \beta_2\varphi_{i,d} + \epsilon$, $CZSCORE_{i,d} = \beta_0 + \beta_1 LNINOV^2_{i,d} + \beta_2\varphi_{i,d} + \epsilon$, $CZSCORE_{i,d} = \beta_0 + \beta_1(LNINOV_{t-1})_{i,d} + \beta_2\varphi_{i,d} + \epsilon$,and $ZCSCORE_{i,d} = \beta_0 + \beta_1(LNINOV_{t-1})^2_{i,d} + \beta_2\varphi_{i,d} + \epsilon$. The variable $\varphi_{i,d}$ is a control variable consisting of Firm Size (FSIZE), Firm Age (FAGE), Price-to-Book Value Ratio (PBV), Debt to Equity Ratio (DER), Inflation Consumer Price (INFCP), Inflation (INFGDP), GDP Growth (GDPGR), Tax Revenue (TR), and Trade (TRADE). The table includes regression coefficients and t-statistics $\left(\frac{b}{t_{stat}}\right)$. Robust regressions have been presented to account for heteroscedasticity and autocorrelation. The significance levels are denoted by ***, **, and *, corresponding to levels of 1%, 5%, and 10% respectively.

"This table presents the results of a robust Ordinary Least Squares (OLS) regression analysis investigating the impact of banking innovations on banking stability in large asset and young Banking Firms (Quadrant 2). The analytical model employed in this study is an OLS regression model: $ZSCORE_{i,d} = \beta_0 + \beta_1 LNINOV_{i,d} + \beta_2\varphi_{i,d} + \epsilon$, $ZSCORE_{i,d} = \beta_0 + \beta_1 LNINOV^2_{i,d} + \beta_2\varphi_{i,d} + \epsilon$, $ZSCORE_{i,d} = \beta_0 + \beta_1(LNINOV_{t-1})_{i,d} + \beta_2\varphi_{i,d} + \epsilon$, $ZSCORE_{i,d} = \beta_0 + \beta_1(LNINOV_{t-1})^2_{i,d} + \beta_2\varphi_{i,d} + \epsilon$, $CZSCORE_{i,d} = \beta_0 + \beta_1 LNINOV_{i,d} + \beta_2\varphi_{i,d} + \epsilon$, $CZSCORE_{i,d} = \beta_0 + \beta_1 LNINOV^2_{i,d} + \beta_2\varphi_{i,d} + \epsilon$, $CZSCORE_{i,d} = \beta_0 + \beta_1(LNINOV_{t-1})_{i,d} + \beta_2\varphi_{i,d} + \epsilon$,and $ZCSCORE_{i,d} = \beta_0 + \beta_1(LNINOV_{t-1})^2_{i,d} + \beta_2\varphi_{i,d} + \epsilon$. The variable $\varphi_{i,d}$ is a control variable consisting of Firm Size (FSIZE), Firm Age (FAGE), Price-to-Book Value Ratio (PBV), Debt to Equity Ratio (DER), Inflation Consumer Price (INFCP), Inflation (INFGDP), GDP Growth (GDPGR), Tax Revenue (TR), and Trade (TRADE). The table includes regression coefficients and t-statistics $\left(\frac{b}{t_{stat}}\right)$. Robust regressions have been presented to account for heteroscedasticity and autocorrelation. The significance levels are denoted by ***, **, and *, corresponding to levels of 1%, 5%, and 10% respectively."

Table 11. Ordinary Least Squares (OLS) regression analysis of the impact of banking innovations on banking stability in large asset and mature Banking Firms (Quadrant 1)

	(1) ZSCORE	(2) ZSCORE	(3) ZSCORE	(4) ZSCORE	(5) CZSCORE	(6) CZSCORE	(7) CZSCORE	(8) CZSCORE
LNINOV	0.000998				0.00289**			
	(1.26)				(1.97)			
$LNINOV_{T-1}$		0.000731				0.00406***		
		(0.94)				(2.85)		
$LNINOV^2$			0.0000404				0.000114**	
			(1.40)				(2.11)	
$(LNINOV_{T-1})^2$				0.0000293				0.000155***
				(1.03)				(2.94)
FSIZE	0.0657***	0.0660***	0.0654***	0.0658***	0.0780***	0.0772***	0.0772***	0.0762***
	(6.62)	(6.66)	(6.60)	(6.64)	(4.89)	(4.91)	(4.84)	(4.84)
FAGE	0.0422	0.0397	0.0414	0.0391	0.0453	0.0549	0.0426	0.0502
	(1.27)	(1.20)	(1.26)	(1.19)	(0.75)	(0.93)	(0.71)	(0.86)
PBV	0.00353	0.00355	0.00354	0.00356	-0.00664***	-0.00669***	-0.00661***	-0.00658***
	(0.90)	(0.92)	(0.90)	(0.92)	(-2.90)	(-2.95)	(-2.92)	(-2.94)
DER	-0.00220***	-0.00220***	-0.00220***	-0.00220***	0.000446	0.000401	0.000451	0.000415
	(-12.87)	(-12.79)	(-12.87)	(-12.79)	(1.48)	(1.33)	(1.50)	(1.38)
INFCP	0.00533	0.00492	0.00529	0.00492	-0.00492	-0.00735	-0.00502	-0.00720
	(0.79)	(0.72)	(0.78)	(0.72)	(-0.35)	(-0.53)	(-0.36)	(-0.52)
INFGDP	-0.00444	-0.00467	-0.00442	-0.00466	-0.0340***	-0.0336***	-0.0340***	-0.0337***
	(-0.95)	(-1.00)	(-0.94)	(-1.00)	(-5.57)	(-5.64)	(-5.59)	(-5.68)
GDPGR	0.00849	0.00884	0.00851	0.00887	0.112***	0.113***	0.112***	0.113***
	(0.96)	(1.00)	(0.97)	(1.01)	(12.68)	(12.83)	(12.67)	(12.81)
TR	-0.0316	-0.0300	-0.0315	-0.0299	-0.0988**	-0.0874**	-0.0986**	-0.0874**
	(-1.43)	(-1.33)	(-1.43)	(-1.33)	(-2.42)	(-2.12)	(-2.42)	(-2.13)
TRADE	0.00495	0.00466	0.00498	0.00466	-0.0466***	-0.0480***	-0.0466***	-0.0479***
	(1.55)	(1.46)	(1.56)	(1.46)	(-9.27)	(-9.61)	(-9.27)	(-9.64)
_CONS	-1.665***	-1.663***	-1.656***	-1.656***	4.776***	4.693***	4.804***	4.738***
	(-4.18)	(-4.16)	(-4.17)	(-4.15)	(7.20)	(7.08)	(7.27)	(7.18)
N	291	291	291	291	291	291	291	291
R^2-Adj	0.391	0.390	0.391	0.390	0.793	0.797	0.794	0.797
F-Statistics	24.48	23.92	24.53	24.00	307.3	314.3	307.6	315.4
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 12. Ordinary Least Squares (OLS) regression analysis of the impact of banking innovations on banking stability in large asset and young Banking Firms (Quadrant 2)

	(1) ZSCORE	(2) ZSCORE	(3) ZSCORE	(4) ZSCORE	(5) CZSCORE	(6) CZSCORE	(7) CZSCORE	(8) CZSCORE
LNINOV	0.0110***				-0.00783			
	(5.14)				(-1.54)			
$LNINOV_{T-1}$		0.00988***				-0.00262		
		(4.54)				(-0.58)		
$LNINOV^2$			0.000394***				-0.000263	
			(5.32)				(-1.50)	
$(LNINOV_{T-1})^2$				0.000351***				-0.0000867
				(4.63)				(-0.56)
FSIZE	-0.0820***	-0.0717***	-0.0833***	-0.0723***	0.296***	0.260***	0.293***	0.259***
	(-4.34)	(-3.16)	(-4.35)	(-3.22)	(9.34)	(7.30)	(9.24)	(7.30)
FAGE	-0.114	-0.139*	-0.122	-0.145*	1.336***	1.337***	1.341***	1.338***
	(-1.39)	(-1.72)	(-1.53)	(-1.83)	(7.04)	(8.27)	(7.27)	(8.36)
PBV	0.0314***	0.0327***	0.0315***	0.0327***	0.00641	0.00685	0.00639	0.00691
	(18.43)	(10.32)	(19.58)	(10.67)	(1.71)	(1.42)	(1.69)	(1.43)
DER	-0.000146	-0.000190	-0.000149	-0.000196	-0.000324	-0.000162	-0.000309	-0.000155
	(-1.02)	(-1.52)	(-1.07)	(-1.58)	(-0.61)	(-0.32)	(-0.58)	(-0.31)
INFCP	-0.00326	-0.00828	-0.00326	-0.00805	0.0249	0.0295	0.0252	0.0295
	(-0.29)	(-0.83)	(-0.29)	(-0.81)	(0.68)	(0.85)	(0.69)	(0.85)
INFGDP	0.000954	0.0100*	0.000920	0.00946	-0.0181**	-0.0213**	-0.0181**	-0.0210**
	(0.18)	(1.80)	(0.19)	(1.71)	(-2.31)	(-2.42)	(-2.26)	(-2.39)
GDPGR	0.00441	0.0141	0.00547	0.0146	0.0947***	0.0875***	0.0935***	0.0873***
	(0.48)	(1.32)	(0.63)	(1.40)	(6.48)	(5.20)	(6.24)	(5.16)
TR	0.0311	0.0447	0.0298	0.0421	-0.0930	-0.0928	-0.0918	-0.0917
	(1.09)	(1.06)	(1.06)	(1.01)	(-1.33)	(-1.26)	(-1.29)	(-1.24)
TRADE	-0.00528	-0.0157**	-0.00529	-0.0150*	-0.00600	-0.00359	-0.00602	-0.00396
	(-1.34)	(-2.09)	(-1.36)	(-2.03)	(-0.48)	(-0.27)	(-0.47)	(-0.30)
_CONS	3.167***	3.153***	3.244***	3.192***	-8.105***	-7.087***	-8.064***	-7.056***
	(4.17)	(3.28)	(4.26)	(3.35)	(-7.48)	(-5.15)	(-7.28)	(-5.12)
N	33	33	33	33	33	33	33	33
R^2-Adj	0.912	0.861	0.917	0.863	0.940	0.929	0.939	0.929
F-Statistics	521.0	112.2	603.2	110.8	127.2	47.83	116.4	47.38
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 13. Ordinary Least Squares (OLS) regression analysis of the impact of banking innovations on banking stability in low asset and young Banking Firms (Quadrant 3)

	(1) ZSCORE	(2) ZSCORE	(3) ZSCORE	(4) ZSCORE	(5) CZSCORE	(6) CZSCORE	(7) CZSCORE	(8) CZSCORE
LNINOV	6.339***				0.00181*			
	(3.10)				(1.94)			
$LNINOV_{T-1}$		3.479				0.00280***		
		(1.54)				(3.09)		
$LNINOV^2$			0.286***				0.0000655*	
			(3.16)				(1.70)	
$(LNINOV_{T-1})^2$				0.155				0.000115***
				(1.62)				(3.05)
FSIZE	50.47**	53.23**	46.95**	51.25*	-0.0411***	-0.0432***	-0.0414***	-0.0444***
	(2.18)	(2.05)	(2.10)	(1.97)	(-3.16)	(-3.33)	(-3.17)	(-3.40)
FAGE	-250.5	-217.0	-264.3	-217.6	2.320***	2.316***	2.320***	2.318***
	(-0.73)	(-0.65)	(-0.77)	(-0.65)	(17.99)	(18.67)	(17.89)	(18.73)
PBV	0.00252***	0.00255***	0.00251***	0.00254***	-0.000000288***	-0.000000292***	-0.000000288***	-0.000000294***
	(2.94)	(2.88)	(2.94)	(2.88)	(-3.55)	(-3.77)	(-3.57)	(-3.77)
DER	1.224	1.432	1.298	1.487	0.00183***	0.00186***	0.00186***	0.00191***
	(0.88)	(1.03)	(0.94)	(1.06)	(3.84)	(4.11)	(3.88)	(4.20)
INFCP	26.93	23.57	27.41	23.35	-0.0303**	-0.0311***	-0.0304**	-0.0312***
	(0.79)	(0.68)	(0.80)	(0.67)	(-2.43)	(-2.61)	(-2.43)	(-2.63)
INFGDP	-3.919	-4.481	-4.311	-4.760	-0.0236***	-0.0239***	-0.0238***	-0.0241***
	(-0.35)	(-0.40)	(-0.39)	(-0.42)	(-6.67)	(-6.93)	(-6.66)	(-6.96)
GDPGR	18.91	19.83	19.15	20.19	0.116***	0.117***	0.116***	0.117***
	(1.45)	(1.42)	(1.47)	(1.43)	(17.54)	(17.73)	(17.47)	(17.78)
TR	-78.35	-79.52	-79.63	-81.06	-0.0205	-0.0252	-0.0203	-0.0258
	(-1.29)	(-1.22)	(-1.31)	(-1.23)	(-0.79)	(-0.99)	(-0.78)	(-1.01)
TRADE	9.101	8.985	9.231	9.228	-0.0254***	-0.0249***	-0.0255***	-0.0248***
	(0.86)	(0.83)	(0.88)	(0.85)	(-6.43)	(-6.29)	(-6.42)	(-6.24)
_CONS	-452.3	-571.1	-303.7	-507.6	-0.457	-0.370	-0.443	-0.338
	(-0.56)	(-0.77)	(-0.38)	(-0.70)	(-1.07)	(-0.88)	(-1.04)	(-0.80)
N	220	220	220	220	220	220	220	220
R^2-Adj	0.188	0.171	0.192	0.172	0.927	0.929	0.927	0.929
F-Statistics	2.024	1.927	2.039	1.937	229.0	275.0	227.9	286.9
Prob > F	0.0324	0.0431	0.0310	0.0419	0.000	0.000	0.000	0.000

Table 13 presents the results of a robust Ordinary Least Squares (OLS) regression analysis investigating the impact of banking innovations on banking stability in low asset and young Banking Firms (Quadrant 3). The analytical model employed in this study is an OLS regression model: $\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d} + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d}^2 + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d} + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d}^2 + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{CZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d} + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{CZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d}^2 + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{CZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d} + \beta_2 \varphi_{i,d} + \epsilon$,and $\mathrm{ZCSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d}^2 + \beta_2 \varphi_{i,d} + \epsilon$. The variable $\varphi_{i,d}$ is a control variable consisting of Firm Size (FSIZE), Firm Age (FAGE), Price-to-Book Value Ratio (PBV), Debt to Equity Ratio (DER), Inflation Consumer Price (INFCP), Inflation (INFGDP), GDP Growth (GDPGR), Tax Revenue (TR), and Trade (TRADE). The table includes regression coefficients and t-statistics $\left(\frac{b}{t_{stat}}\right)$. Robust regressions have been presented to account for heteroscedasticity and autocorrelation. The significance levels are denoted by ***, **, and *, corresponding to levels of 1%, 5%, and 10% respectively.

Table 14 presents the results of a robust Ordinary Least Squares (OLS) regression analysis investigating the impact of banking innovations on banking stability in large asset and young Banking Firms (Quadrant 4). The analytical model employed in this study is an OLS regression model: $\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d} + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d}^2 + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d} + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d}^2 + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{CZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d} + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{CZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d}^2 + \beta_2 \varphi_{i,d} + \epsilon$, $\mathrm{CZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d} + \beta_2 \varphi_{i,d} + \epsilon$,and $\mathrm{ZCSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d}^2 + \beta_2 \varphi_{i,d} + \epsilon$. The variable $\varphi_{i,d}$ is a control variable consisting of Firm Size (FSIZE), Firm Age (FAGE), Price-to-Book Value Ratio (PBV), Debt to Equity Ratio (DER), Inflation Consumer Price (INFCP), Inflation (INFGDP), GDP Growth (GDPGR), Tax Revenue (TR), and Trade (TRADE). The table includes regression coefficients and t-statistics $\left(\frac{b}{t_{stat}}\right)$. Robust regressions have been presented to account for heteroscedasticity and autocorrelation. The significance levels are denoted by ***, **, and *, corresponding to levels of 1%, 5%, and 10% respectively.

Table 14. Ordinary Least Squares (OLS) regression analysis investigating the impact of banking innovations on banking stability in large asset and young Banking Firms (Quadrant 4)

	(1) ZSCORE	(2) ZSCORE	(3) ZSCORE	(4) ZSCORE	(5) CZSCORE	(6) CZSCORE	(7) CZSCORE	(8) CZSCORE
LNINOV	-0.00494				0.0188***			
	(-0.32)				(4.80)			
$LNINOV_{T-1}$		0.00428				0.0102**		
		(0.38)				(2.53)		
$LNINOV^2$			-0.000113				0.000771***	
			(-0.16)				(4.82)	
$(LNINOV_{T-1})^2$				0.000613				0.000391**
				(1.29)				(2.49)
FSIZE	-0.0426	-0.0556	-0.0449	-0.0723	0.128***	0.142***	0.121***	0.142***
	(-0.30)	(-0.41)	(-0.31)	(-0.52)	(3.79)	(2.98)	(3.77)	(2.95)
FAGE	-0.661*	-0.746*	-0.685*	-0.820**	-0.164*	-0.0572	-0.147	-0.0424
	(-1.70)	(-1.84)	(-1.87)	(-2.06)	(-1.83)	(-0.55)	(-1.65)	(-0.42)
PBV	0.855***	0.852***	0.854***	0.848***	0.0168**	0.0181**	0.0165*	0.0179**
	(4.84)	(4.88)	(4.80)	(4.90)	(2.16)	(2.36)	(1.91)	(2.29)
DER	-0.00494	-0.00473	-0.00485	-0.00468	-0.000736	-0.00125	-0.000852	-0.00131
	(-1.05)	(-1.01)	(-1.01)	(-0.99)	(-0.97)	(-1.25)	(-1.11)	(-1.28)
INFCP	-0.183	-0.180	-0.183	-0.174	-0.117***	-0.119***	-0.116***	-0.118***
	(-1.18)	(-1.18)	(-1.17)	(-1.16)	(-4.71)	(-4.38)	(-4.61)	(-4.29)
INFGDP	-0.0328	-0.0304	-0.0319	-0.0289	-0.0190**	-0.0249**	-0.0195**	-0.0248**
	(-0.77)	(-0.70)	(-0.75)	(-0.66)	(-2.11)	(-2.59)	(-2.23)	(-2.60)
GDPGR	-0.145	-0.145	-0.146	-0.139	0.0984***	0.104***	0.0987***	0.105***
	(-1.33)	(-1.32)	(-1.33)	(-1.28)	(6.68)	(6.06)	(6.67)	(6.13)
TR	1.254	1.235	1.250	1.212	0.0552	0.0693	0.0550	0.0707
	(1.51)	(1.51)	(1.50)	(1.50)	(0.77)	(0.88)	(0.76)	(0.89)
TRADE	-0.0820	-0.0753	-0.0805	-0.0687	-0.0352***	-0.0417***	-0.0348***	-0.0430***
	(-1.03)	(-1.00)	(-0.98)	(-0.95)	(-3.45)	(-3.73)	(-3.42)	(-3.91)
_CONS	-4.707	-4.276	-4.615	-3.765	2.400**	1.870	2.535**	1.883
	(-0.72)	(-0.68)	(-0.68)	(-0.60)	(2.28)	(1.26)	(2.53)	(1.26)
N	93	93	93	93	93	93	93	93
R^2-Adj	0.762	0.762	0.762	0.763	0.823	0.790	0.822	0.789
F-Statistics	5.862	5.679	6.436	5.639	83.39	56.22	72.09	58.29
Prob > F	0.00000128	0.00000205	0.000000305	0.00000227	0.000	0.000	0.000	0.000

V. Conclusions

This study shows that banking innovation has a significant positive influence on banking stability in Indonesia. New technological and process innovations in banking contribute to better operational efficiency and more effective risk management. However, a surprising finding emerges from the moderation of gender diversity that negatively affects the relationship between banking innovation and banking stability, contrary to the literature that often shows a positive effect of gender diversity on firm performance. This finding raises questions about internal dynamics that may be different in the context of bank operations. Additional analysis examining the differences between SOEs and non-SOE firms reveals that, despite innovations, SOEs with strict structures and regulations may not be able to fully capitalise on the efficacy of such innovations due to bureaucratic barriers and strict government policies. In contrast, non-SOE firms show that they are more agile and able to implement innovations with higher effectiveness, which contributes to their financial stability. The study also analyses different financial quadrants, showing that the effect of innovation on banking stability varies by asset characteristics and firm age. Firms with large assets and mature age tend to be more integrated in the national financial system, so innovation has a wider impact at the national level but not at the firm level. On the other hand, young firms with large assets and firms with small assets and young age are more dynamic and responsive to innovation, which directly affects their internal stability.

This study provides significant theoretical implications in the literature on banking innovation and banking stability, by showing that innovation can strengthen financial stability through improved operational efficiency and more effective risk management. Practically, the results support the argument that banks should continue to adopt new technologies and innovative processes to improve their financial performance and resilience in the face of market fluctuations. However, this study has several limitations, including limitations in generalising the results due to the specific geographical focus and the use of quantitative data that does not capture the deeper contextual nuances of the innovation process. Therefore, it is recommended that future research

broaden the geographical coverage and incorporate qualitative methods to understand the influence of social and organisational factors on banking innovation and stability. Recommendations for future research include further investigation of the specific ways in which banking innovations affect various aspects of risk and stability, as well as more in-depth testing of the moderating role of gender diversity in this context. Future researchers should also consider the influence of external variables such as government policies and macroeconomic conditions on the effectiveness of banking innovations.

VI. Policy Recommendations

In order to maintain financial system stability in the context of rapidly evolving banking innovations, it is essential that the Financial Services Authority (OJK) and Bank Indonesia consider a number of policy recommendations. Firstly, it is imperative that the OJK and Bank Indonesia enhance their cooperation and coordination with regard to the supervision of banking innovation. This is in order to guarantee that the advent of new technological developments serves to reinforce, rather than erode, the stability of the financial system. This encompasses more rigorous regulation and a proactive risk assessment of novel banking products and services. In particular, policy recommendations can be tailored to align with the specific characteristics and internal dynamics of banks situated in different quadrants. For banks with substantial assets and a mature operational history (Quadrant 1), it is advised to adopt innovations that reinforce financial infrastructure and reduce reliance on antiquated operational systems. This will enable them to leverage their scale and experience to enhance overall operational efficiency. For banking companies with large assets but young age (Quadrant 2), they should focus on utilising innovation to gain competitive advantage and improve internal stability. Innovation here should be aimed at optimising operations and creating added value for customers, which in turn can improve reputation and consumer confidence. For banks with small assets and young age (Quadrant 3), it is important to adopt technologies that can help them grow quickly and manage risks effectively. Support policies from OJK and Bank Indonesia, such as facilitating access to the latest technology and

training in risk management, will be helpful. Finally, for banks with large assets but young age (Quadrant 4), it is advisable to prioritise innovations that support data-driven decision-making to improve the effectiveness of risk management. Innovations such as big data and advanced analytics can enable these banks to better understand market risks and opportunities.

Appendix 1

"This table presents the results of a robust Ordinary Least Squares (OLS) regression analysis investigating the impact of banking innovation on banking stability with the moderating variable of Female Directors (FEMDIR). The analytical model employed in this study is an OLS regression model: $\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d} + \beta_2 \mathrm{FEMDIR}_{i,d} + \beta_3 (\mathrm{LNINOV}_{i,d} \times \mathrm{FEMDIR}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d}^2 + \beta_2 \mathrm{FEMDIR}_{i,d} + \beta_3 \left(\mathrm{LNINOV}_{i,d}^2 \times \mathrm{FEMDIR}_{i,d}\right) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d} + \beta_2 \mathrm{FEMDIR}_{i,d} + \beta_3 (\mathrm{LNINOV}_{t-1})_{i,d} \times \mathrm{FEMDIR}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d}^2 + \beta_2 \mathrm{FEMDIR}_{i,d} + \beta_3 ((\mathrm{LNINOV}_{t-1})_{i,d}^2 \times \mathrm{FEMDIR}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \quad C\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d} + \beta_2 \mathrm{FEMDIR}_{i,d} + \beta_3 (\mathrm{LNINOV}_{i,d} \times \mathrm{FEMDIR}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{CZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d}^2 + \beta_2 \mathrm{FEMDIR}_{i,d} + \beta_3 \left(\mathrm{LNINOV}_{i,d}^2 \times \mathrm{FEMDIR}_{i,d}\right) + \beta_4 \varphi_{i,d} + \epsilon, C\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d} + \beta_2 \mathrm{FEMDIR}_{i,d} + \beta_3 (\mathrm{LNINOV}_{t-1})_{i,d} \times \mathrm{FEMDIR}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{CZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d}^2 + \beta_2 \mathrm{FEMDIR}_{i,d} + \beta_3 ((\mathrm{LNINOV}_{t-1})_{i,d}^2 \times \mathrm{FEMDIR}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon,$. The variable $\varphi_{i,d}$ is a control variable consisting of Firm Size (FSIZE), Firm Age (FAGE), Price-to-Book Value Ratio (PBV), Debt to Equity Ratio (DER), Inflation Consumer Price (INFCP), Inflation (INFGDP), GDP Growth (GDPGR), Tax Revenue (TR), and Trade (TRADE) The table includes regression coefficients and t-statistics $\left(\frac{b}{t_{stat}}\right)$. Robust regressions have been presented to account for heteroscedasticity and autocorrelation. The significance levels are denoted by ***, **, and *, corresponding to levels of 1%, 5%, and 10% respectively."

	(1) ZSCORE	(2) ZSCORE	(3) ZSCORE	(4) ZSCORE	(5) CZSCORE	(6) CZSCORE	(7) CZSCORE	(8) CZSCORE
LNINOV×FEMDIR	-9.080***				-0.00470**			
	(-3.33)				(-2.05)			
LNINOV	9.296***				0.00854***			
	(3.35)				(4.35)			
$LNINOV_{T-1}$×FEMDIR		-6.452**				-0.00401*		
		(-2.09)				(-1.74)		
$LNINOV_{T-1}$		6.381**				0.00885***		
		(2.10)				(4.60)		
$LNINOV^2$×FEMDIR			-0.370***				-0.000199**	
			(-3.30)				(-2.17)	
$LNINOV^2$			0.377***				0.000344***	
			(3.31)				(4.31)	
$(LNINOV_{T-1})^2$×FEMDIR				-0.256**				-0.000162*
				(-2.08)				(-1.76)
$(LNINOV_{T-1})^2$				0.252**				0.000343***
				(2.09)				(4.43)

FEMDIR	7.791	-27.80	6.088	-30.98	0.00316	-0.00905	0.00505	-0.00928
	(1.31)	(-0.77)	(0.90)	(-0.88)	(0.07)	(-0.20)	(0.11)	(-0.21)
FSIZE	9.677***	9.016***	9.323***	8.870***	0.0242***	0.0240***	0.0221**	0.0215**
	(2.81)	(2.62)	(2.76)	(2.61)	(2.85)	(2.79)	(2.55)	(2.45)
FAGE	-60.51***	-58.60***	-61.96***	-59.18***	0.0233	0.0254	0.0221	0.0245
	(-3.00)	(-3.03)	(-3.00)	(-3.04)	(0.84)	(0.93)	(0.80)	(0.90)
PBV	0.00246***	0.00252***	0.00246***	0.00252***	-0.000000432***	-0.000000422***	-0.000000430***	-0.000000416***
	(2.91)	(2.84)	(2.91)	(2.85)	(-2.94)	(-3.31)	(-2.92)	(-3.27)
DER	0.128	0.158	0.116	0.151	-0.000161	-0.000150	-0.000170	-0.000152
	(1.09)	(1.30)	(1.01)	(1.25)	(-0.70)	(-0.67)	(-0.73)	(-0.67)
INFCP	4.279	3.781	4.456	3.779	-0.0482***	-0.0502***	-0.0481***	-0.0501***
	(0.67)	(0.58)	(0.70)	(0.58)	(-4.10)	(-4.27)	(-4.09)	(-4.25)
INFGDP	-0.492	-1.313	-0.634	-1.369	-0.0295***	-0.0297***	-0.0297***	-0.0299***
	(-0.14)	(-0.38)	(-0.19)	(-0.39)	(-6.78)	(-7.00)	(-6.86)	(-7.06)
GDPGR	7.782*	8.557*	7.867*	8.588*	0.111***	0.112***	0.111***	0.113***
	(1.66)	(1.72)	(1.67)	(1.73)	(17.52)	(17.82)	(17.51)	(17.80)
TR	-20.91	-22.46	-21.01	-22.59	-0.0347	-0.0307	-0.0348	-0.0310
	(-1.39)	(-1.42)	(-1.39)	(-1.42)	(-1.00)	(-0.89)	(-1.00)	(-0.90)
TRADE	3.243	3.184	3.225	3.166	-0.0504***	-0.0512***	-0.0504***	-0.0512***
	(1.16)	(1.13)	(1.15)	(1.12)	(-12.81)	(-13.19)	(-12.82)	(-13.19)
_CONS	-64.04	11.55	-43.11	24.67	6.323***	6.311***	6.395***	6.399***
	(-0.47)	(0.09)	(-0.31)	(0.19)	(19.46)	(19.60)	(19.63)	(19.75)
N	637	637	637	637	637	637	637	637
R^2-Adj	0.237	0.214	0.237	0.213	0.757	0.761	0.757	0.760
F-Statistics	1.732	1.687	1.730	1.680	326.2	342.2	326.5	341.0
Prob > F	0.0565	0.0655	0.0568	0.0671	0.000	0.000	0.000	0.000

Appendix 2

"This table presents the results of a robust Ordinary Least Squares (OLS) regression analysis investigating the impact of banking innovation on banking stability with the moderating variable of Percentage of Female Directors (PERC_FEMDIR). The analytical model employed in this study is an OLS regression model: $\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d} + \beta_2 \mathrm{PERC\_FEMDIR}_{i,d} + \beta_3(\mathrm{LNINOV}_{i,d} \times \mathrm{PERC\_FEMDIR}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d}^2 + \beta_2 \mathrm{PERC\_FEMDIR}_{i,d} + \beta_3(\mathrm{LNINOV}_{i,d}^2 \times \mathrm{PERC\_FEMDIR}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d} + \beta_2 \mathrm{PERC\_FEMDIR}_{i,d} + \beta_3 (\mathrm{LNINOV}_{t-1})_{i,d} \times \mathrm{PERC\_FEMDIR}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d}^2 + \beta_2 \mathrm{PERC\_FEMDIR}_{i,d} + \beta_3 ((\mathrm{LNINOV}_{t-1})_{i,d}^2 \times \mathrm{PERC\_FEMDIR}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \quad C\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d} + \beta_2 \mathrm{PERC\_FEMDIR}_{i,d} + \beta_3 (\mathrm{LNINOV}_{i,d} \times \mathrm{PERC\_FEMDIR}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, C\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d}^2 + \beta_2 \mathrm{PERC\_FEMDIR}_{i,d} + \beta_3 (\mathrm{LNINOV}_{i,d}^2 \times \mathrm{PERC\_FEMDIR}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, C\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d} + \beta_2 \mathrm{PERC\_FEMDIR}_{i,d} + \beta_3 (\mathrm{LNINOV}_{t-1})_{i,d} \times \mathrm{PERC\_FEMDIR}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, C\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d}^2 + \beta_2 \mathrm{PERC\_FEMDIR}_{i,d} + \beta_3 ((\mathrm{LNINOV}_{t-1})_{i,d}^2 \times \mathrm{PERC\_FEMDIR}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon,$. The variable $\varphi_{i,d}$ is a control variable consisting of Firm Size (FSIZE), Firm Age (FAGE), Price-to-Book Value Ratio (PBV), Debt to Equity Ratio (DER), Inflation Consumer Price (INFCP), Inflation (INFGDP), GDP Growth (GDPGR), Tax Revenue (TR), and Trade (TRADE) The table includes regression coefficients and t-statistics $\left(\frac{b}{t_{stat}}\right)$. Robust regressions have been presented to account for heteroscedasticity and autocorrelation. The significance levels are denoted by ***, **, and *, corresponding to levels of 1%, 5%, and 10% respectively."

	(1) ZSCORE	(2) ZSCORE	(3) ZSCORE	(4) ZSCORE	(5) CZSCORE	(6) CZSCORE	(7) CZSCORE	(8) CZSCORE
LNINOV×PERC_FEMDIR	-17.79***				-0.00295			
	(-3.10)				(-0.45)			
LNINOV	4.697***				0.00577***			
	(3.19)				(3.46)			
LNINOV_{T-1}×PERC_FEMDIR		-12.81**				-0.00640		
		(-2.09)				(-1.00)		
LNINOV_{T-1}		2.905*				0.00723***		
		(1.76)				(4.57)		
LNINOV^2×PERC_FEMDIR			-0.712***				-0.000117	
			(-3.07)				(-0.44)	
LNINOV^2			0.184***				0.000219***	
			(3.19)				(3.31)	
$(\mathrm{LNINOV}_{T-1})^2$×PERC_FEMDIR				-0.505**				-0.000249
				(-2.10)				(-0.98)
$(\mathrm{LNINOV}_{T-1})^2$				0.112*				0.000271***

				(1.79)				(4.41)
PERC_FEMDIR	26.89	-57.68	16.86	-66.64	0.210*	0.262**	0.200*	0.248**
	(1.29)	(-0.79)	(0.83)	(-0.95)	(1.79)	(2.32)	(1.74)	(2.24)
FSIZE	-0.602	0.00779	-1.701	-0.463	0.0187**	0.0188**	0.0158*	0.0159*
	(-0.29)	(0.00)	(-0.81)	(-0.24)	(2.30)	(2.31)	(1.92)	(1.91)
FAGE	-68.56***	-67.04***	-68.85***	-66.98***	0.0268	0.0270	0.0264	0.0265
	(-3.04)	(-3.05)	(-3.04)	(-3.05)	(0.97)	(1.00)	(0.95)	(0.98)
PBV	0.00259***	0.00261***	0.00259***	0.00261***	-0.000000290**	-0.000000297***	-0.000000286**	-0.000000293***
	(2.92)	(2.88)	(2.92)	(2.88)	(-2.46)	(-2.92)	(-2.44)	(-2.86)
DER	0.120	0.125	0.117	0.123	-0.000183	-0.000204	-0.000183	-0.000199
	(1.10)	(1.12)	(1.08)	(1.11)	(-0.80)	(-0.90)	(-0.80)	(-0.88)
INFCP	2.596	2.551	2.661	2.537	-0.0482***	-0.0506***	-0.0483***	-0.0505***
	(0.40)	(0.40)	(0.41)	(0.40)	(-4.07)	(-4.30)	(-4.07)	(-4.28)
INFGDP	-0.526	-1.070	-0.623	-1.129	-0.0293***	-0.0293***	-0.0295***	-0.0295***
	(-0.15)	(-0.30)	(-0.17)	(-0.32)	(-6.65)	(-6.87)	(-6.73)	(-6.95)
GDPGR	6.349	7.662*	6.596	7.696*	0.111***	0.112***	0.111***	0.112***
	(1.42)	(1.71)	(1.47)	(1.71)	(17.46)	(17.99)	(17.46)	(17.93)
TR	-18.60	-17.83	-18.51	-17.83	-0.0347	-0.0280	-0.0347	-0.0283
	(-1.23)	(-1.23)	(-1.23)	(-1.23)	(-0.99)	(-0.81)	(-0.99)	(-0.82)
TRADE	2.396	1.681	2.303	1.637	-0.0506***	-0.0517***	-0.0506***	-0.0518***
	(0.84)	(0.60)	(0.81)	(0.58)	(-12.70)	(-13.44)	(-12.71)	(-13.44)
_CONS	317.2*	343.5**	358.3**	363.0**	6.449***	6.403***	6.546***	6.512***
	(1.86)	(2.01)	(2.02)	(2.07)	(20.43)	(20.46)	(20.76)	(20.75)
N	637	637	637	637	637	637	637	637
R^2-Adj	0.196	0.185	0.195	0.185	0.756	0.760	0.755	0.759
F-Statistics	1.593	1.597	1.591	1.593	315.1	344.3	316.2	343.9
Prob > F	0.0891	0.0878	0.0896	0.0892	0.000	0.000	0.000	0.000

Appendix 3

"This table presents the results of a robust Ordinary Least Squares (OLS) regression analysis investigating the impact of banking innovation on banking stability with the moderating variable of Percentage of Female Commissioner (FEMCOM). The analytical model employed in this study is an OLS regression model: $\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d} + \beta_2 \mathrm{FEMCOM}_{i,d} + \beta_3 (\mathrm{LNINOV}_{i,d} \times \mathrm{FEMCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d}^2 + \beta_2 \mathrm{FEMCOM}_{i,d} + \beta_3 \left(\mathrm{LNINOV}_{i,d}^2 \times \mathrm{FEMCOM}_{i,d}\right) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d} + \beta_2 \mathrm{FEMCOM}_{i,d} + \beta_3 (\mathrm{LNINOV}_{t-1})_{i,d} \times \mathrm{FEMCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d}^2 + \beta_2 \mathrm{FEMCOM}_{i,d} + \beta_3 ((\mathrm{LNINOV}_{t-1})_{i,d}^2 \times \mathrm{FEMCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon,$ $C\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d} + \beta_2 \mathrm{FEMCOM}_{i,d} + \beta_3 (\mathrm{LNINOV}_{i,d} \times \mathrm{FEMCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{CZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d}^2 + \beta_2 \mathrm{FEMCOM}_{i,d} + \beta_3 \left(\mathrm{LNINOV}_{i,d}^2 \times \mathrm{FEMCOM}_{i,d}\right) + \beta_4 \varphi_{i,d} + \epsilon, C\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d} + \beta_2 \mathrm{FEMCOM}_{i,d} + \beta_3 (\mathrm{LNINOV}_{t-1})_{i,d} \times \mathrm{FEMCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{CZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d}^2 + \beta_2 \mathrm{FEMCOM}_{i,d} + \beta_3 ((\mathrm{LNINOV}_{t-1})_{i,d}^2 \times \mathrm{FEMCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon,$. The variable $\varphi_{i,d}$ is a control variable consisting of Firm Size (FSIZE), Firm Age (FAGE), Price-to-Book Value Ratio (PBV), Debt to Equity Ratio (DER), Inflation Consumer Price (INFCP), Inflation (INFGDP), GDP Growth (GDPGR), Tax Revenue (TR), and Trade (TRADE) The table includes regression coefficients and t-statistics $\left(\frac{b}{t_{stat}}\right)$. Robust regressions have been presented to account for heteroscedasticity and autocorrelation. The significance levels are denoted by ***, **, and *, corresponding to levels of 1%, 5%, and 10% respectively."

	(1) ZSCORE	(2) ZSCORE	(3) ZSCORE	(4) ZSCORE	(5) CZSCORE	(6) CZSCORE	(7) CZSCORE	(8) CZSCORE
LNINOV×FEMCOM	-3.578***				-0.00262			
	(-3.10)				(-1.23)			
LNINOV	4.161***				0.00606***			
	(3.20)				(4.32)			
LNINOV_{T-1}×FEMCOM		-2.216				-0.00160		
		(-1.48)				(-0.75)		
LNINOV_{T-1}		2.572*				0.00644***		
		(1.83)				(4.74)		
LNINOV^2×FEMCOM			-0.140***				-0.000114	
			(-3.06)				(-1.38)	
LNINOV^2			0.165***				0.000241***	
			(3.19)				(4.31)	
$(\mathrm{LNINOV}_{T-1})^2$×FEMCOM				-0.0847				-0.0000714
				(-1.45)				(-0.86)
$(\mathrm{LNINOV}_{T-1})^2$				0.100*				0.000250***

				(1.84)				(4.61)
FEMCOM	-11.52	-27.72	-14.20*	-30.00	0.0308	0.0142	0.0318	0.0148
	(-1.64)	(-1.28)	(-1.78)	(-1.39)	(0.71)	(0.32)	(0.75)	(0.34)
FSIZE	2.636	2.466	1.826	2.007	0.0205**	0.0199**	0.0185**	0.0177**
	(1.32)	(1.17)	(0.94)	(0.98)	(2.44)	(2.35)	(2.15)	(2.03)
FAGE	-58.51***	-59.57***	-59.70***	-60.20***	0.0268	0.0275	0.0258	0.0267
	(-2.98)	(-2.93)	(-2.99)	(-2.95)	(0.97)	(1.01)	(0.94)	(0.98)
PBV	0.00260***	0.00263***	0.00261***	0.00263***	-0.000000344***	-0.000000342***	-0.000000343***	-0.000000339***
	(2.91)	(2.88)	(2.92)	(2.88)	(-2.69)	(-3.06)	(-2.68)	(-3.03)
DER	0.117	0.0980	0.116	0.0989	-0.000154	-0.000168	-0.000155	-0.000164
	(1.10)	(0.96)	(1.09)	(0.97)	(-0.67)	(-0.75)	(-0.68)	(-0.73)
INFCP	4.506	3.335	4.527	3.437	-0.0480***	-0.0503***	-0.0480***	-0.0501***
	(0.69)	(0.50)	(0.69)	(0.51)	(-4.05)	(-4.25)	(-4.04)	(-4.22)
INFGDP	-0.287	-0.937	-0.393	-0.982	-0.0295***	-0.0296***	-0.0297***	-0.0298***
	(-0.08)	(-0.26)	(-0.11)	(-0.27)	(-6.72)	(-6.93)	(-6.79)	(-6.99)
GDPGR	7.575*	8.471*	7.616*	8.541*	0.111***	0.113***	0.111***	0.113***
	(1.66)	(1.73)	(1.66)	(1.73)	(17.53)	(17.84)	(17.52)	(17.80)
TR	-20.49	-18.68	-20.33	-18.81	-0.0351	-0.0289	-0.0351	-0.0293
	(-1.35)	(-1.25)	(-1.34)	(-1.25)	(-1.00)	(-0.83)	(-1.00)	(-0.84)
TRADE	2.164	1.594	2.192	1.581	-0.0510***	-0.0521***	-0.0510***	-0.0521***
	(0.77)	(0.57)	(0.78)	(0.57)	(-12.82)	(-13.44)	(-12.82)	(-13.44)
_CONS	201.7	243.1	230.5	262.7*	6.444***	6.439***	6.509***	6.521***
	(1.34)	(1.58)	(1.49)	(1.68)	(19.98)	(20.17)	(20.01)	(20.24)
N	637	637	637	637	637	637	637	637
R^2-Adj	0.191	0.179	0.190	0.179	0.755	0.758	0.754	0.758
F-Statistics	1.578	1.579	1.576	1.576	320.0	344.9	321.1	344.5
Prob > F	0.0932	0.0931	0.0939	0.0940	0.000	0.000	0.000	0.000

Appendix 4

"This table presents the results of a robust Ordinary Least Squares (OLS) regression analysis investigating the impact of banking innovation on banking stability with the moderating variable of Percentage of Female Commissioner (PERC_FEMCOM). The analytical model employed in this study is an OLS regression model: $\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d} + \beta_2 \mathrm{PERC\_FEMCOM}_{i,d} + \beta_3 (\mathrm{LNINOV}_{i,d} \times \mathrm{PERC\_FEMCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d}^2 + \beta_2 \mathrm{PERC\_FEMCOM}_{i,d} + \beta_3 (\mathrm{LNINOV}_{i,d}^2 \times \mathrm{PERC\_FEMCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d} + \beta_2 \mathrm{PERC\_FEMCOM}_{i,d} + \beta_3 (\mathrm{LNINOV}_{t-1})_{i,d} \times \mathrm{PERC\_FEMCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d}^2 + \beta_2 \mathrm{PERC\_FEMCOM}_{i,d} + \beta_3 ((\mathrm{LNINOV}_{t-1})_{i,d}^2 \times \mathrm{PERC\_FEMCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \quad C\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d} + \beta_2 \mathrm{PERC\_FEMCOM}_{i,d} + \beta_3 (\mathrm{LNINOV}_{i,d} \times \mathrm{PERC\_FEMCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{CZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d}^2 + \beta_2 \mathrm{PERC\_FEMCOM}_{i,d} + \beta_3 (\mathrm{LNINOV}_{i,d}^2 \times \mathrm{PERC\_FEMCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, C\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d} + \beta_2 \mathrm{PERC\_FEMCOM}_{i,d} + \beta_3 (\mathrm{LNINOV}_{t-1})_{i,d} \times \mathrm{PERC\_FEMCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{CZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d}^2 + \beta_2 \mathrm{PERC\_FEMCOM}_{i,d} + \beta_3 ((\mathrm{LNINOV}_{t-1})_{i,d}^2 \times \mathrm{PERC\_FEMCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon,$. The variable $\varphi_{i,d}$ is a control variable consisting of Firm Size (FSIZE), Firm Age (FAGE), Price-to-Book Value Ratio (PBV), Debt to Equity Ratio (DER), Inflation Consumer Price (INFCP), Inflation (INFGDP), GDP Growth (GDPGR), Tax Revenue (TR), and Trade (TRADE) The table includes regression coefficients and t-statistics $\left(\frac{b}{t_{stat}}\right)$. Robust regressions have been presented to account for heteroscedasticity and autocorrelation. The significance levels are denoted by ***, **, and *, corresponding to levels of 1%, 5%, and 10% respectively."

	(1) ZSCORE	(2) ZSCORE	(3) ZSCORE	(4) ZSCORE	(5) CZSCORE	(6) CZSCORE	(7) CZSCORE	(8) CZSCORE
LNINOV×PERC_FEMCOM	-10.14***				-0.00290			
	(-2.99)				(-0.39)			
LNINOV	3.360***				0.00503***			
	(3.18)				(3.78)			
LNINOV_{T-1}×PERC_FEMCOM		-5.695				-0.000596		
		(-1.29)				(-0.08)		
LNINOV_{T-1}		1.997*				0.00563***		
		(1.70)				(4.35)		
LNINOV^2×PERC_FEMCOM			-0.413***				-0.000153	
			(-2.97)				(-0.51)	
LNINOV^2			0.132***				0.000196***	
			(3.18)				(3.70)	
$(\mathrm{LNINOV}_{T-1})^2$×PERC_FEMCOM				-0.221				-0.0000727
				(-1.25)				(-0.25)
$(\mathrm{LNINOV}_{T-1})^2$				0.0761*				0.000217***

				(1.69)				(4.24)
PERC_FEMCOM	-36.82	-96.58	-41.97*	-102.5	0.140	0.0980	0.148	0.112
	(-1.61)	(-1.33)	(-1.66)	(-1.42)	(0.92)	(0.62)	(0.99)	(0.73)
FSIZE	-1.060	-0.835	-1.780	-1.261	0.0194**	0.0191**	0.0171**	0.0166*
	(-0.58)	(-0.47)	(-0.94)	(-0.71)	(2.34)	(2.28)	(2.02)	(1.94)
FAGE	-57.33***	-58.45***	-57.74***	-58.68***	0.0275	0.0286	0.0272	0.0283
	(-2.97)	(-2.92)	(-2.97)	(-2.92)	(0.99)	(1.05)	(0.99)	(1.04)
PBV	0.00262***	0.00264***	0.00262***	0.00264***	-0.000000308**	-0.000000311***	-0.000000306**	-0.000000308***
	(2.91)	(2.88)	(2.91)	(2.89)	(-2.55)	(-2.90)	(-2.54)	(-2.86)
DER	0.0984	0.0842	0.0945	0.0837	-0.000133	-0.000145	-0.000136	-0.000142
	(0.99)	(0.87)	(0.96)	(0.87)	(-0.58)	(-0.64)	(-0.59)	(-0.63)
INFCP	4.192	2.998	4.169	3.091	-0.0480***	-0.0503***	-0.0480***	-0.0501***
	(0.64)	(0.45)	(0.63)	(0.46)	(-4.05)	(-4.26)	(-4.04)	(-4.23)
INFGDP	-0.499	-0.945	-0.606	-0.996	-0.0297***	-0.0297***	-0.0299***	-0.0299***
	(-0.14)	(-0.26)	(-0.17)	(-0.27)	(-6.75)	(-6.96)	(-6.82)	(-7.03)
GDPGR	7.631*	8.288*	7.658*	8.353*	0.111***	0.112***	0.111***	0.113***
	(1.67)	(1.72)	(1.67)	(1.72)	(17.56)	(17.85)	(17.54)	(17.82)
TR	-19.30	-17.57	-19.11	-17.73	-0.0350	-0.0291	-0.0350	-0.0293
	(-1.28)	(-1.20)	(-1.27)	(-1.21)	(-1.00)	(-0.84)	(-0.99)	(-0.84)
TRADE	1.694	1.220	1.698	1.206	-0.0509***	-0.0519***	-0.0509***	-0.0520***
	(0.60)	(0.44)	(0.61)	(0.43)	(-12.78)	(-13.41)	(-12.79)	(-13.41)
_CONS	324.9*	349.4**	349.4**	367.2**	6.468***	6.452***	6.542***	6.538***
	(1.91)	(2.03)	(2.00)	(2.09)	(20.10)	(20.20)	(20.16)	(20.29)
N	637	637	637	637	637	637	637	637
R^2-Adj	0.184	0.175	0.183	0.174	0.755	0.758	0.754	0.758
F-Statistics	1.558	1.564	1.555	1.560	320.0	346.2	320.8	345.9
Prob > F	0.0995	0.0976	0.100	0.0988	0.000	0.000	0.000	0.000

Appendix 5

"This table presents the results of a robust Ordinary Least Squares (OLS) regression analysis investigating the impact of banking innovation on banking stability with the moderating variable of Percentage of Female Audit Committee (FEMAUDITCOM). The analytical model employed in this study is an OLS regression model: $\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d} + \beta_2 \mathrm{FEMAUDITCOM}_{i,d} + \beta_3 (\mathrm{LNINOV}_{i,d} \times \mathrm{FEMAUDITCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d}^2 + \beta_2 \mathrm{FEMAUDITCOM}_{i,d} + \beta_3 (\mathrm{LNINOV}_{i,d}^2 \times \mathrm{FEMAUDITCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d} + \beta_2 \mathrm{FEMAUDITCOM}_{i,d} + \beta_3 (\mathrm{LNINOV}_{t-1})_{i,d} \times \mathrm{FEMAUDITCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d}^2 + \beta_2 \mathrm{FEMAUDITCOM}_{i,d} + \beta_3 ((\mathrm{LNINOV}_{t-1})_{i,d}^2 \times \mathrm{FEMAUDITCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \quad C\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d} + \beta_2 \mathrm{FEMAUDITCOM}_{i,d} + \beta_3 (\mathrm{LNINOV}_{i,d} \times \mathrm{FEMAUDITCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{CZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d}^2 + \beta_2 \mathrm{FEMAUDITCOM}_{i,d} + \beta_3 (\mathrm{LNINOV}_{i,d}^2 \times \mathrm{FEMAUDITCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, C\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d} + \beta_2 \mathrm{FEMAUDITCOM}_{i,d} + \beta_3 (\mathrm{LNINOV}_{t-1})_{i,d} \times \mathrm{FEMAUDITCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{CZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d}^2 + \beta_2 \mathrm{FEMAUDITCOM}_{i,d} + \beta_3 ((\mathrm{LNINOV}_{t-1})_{i,d}^2 \times \mathrm{FEMAUDITCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon,$. The variable $\varphi_{i,d}$ is a control variable consisting of Firm Size (FSIZE), Firm Age (FAGE), Price-to-Book Value Ratio (PBV), Debt to Equity Ratio (DER), Inflation Consumer Price (INFCP), Inflation (INFGDP), GDP Growth (GDPGR), Tax Revenue (TR), and Trade (TRADE) The table includes regression coefficients and t-statistics $\left(\frac{b}{t_{stat}}\right)$. Robust regressions have been presented to account for heteroscedasticity and autocorrelation. The significance levels are denoted by ***, **, and *, corresponding to levels of 1%, 5%, and 10% respectively."

	(1) ZSCORE	(2) ZSCORE	(3) ZSCORE	(4) ZSCORE	(5) CZSCORE	(6) CZSCORE	(7) CZSCORE	(8) CZSCORE
LNINOV×FEMAUDITCOM	-4.742***				-0.00223			
	(-3.18)				(-1.02)			
LNINOV	5.139***				0.00610***			
	(3.24)				(4.33)			
LNINOV_{T-1}×FEMAUDITCOM		-3.363**				-0.00126		
		(-1.98)				(-0.57)		
LNINOV_{T-1}		3.537**				0.00655***		
		(2.18)				(4.83)		
LNINOV^2×FEMAUDITCOM			-0.182***				-0.000114	
			(-3.15)				(-1.33)	
LNINOV^2			0.199***				0.000248***	
			(3.22)				(4.44)	
$(\mathrm{LNINOV}_{T-1})^2$×FEMAUDITCOM				-0.127*				-0.0000864
				(-1.91)				(-1.01)
$(\mathrm{LNINOV}_{T-1})^2$				0.135**				0.000266***

				(2.15)				(4.96)
FEMAUDITCOM	-10.15	-24.33	-13.07*	-27.18	0.00869	-0.0110	0.0180	0.00282
	(-1.57)	(-1.23)	(-1.78)	(-1.36)	(0.20)	(-0.25)	(0.42)	(0.07)
FSIZE	6.222**	5.200*	5.620**	4.804*	0.0214**	0.0207**	0.0199**	0.0190**
	(2.28)	(1.96)	(2.14)	(1.85)	(2.49)	(2.40)	(2.22)	(2.12)
FAGE	-65.80***	-64.50***	-66.58***	-64.84***	0.0224	0.0239	0.0217	0.0235
	(-3.03)	(-3.00)	(-3.03)	(-3.01)	(0.81)	(0.88)	(0.79)	(0.87)
PBV	0.00257***	0.00260***	0.00258***	0.00260***	-0.000000360***	-0.000000360***	-0.000000358***	-0.000000358***
	(2.91)	(2.87)	(2.91)	(2.87)	(-2.75)	(-3.11)	(-2.74)	(-3.11)
DER	0.167	0.147	0.159	0.144	-0.000148	-0.000157	-0.000153	-0.000156
	(1.36)	(1.25)	(1.32)	(1.25)	(-0.64)	(-0.70)	(-0.66)	(-0.69)
INFCP	4.159	3.686	4.189	3.764	-0.0483***	-0.0503***	-0.0484***	-0.0500***
	(0.64)	(0.55)	(0.64)	(0.56)	(-4.09)	(-4.25)	(-4.09)	(-4.21)
INFGDP	0.0129	-0.736	-0.0861	-0.809	-0.0293***	-0.0294***	-0.0295***	-0.0297***
	(0.00)	(-0.21)	(-0.02)	(-0.23)	(-6.68)	(-6.89)	(-6.75)	(-6.96)
GDPGR	7.550*	8.566*	7.573*	8.610*	0.111***	0.112***	0.111***	0.113***
	(1.65)	(1.76)	(1.65)	(1.76)	(17.52)	(17.77)	(17.51)	(17.76)
TR	-19.99	-18.89	-19.99	-19.15	-0.0346	-0.0283	-0.0349	-0.0296
	(-1.32)	(-1.24)	(-1.32)	(-1.24)	(-0.98)	(-0.82)	(-0.99)	(-0.85)
TRADE	2.029	1.461	2.080	1.506	-0.0510***	-0.0521***	-0.0510***	-0.0521***
	(0.73)	(0.52)	(0.74)	(0.54)	(-12.81)	(-13.43)	(-12.81)	(-13.38)
_CONS	116.9	178.5	139.5	195.1	6.436***	6.434***	6.486***	6.497***
	(0.82)	(1.24)	(0.96)	(1.34)	(19.81)	(20.16)	(19.59)	(20.00)
N	637	637	637	637	637	637	637	637
R^2-Adj	0.201	0.187	0.200	0.186	0.755	0.759	0.755	0.758
F-Statistics	1.604	1.596	1.598	1.590	320.3	343.3	321.9	342.0
Prob > F	0.0860	0.0882	0.0877	0.0899	0.000	0.000	0.000	0.000

Appendix 6

"This table presents the results of a robust Ordinary Least Squares (OLS) regression analysis investigating the impact of banking innovation on banking stability with the moderating variable of Percentage of Female Audit Committee (PERC_FEMAUDITCOM). The analytical model employed in this study is an OLS regression model: $\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d} + \beta_2 \mathrm{PERC\_FEMAUDITCOM}_{i,d} + \beta_3(\mathrm{LNINOV}_{i,d} \times \mathrm{PERC\_FEMAUDITCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d}^2 + \beta_2 \mathrm{PERC\_FEMAUDITCOM}_{i,d} + \beta_3(\mathrm{LNINOV}_{i,d}^2 \times \mathrm{PERC\_FEMAUDITCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d} + \beta_2 \mathrm{PERC\_FEMAUDITCOM}_{i,d} + \beta_3 (\mathrm{LNINOV}_{t-1})_{i,d} \times \mathrm{PERC\_FEMAUDITCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d}^2 + \beta_2 \mathrm{PERC\_FEMAUDITCOM}_{i,d} + \beta_3 ((\mathrm{LNINOV}_{t-1})_{i,d}^2 \times \mathrm{PERC\_FEMAUDITCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon,$ $C\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d} + \beta_2 \mathrm{PERC\_FEMAUDITCOM}_{i,d} + \beta_3(\mathrm{LNINOV}_{i,d} \times \mathrm{PERC\_FEMAUDITCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{CZSCORE}_{i,d} = \beta_0 + \beta_1 \mathrm{LNINOV}_{i,d}^2 + \beta_2 \mathrm{PERC\_FEMAUDITCOM}_{i,d} + \beta_3(\mathrm{LNINOV}_{i,d}^2 \times \mathrm{PERC\_FEMAUDITCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, C\mathrm{ZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d} + \beta_2 \mathrm{PERC\_FEMAUDITCOM}_{i,d} + \beta_3 (\mathrm{LNINOV}_{t-1})_{i,d} \times \mathrm{PERC\_FEMAUDITCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon, \mathrm{CZSCORE}_{i,d} = \beta_0 + \beta_1 (\mathrm{LNINOV}_{t-1})_{i,d}^2 + \beta_2 \mathrm{PERC\_FEMAUDITCOM}_{i,d} + \beta_3 ((\mathrm{LNINOV}_{t-1})_{i,d}^2 \times \mathrm{PERC\_FEMAUDITCOM}_{i,d}) + \beta_4 \varphi_{i,d} + \epsilon,$. The variable $\varphi_{i,d}$ is a control variable consisting of Firm Size (FSIZE), Firm Age (FAGE), Price-to-Book Value Ratio (PBV), Debt to Equity Ratio (DER), Inflation Consumer Price (INFCP), Inflation (INFGDP), GDP Growth (GDPGR), Tax Revenue (TR), and Trade (TRADE) The table includes regression coefficients and t-statistics $\left(\frac{b}{t_{stat}}\right)$. Robust regressions have been presented to account for heteroscedasticity and autocorrelation. The significance levels are denoted by ***, **, and *, corresponding to levels of 1%, 5%, and 10% respectively."

	(1) ZSCORE	(2) ZSCORE	(3) ZSCORE	(4) ZSCORE	(5) CZSCORE	(6) CZSCORE	(7) CZSCORE	(8) CZSCORE
LNINOV×PERC_FEMAUDITCOM	-9.509***				0.000637			
	(-3.17)				(0.15)			
LNINOV	4.032***				0.00472***			
	(3.20)				(3.54)			
LNINOV_{T-1}×PERC_FEMAUDITCOM		-6.948**				0.00113		
		(-2.23)				(0.27)		
LNINOV_{T-1}		2.676**				0.00549***		
		(2.07)				(4.28)		
LNINOV^2×PERC_FEMAUDITCOM			-0.335***				-0.0000174	
			(-3.14)				(-0.11)	
LNINOV^2			0.149***				0.000188***	
			(3.19)				(3.60)	
$(\mathrm{LNINOV}_{T-1})^2$×PERC_FEMAUDITCOM				-0.240**				-0.0000110
				(-2.12)				(-0.07)

$(LNINOV_{T-1})^2$				0.0969**				0.000217***
				(2.02)				(4.32)
PERC_FEMAUDITCOM	15.31*	-14.23	3.426	-24.63	-0.0512	-0.0632	-0.0362	-0.0436
	(1.70)	(-0.50)	(0.40)	(-0.87)	(-0.61)	(-0.75)	(-0.44)	(-0.53)
FSIZE	2.772	2.681	1.832	2.175	0.0195**	0.0195**	0.0170**	0.0169**
	(1.19)	(1.23)	(0.83)	(1.04)	(2.34)	(2.33)	(2.01)	(1.98)
FAGE	-57.31***	-55.95***	-56.68***	-55.40***	0.0271	0.0292	0.0263	0.0282
	(-2.92)	(-2.92)	(-2.91)	(-2.91)	(0.98)	(1.07)	(0.95)	(1.04)
PBV	0.00262***	0.00264***	0.00262***	0.00264***	-0.000000330***	-0.000000334***	-0.000000328***	-0.000000333***
	(2.91)	(2.88)	(2.91)	(2.88)	(-2.64)	(-2.97)	(-2.63)	(-2.96)
DER	0.127	0.0986	0.117	0.0935	-0.000179	-0.000193	-0.000174	-0.000184
	(1.16)	(0.93)	(1.10)	(0.90)	(-0.78)	(-0.86)	(-0.76)	(-0.81)
INFCP	3.915	3.733	3.886	3.716	-0.0483***	-0.0506***	-0.0483***	-0.0504***
	(0.60)	(0.56)	(0.59)	(0.56)	(-4.07)	(-4.28)	(-4.08)	(-4.25)
INFGDP	-0.343	-0.812	-0.435	-0.874	-0.0295***	-0.0294***	-0.0297***	-0.0297***
	(-0.10)	(-0.23)	(-0.12)	(-0.24)	(-6.69)	(-6.90)	(-6.75)	(-6.96)
GDPGR	7.440	8.169*	7.422	8.188*	0.111***	0.112***	0.111***	0.112***
	(1.64)	(1.74)	(1.64)	(1.74)	(17.49)	(17.81)	(17.48)	(17.78)
TR	-19.80	-17.85	-19.68	-18.05	-0.0337	-0.0276	-0.0338	-0.0280
	(-1.31)	(-1.22)	(-1.30)	(-1.22)	(-0.96)	(-0.80)	(-0.96)	(-0.81)
TRADE	2.045	1.265	2.095	1.331	-0.0511***	-0.0521***	-0.0510***	-0.0522***
	(0.73)	(0.45)	(0.74)	(0.47)	(-12.79)	(-13.43)	(-12.79)	(-13.43)
_CONS	188.8	219.6	216.9	236.0	6.485***	6.451***	6.566***	6.544***
	(1.25)	(1.45)	(1.40)	(1.53)	(20.30)	(20.35)	(20.50)	(20.55)
N	637	637	637	637	637	637	637	637
R^2-Adj	0.187	0.176	0.184	0.174	0.754	0.758	0.754	0.757
F-Statistics	1.560	1.564	1.551	1.555	317.3	342.1	318.3	342.2
Prob > F	0.0989	0.0977	0.102	0.100	0.000	0.000	0.000	0.000

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