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Article

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BANKING & FINANCE | RESEARCH ARTICLE

The impact of bank competition on bank stability in Vietnam: The moderating role of shadow banking

Nhung Thi Nguyen^{1*}, An Tuan Nguyen¹, Thanh Ta Hong Le¹ and Ha Thi Nguyet To¹

Abstract: This paper aims to examine the moderating role of shadow banking in relation to the impact of bank competition on bank stability over a period from 2016 to 2021 in Vietnam. After building a bank stability index by combining the principal components of CAMELS through Principal Component Analysis (PCA), and the Lerner index as a measure of bank competition, this research uses panel corrected standard errors (PCSE) to analyze data of 20 Vietnamese commercial banks over a period from 2016 to 2021. As a result, the research shows that shadow banking reduces the positive impact of bank competition on bank stability in Vietnam despite it being considered a competitive strategy of banks. Furthermore, the research also indicates the positive role of bank size, equity to total assets, state ownership, and banking sector development for enhancing bank stability, while the opposite impact can be seen in the case of inflation. These results can help authorities in the banking sector and commercial banks in Vietnam to take appropriate measures to actively supervise or carefully implement shadow banking services in order to ensure bank stability.

Subjects: Asian Studies; Finance; Business, Management and Accounting

Keywords: bank competition; bank stability; bank risks; shadow banking; Vietnamese commercial banks



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1. Introduction

Bank stability can be defined as a state in which banks operate effectively in terms of resource distribution, risk dispersal, and income distribution (Jahn & Kick, 2012), helping them cope well with both internal and external issues, particularly economic shocks. By contrast, instability occurs when banks assets drop and they cannot repay their debts or the market value of their assets is less than their total liabilities (Jokipii & Monnin, 2013). Bank stability is strictly associated with the stability of the financial system, and GDP growth (Bayar et al., 2021; Jayakumar et al., 2018; Jokipii & Monnin, 2013).

There are different determinants of bank stability, such as bank characteristics (Nyangu et al., 2022; Tabak et al., 2012), financial structure (Goetz, 2018; Mirzaei et al., 2013), and macroeconomic factors (Bashir, 2022; Goetz, 2018). As an important factor, the degree of market power of banks, called bank competition, has inconsistent impacts on bank stability. To be precise, the positive impact of bank competition on bank stability is supported by the theory of market position of Boyd and De Nicolo (2005), while the theory of charter value of Marcus (1984) and Keeley (1990) tries to explain the negative aspect of this relationship.

Boyd and De Nicolo (2005) develop the theory of market position based on the ideas of “too big to monitor” of Boyd et al. (1993) and “too big to fail” of Mishkin (1999). Authors argue that banks in centralized or concentrated markets seem to be, almost without exception, bailed out by governments in case of bankruptcy since they are too large and too important to the economy. Banks are willing to take excessive risks or acquire riskier assets on portfolio to generate a lot of profit, which when successful increases the stability of the bank. In other words, the power of a high position in the market promotes financial stability in banks. Besides this, Supangkat et al. (2020) argue that as banks becomes more competitive, the operational efficiency of banks rises, leading to an increase in bank stability.

By contrast, Marcus (1984) and Keeley (1990) base their research on the charter value in order to explain the relationship between bank competition and bank instability. Charter value is defined as the difference between the market price and the book value, meaning capital gains for the bank's shareholders. In the case of concentrated or monopolistic markets, the market power of banks increases (Berger et al., 2008; Mateev et al., 2021), then banks will get higher returns on the lending market by offering higher lending rates (or higher charter values), leading to an increase in the likelihood of bankruptcy of borrowers, and consequently the risk of banks' bankruptcy or financial instability. Jiménez et al. (2013) conclude that less bank competition encourages banks to protect their high charter value using capital adequacy strategies, thus making banks more stable. However, this hypothesis is rejected by Beck (2008) who argues that more competitive banks are also less likely to the bank system distress. Negative or positive impacts of bank competition on bank stability are mostly affected by non-traditional or non-interest products offered by banks. Shadow banking is an example of such a product. Shadow banking is defined as activities providing capital to businesses through credit while breaking certain regulatory restrictions and constraints on lending by applying non-standard accounting methods (Sun, 2019). Shen et al. (2020) show that shadow banks involve unregulated credit intermediaries of banks, which are created “inside the bank”. In a competitive market, developing shadow banking is a way to increase bank competition (Tan et al., 2022). However, shadow banking can lead to considerable risk for banks, thus increasing the banking system's vulnerability according to some (Ding et al., 2020; Ilesanmi et al., 2019), or not according to others (Demirgüç-Kunt & Huizinga, 2010; Rose, 1989).

For many years, Vietnam has been considered as a banking-based economy. However, commercial banks have been accused of carrying out insider activities, called shadow banking, which could damage the stability of banks and the banking system (T. A. Pham, 2022). Some banks own controlling stakes in several companies which conduct business separately and independently, while some enterprises own banks. Recently, banks introduced corporate bonds to their clients

(even to those with low credit ratings) but mislead them into believing that all corporate bonds were guaranteed by the bank, whereas in fact banks only played the role of brokers (T. A. Pham, 2022). Consequently, bank clients had to face all risks when businesses went bankrupt in 2022, causing a decrease in confidence in the banking system

Considering the current situation in Vietnam and the inconsistent findings observed in previous studies, the study aims to investigate the moderating role of shadow banking in the relationship between bank competitiveness and bank stability. This focus sets this study apart from previous studies of scholars, such as Vo and Dang (2016), T. T. Pham and Dao (2021), and Son (2022) who only focus on the relation between bank competition and bank stability, Tran (2016) who investigate the effect of shadow banking activities on the financial conditions of Vietnam securities company or Nguyen (2018) who are interested in shadow banking separately. This paper investigates 20 Vietnamese commercial bank-level datasets which are collected from audited financial statements of banks over a period from 2016 to 2021 and uses the Hierarchical Multiple Regression Approach using Panel Corrected Standard Errors (PCSE) to achieve the research objectives.

This paper makes the following two contributions. First, this paper adds to the research on the link between bank competition and bank stability as well as the moderating role of shadow banking. This research provides evidence of the positive impact of bank competition on bank stability among Vietnamese commercial banks, providing support for the theory of market position. In addition, the empirical results also show that shadow banking reduces the positive impact of competition on stability instead. Furthermore, this paper makes policy recommendations dealing with the relationship between bank competition and bank stability while considering the role of shadow banking. In terms of policy implications, this study suggests that authorities should actively supervise shadow banking activities. Moreover, commercial banks should be aware of the trade-off between benefits and drawbacks brought by shadow banking, in order to implement appropriate strategies of risk management.

This paper proceeds in six sections. Section two presents a related literature review on the link between bank competition and bank stability and the moderating role of shadow banking in this relationship. Section three explains variables, the data collection, and the data analysis. Section four describes the analysis results before discussing findings and providing conclusions in section five and section six.

2. Literature review and developing hypotheses

It can be seen that empirical results on the impact of bank competition on bank stability follow two theoretical perspectives, including “competition—stability” and “competition—fragility”. The positive impact of bank competition on bank stability can be found in many studies, such as those of Schaeck and Čihák (2012), Amidu and Wolfe (2013), Noman et al. (2017), Goetz (2018), Noman et al. (2018), and Islam et al. (2020). These authors argue that competition is necessary to enhance financial stability and overcome the limitations of monopoly markets (Caminal & Matutes, 2002; Schaeck et al., 2009). In an era of the rapid growth of financial institutions, GC and Sharma (2020) show a positive relationship between greater bank competition and more excellent financial stability in Nepal, providing evidence for the “competition-stability” view. However, the positive impact of bank competition on bank stability depends on the extent to which banks can benefit from subsidies because they are deemed “too large to fail” (Mishkin, 1999; Soedarmono et al., 2013). By contrast, the “competition—fragility” view can be seen in many studies executed in different regions of the world, such as the East Asian countries (Phan et al., 2019), the Sub-Saharan African countries (Sarpong-Kumankoma et al., 2020), the MENA countries (Albaity et al., 2019; Moudud-UI-Huq et al., 2022), and the BRICS countries (Moudud-UI-Huq, 2021). López-Penabad et al. (2021) argue that competition motivates banks to take risks, which increases the fragility of banks (Leroy & Lucotte, 2017; Schaeck et al., 2009).

In particular, Martínez-Miera and Repullo (2010) show that the likelihood of bankruptcy increases but then decreases after a certain level of banking competition occurs, which results in a bell-shaped non-linear relationship between competition and financial stability. According to the authors, when the level of competition does not exceed the optimal, the hypothesis of “competition—stability” holds, and the hypothesis of “competition—fragility” is accepted when bank competition is beyond optimal (Dutta & Saha, 2021; S. Hou, 2023; Liu et al., 2013). Similarly, inverted U-shaped relationships can be seen in the studies of Tabak et al. (2012) in Latin America, Jiménez et al. (2013) in Spain, Jeon and Lim (2013) in Korea, González et al. (2017) in MENA, and Yuan et al. (2022) in America. However, the non-linear relationship between bank competition and bank stability is not found in the European market (López-Penabad et al., 2022) or in the East African Community (Nyangu et al., 2022).

The relationship between competition and bank stability in Vietnam is also of interest to researchers. Vo and Dang (2016) and T. T. Pham and Dao (2021) support the “competition—stability” nexus, while Son (2022) indicates that banks tend to take on more risks when having to face an increase in competition among banks. This research proposes the first hypothesis as follows:

Hypothesis 1 Bank competition impacts on bank stability in Vietnam.

In terms of shadow banking, it has interactions with both bank competition and bank stability (Tan et al., 2022; Wu & Shen, 2019; Zhang et al., 2022; Zhu, 2022). The non-zero-sum game theory of Brandenburger and Nalebuff (1995) explains that commercial banks co-conduct conventional credit business with shadow banking to maximize profits, avoid scrutiny from authorities, and enhance the innovation and competitiveness of banks. Zhang et al. (2023) conclude that the greater the proportion of investment in shadow banking, the higher the bank’s profitability, which motivates banks to carry out shadow banking activities. Tan et al. (2022) also find that the extent of shadow banking can be affected by the intensity of competition in the banking market and vice versa.

Moreover, the risk-return trade-off theory proposed by Rose (1989) indicates that diversifying operations into non-traditional sectors will mitigate the overall risk of the bank if the rate of return or cash flow of these activities is lower than the return rate or general cash flow of the bank. According to Demirgüç-Kunt and Huizinga (2010), the more diverse the bank’s non-interest income index is, the lower the lending risk, leading to improved bank stability. Using a variety of measuring of bank stability, Tahir et al. (2016) demonstrated that through diversification strategies, banks’ risks can be minimized, improving their stability in South Asian countries. By contrast, shadow banking increases credit risk (Bashir, 2022) or liquidity risk since shadow banking investments are hardly ever liquidated in volatile market conditions. The interconnectedness of shadow banks and traditional banks easily leads to a risk transformation from shadow banking activities to large commercial banks (Ilesanmi et al., 2019; Shen et al., 2020), which results from a lack of regulations (Isayev & Bektas, 2022). Ding et al. (2020) claim that the non-transparency of shadow banks detailed in financial reports and their hard-to-identify underlying assets make it difficult to assess their quality or make provisions for default. Furthermore, Ouyang and Wang (2022) confirm a negative impact of shadow banking on bank stability in large-scale banks, but this effect is not considerable in small and medium-sized banks. It can therefore be seen that the relationship between bank competition and bank stability can be moderated by shadow banking. Accordingly, this paper proposes the following hypothesis:

Hypothesis 2 Shadow banking activities moderate the impact of bank competition and bank stability in Vietnam.

Figure 1. Conceptual framework.

Source: Authors.

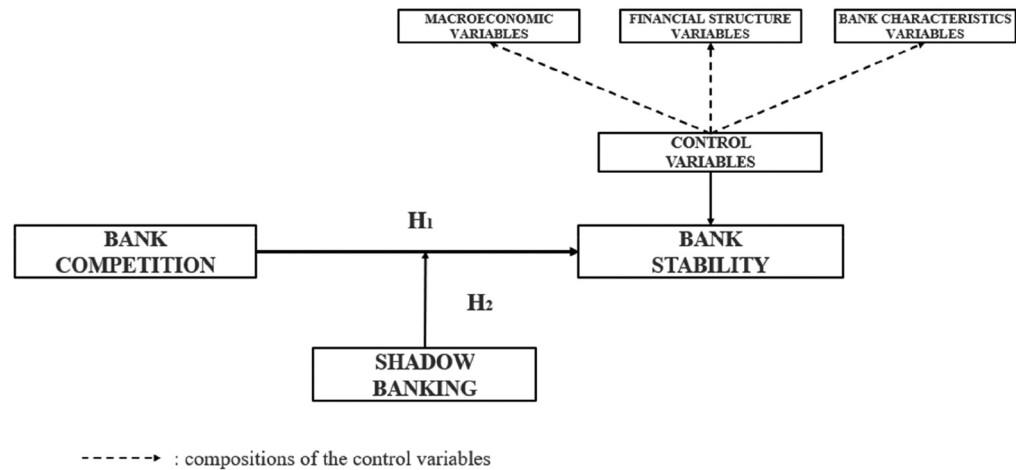


Figure 1 describes the design of this research.

3. Methodology

3.1. Measuring variables

3.1.1. Dependent variable: bank stability

For years, the Z-score has been largely used to measure bank stability by scholars, including Beck et al. (2013), T. T. Pham et al. (2021), and Nyangu et al. (2022), while CAMELS is considered a benchmark criterion for most financial institutions to assess the strength of banks and financial institutions. Comparing these two indicators, Permata and Purwanto (2018) criticize the Z-score indicator for two reasons, including: (i) It is said that the reliability of scale largely depends on financial reports of quality; (ii) The Z-score only reflects bank risks but ignores spillover or inter-connectedness in system risk or non-financial factors. That's why, this paper uses CAMELS which is described in Table 1, as indicators of bank stability.

Since each financial ratio only explains a specific aspect of bank stability, this paper tries to build a bank stability index by combining the principal components of CAMELS through Principal Component Analysis (PCA) in the same way as Creel et al. (2015), Horváth and Vaško (2016) and Jayakumar et al. (2018) did. The process of calculating the bank stability index is shown in the following steps:

- (i) Step 1: Collect bank-level data on CAMELS-related- financial ratios.
- (ii) Step 2: Normalize data by using the Min-Max method proposed by Moesen and Cherchye (1998) to convert component ratios to the same unit of calculation so that they can be compared as well as combined. The normalization process can be expressed as following:

$$\begin{cases} I_{i,t}^{norm} = \frac{I_{i,t} - I_t^{min}}{I_t^{max} - I_t^{min}}, & \text{if ratios have apositive impact} \\ I_{i,t}^{norm} = \frac{I_t^{max} - I_{i,t}}{I_t^{max} - I_t^{min}}, & \text{if ratios have anegative impact} \end{cases}$$

In which:

- o $I_{i,t}^{norm}$ is the normalized value of the ratio for the bank i at time t.
- o $I_{i,t}$ is the actual value of a ratio for the bank i at time t.
- o I_t^{min} is the minimum value of a ratio at time t.
- o I_t^{max} is the maximum value of a ratio at time t.

Table 1. Dimensions and indicators of the bank stability index

Dimensions		Code	Measure	Impact
Capital Adequacy (C)	Capital Adequacy ratio (0.5)	CAR	Consolidated equity capital/Total risky assets	+
	Financial leverage coefficient (0.5)	EL	Total equity/Total liability	+
Asset Quality (A)	NPL/total loan ratio (0.5)	NPL	Total bad debt/ Total outstanding debt	-
	NPL/total assets ratio (0.5)	NAR	Total bad debt/ Total assets	-
Management (M)	Operation cost index (0.5)	OCA	Operational expenses/Total assets	+
	Loan growth rate (0.5)	LGR	Average of historical loan rate	+
Earnings (E)	Return on assets (0.33)	ROA	Net income/Total Assets	+
	Return on equity (0.33)	ROE	Net income/Total Equity	+
	Net interest margin (0.33)	NIM	(Investment Income – Interest Expenses)/Average Earning Assets	+
Liquidity (L)	Liquidation ratio of assets (0.25)	LROA	Liquidated assets/ Total assets	+
	Deposit guarantee coefficient (0.25)	DGC	Liquidated assets/ Total deposits	+
	Short-term liquidity coefficient (0.25)	SLC	Liquidated assets/ Total current liabilities	+
	The ratio of outstanding loans and deposits (0.25)	ROLD	Total outstanding loans/Total deposits	+
Sensitivity to market risk (S)	The ratio of bank assets and bank system assets (0.5)	S1	The ratio of bank assets and bank system assets	-
	Difference between interest-sensitive assets and interest-sensitive liabilities to total assets (0.5)	S2	(Rate-sensitive assets - rate-sensitive liabilities)/ Total assets	-

Source: Authors.

- (iii) Step 3: Use the PCA approach to assign weights to all six bank stability dimensions and combined them to create a composite index called the Bank Stability Index. The process for calculating the weights is shown in *Appendix 1*.

3.1.2. Independent variable: bank competition

In a non-structured approach used to measure bank competition, there are different indicators, such as H-statistic (Panzar & Rosse, 1987), Boone indicator (Boone, 2008), the Lerner index (Lerner, 1934) and efficiency-adjusted Lerner. However, H-statistic and Boone indicator have major drawbacks. To be precise, H-statistic is strictly based on the assumption of an equilibrium market while this is unrealistic (Claessens & Laeven, 2004). For the Boone indicator, it exploits the reallocation from inefficient units to efficient ones, while the Lerner index is a competitive measure rooted in banking optimization problems (Maudos & Solís, 2011). In particular, Berger et al. (2008) argue that

Lerner index has a solid theoretical basis and can identify different patterns of behavior in the same market and/or between years as well as better capture the market power of banks. Hence, this paper uses the Lerner index to measure bank competition. The Lerner index is determined by the ratio of the difference between the output price and the marginal cost to the output price, through the following formula:

$$LERNER_{it} = \frac{Price_{it} - MC_{it}}{Price_{it}} \quad (1)$$

In which:

- o $Price_{it}$ is the output price of the bank i at time t , which is calculated as total revenue on total assets.
- o MC_{it} is the marginal cost of the bank i at time t .

The value of the Lerner index ranges from 0 to 1. The lower Lerner index value implies a weaker level of competition between banks whereas equal to 1, the market becomes a complete monopoly, i.e. the bank has absolute market power. The Lerner index is presented in Appendix 2.

3.1.3. Moderating variable: shadow banking

Although the task of extracting this activity-related-data from banks' financial statements is quite difficult, this paper tries to measure the moderating variable of shadow banking in Vietnamese commercial banks based on previous studies, the availability of data, and results from deep interviews with experts in the banking sector. Firstly, based on the research of Ding et al. (2020), and Zhang et al. (2023), and available data, we can calculate interbank loans, entrusted loans, financial products or investment receivables through "loans to other credit institutions" (LCI), payment on behalf of customers (PBC), and contingent liabilities (CL) which are detailed on notes of banks' financial statements. Moreover, data on financial conglomerates which have recorded their total investment in subsidiaries, investment in associate companies, and other long-term investments (ILT), can also be utilised. Accordingly, this paper measures shadow banking in banks by using the following formula:

$$SB_{i,t} = \frac{LCI_{i,t} + PBC_{i,t} + CL_{i,t} + ILT_{i,t}}{TA_{i,t}}$$

In which:

- o $SB_{i,t}$ is the shadow banking of the bank i at time t .
- o $LCI_{i,t}$ is the loans to other credit institutions of the bank i at time t .
- o $PBC_{i,t}$ is the payment on behalf of customers of the bank i at time t .
- o $CL_{i,t}$ is the contingent liabilities of the bank i at time t .
- o $ILT_{i,t}$ is the investment in associate companies, and other long-term investments of the bank i at time t .
- o $TA_{i,t}$ is the total assets of the bank i at time t .

Secondly, another banking activity which Vietnamese financial experts have been interested in for many years in Vietnam, is the services of agency and brokerage for corporate bonds. In fact, the income from fees and services is considered to be a representative indicator of shadow banking activity in a corporate sense based on regulatory loopholes. Therefore, the ratio of income from agency and brokerage services to total income of banks will be used to measure bank services of agency and brokerage for corporate bonds.

$$SB_{i,t} = \frac{IABS_{i,t}}{TI_{i,t}}$$

In which:

- o $SB_{i,t}$ is the shadow banking of the bank i at time t .
- o $IABS_{i,t}$ is the income from agency and brokerage services of the bank i at time t .
- o $TI_{i,t}$ is the total income of the bank i at time t .

3.1.4. Control variables

In order to ensure the stability of the estimated results, this paper uses some control variables, including: (i) bank characteristics; (ii) financial structure; and (iii) macroeconomic conditions.

In terms of bank characteristics, this paper refers to bank size, equity to total assets, and ownership structure. Firstly, large banks are able to dominate the market and then generate higher revenues than small banks, resulting in a more stable state (Laeven et al., 2016). However, Tabak et al. (2012), Mirzaei et al. (2013) and Fu et al. (2014) argue that large-scale banks tend to engage in more high-risk activities than small banks, leading to risk for their financial stability. As a result, the relationship between bank size and bank stability is still undetermined. Secondly, equity to total assets (ETA) is used to maintain bank stability in the case of losses due to bad debts or financial shocks (Diaconu & Oanea, 2014; Tabak et al., 2012). Finally, the ownership structure (STO) which in this paper, refers to state ownership, is a factor influencing banks' innovation business strategies (Bashir, 2022; X. Hou et al., 2018).

Concerning financial structures, this paper refers to banking sector development (BSD) and stock market development (SMD). The first indicator which is measured by the ratio of banking sector assets to GDP, means the level of development of the banking sector (Goetz, 2018; Mirzaei et al., 2013). Moreover, stock market development (SMD) measured by the ratio of listed companies' market capitalization to GDP, refers to an efficient capital market, lowering moral hazard and adverse selection (Mirzaei et al., 2013).

Finally, Nyangu et al. (2022), and Bashir (2022) argue that macroeconomic conditions can affect the quality of assets and financial stability of banks. This paper uses GDP and the inflation rate (INF) as factors of macroeconomic conditions, as per the studies of Goetz (2018), and Zhang et al. (2023).

In brief, all variables are summarized in Table 2.

3.2. Data collection

The panel bank-level data used in this paper is sourced from audited financial statements and annual reports of 20 commercial banks over a period from 2016 to 2021 which are extracted from FiinPro Platform. The research period starts at 2016, which marks the second restructuring phase of the banking system in Vietnam. Moreover, 20 commercial banks examined by the research are able to represent the whole of the Vietnamese banking sector because their total assets account for a major part of total bank industry assets. Further data related to financial market structures and macroeconomic factors such as GDP growth rates and inflation rates are collected from the IMF and the World Bank.

3.3. Data analysis

To test the impact of independent variables and moderating roles, the hierarchical regression method is perfectly suitable. This is because this framework for model comparison allows for statistical control by assessing the contribution of added variables in the model with previous variables and as a means of checking for increased validity. There are three regression models to be tested.

Table 2. Summary of variables

Variable	Code	Definition	Source
Dependent variable: Bank stability			
Bank Stability Index	BS	CAMELS with PCA	Creel et al. (2015), Horváth and Vaško (2016), Jayakumar et al. (2018)
Independent variable: Bank competition			
Lerner Index	BC	(Price—Marginal cost)/ Price (%)	Lerner (1934), Vo and Dang (2016)
Moderator variable: Shadow Banking			
Shadow Banking 1	SB1	Ratio of loans to other credit institutions, payment on behalf of customers, contingent liabilities and long-term investments to total asset (%)	Ding et al. (2020), Zhang et al. (2023)
Shadow Banking 2	SB2	Ratio of incomes from agency and brokerage services to total income (%)	Authors
Control variables			
Bank size	SIZE	Natural log of total assets	Tabak et al. (2012), Laeven et al. (2016)
Equity to total assets	ETA	Ratio of equity to total assets (%)	Tabak et al. (2012), Diaconu and Oanea (2014)
State ownership	STO	The rate of government ownership (%)	X. Hou et al. (2018), Bashir (2022)
Banking sector development	BSD	The ratio of banking sector assets/GDP (%)	Goetz (2018), Mirzaei et al. (2013)
Stock market development	SMD	The ratio of value of shares traded to market capitalization (%)	Mirzaei et al. (2013)
GDP Growth	GDP	Rate of GDP growth (%)	Goetz (2018), Zhang et al. (2023)
Inflation rate	INF	Rate of change of GDP deflator (%)	Nyangu et al. (2022), Bashir (2022)

Source: Authors.

$$BS_{it} = \alpha_1 + \alpha_2 BC_{it} + \sum_{j=1}^8 \gamma_j Controls_{it,j} + \varepsilon_{it} \quad (2)$$

$$BS_{it} = \alpha_1 + \alpha_2 BC_{it} + \alpha_3 SB_{it} + \sum_{j=1}^8 \gamma_j Controls_{it,j} + \varepsilon_{it} \quad (3)$$

$$BS_{it} = \alpha_1 + \alpha_2 BC_{it} + \alpha_3 SB_{it} + \alpha_4 BC_{it} \times SB_{it} + \sum_{j=1}^8 \gamma_j Controls_{it,j} + \varepsilon_{it} \quad (4)$$

Where:

- o $i = 1, 2, \dots, N$ with N is the number of banks.
- o $t = 1, 2, \dots, T$ with T is the number of years studied.
- o BS_{it} is a dependent variable, measured by the PCA method.
- o BC_{it} is an independent variable representing bank competitiveness, measured by the Lerner index.

- o SB_{it} is the variable representing Shadow banking.
- o $Controls_{it,j}$ are control variables, including variables related to bank characteristics, financial structure, and macroeconomic factors.
- o $\alpha_1 \dots \alpha_4$ are estimated coefficients that explain the impact of independent variables on the dependent variable.
- o $\sum_{j=1}^8 \gamma_j$ are blocking coefficients.
- o ε_{it} is statistical error.

The regression Equation 1 expresses the effect of the independent variable (BC_{it}) on the dependent variable (BSt_{it}). The regression Equation 2 shows the effect of the independent variable (BC_{it}) on the dependent variable (BS_{it}) but the moderated variable (SB_{it}) is introduced into the model as an independent variable. The regression Equation 3 represents the effect of the independent variable (BC_{it}) and the interaction variable ($BC_{it} \times SB_{it}$) on the dependent variable (BSt_{it}). If the interaction variable has statistical significance, then that proves that the variable SB_{it} acts as the regulatory variable.

Hierarchical regression in this study is approached in three steps with two proxy variables for shadow banking control variables. In the second step, shadow banking is treated as an independent variable, whereas in the third step, there is an interaction variable between bank competitiveness and shadow banking. Furthermore, this research uses the PCSE and FGLS estimators as base regression techniques to deal with issues of cross-sectional data, such as serial correlation, heteroskedasticity, cross-sectional dependence, autocorrelation (Le & Nguyen, 2019; Parks, 1967), and the problem that there are more cross-sections than intervals ($N > T$). In fact, to account for this disparity, the FGLS estimator generates undervalued standard errors, while the PCSE estimator generates accurate standard error estimates with no loss in efficiency compared to FGLS. This means that the FGLS estimator is better suited for temporal-dominant data in panel data.

4. Results

4.1. Descriptive statistics

Table 3 reports the data description with 120 total observations for each variable. It can be seen that the average value and the standard deviation of bank stability (BS) is 0.352 and 0.199, respectively. The Lerner Index which represents the independent variable of bank competition (BC) has an average value of 0.410, a standard deviation of 0.085, and the min-max values of 0.205 and 0.613, respectively. Furthermore, the volatilities of two proxies of the shadow banking variable, including SB1 and SB2, are

Table 3. Descriptive statistics

Variable	Obs	Mean	Std. dev.	Min	Max
BS	120	0.352148	0.199118	-0.02746	0.932065
BC	120	0.410166	0.084706	0.205419	0.613407
SB1	120	0.08834	0.071262	0.002069	0.34887
SB2	120	0.005159	0.0126	1.22E-06	0.097896
SIZE	120	12.52823	0.983428	10.32387	14.38193
ETA	120	0.077484	0.027096	0.040618	0.169732
STO	120	0.194786	0.333153	0	1
BSD	120	1.654714	0.18657	1.3618	1.930403
SMD	120	50.761	19.25552	28.48049	90.3
GDP	120	5.646905	2.100597	2.561551	7.464991
INF	120	2.929934	0.592794	1.834716	3.539628

Source: Authors extracted information from Stata 17.

0.071 and 0.013 respectively, while controlled variables, such as SIZE, ETA, STO, BSD, SMD, GDP, and INF, have average values of 12.528, 0.077, 0.195, 1.655, 50.761, 5,647, and 2.930, respectively.

4.2. Multicollinearity analysis and other data diagnosis

Table 4 shows the estimates of pairwise and multilinear correlations for variables in this sample. It can be seen that the correlation values reported had no absolute values greater than 0.8, ruling out the possibility of high multicollinearity between the study variables. Furthermore, the variance inflation factor values (VIF) are all as small as 10, so it adds to the certainty that no multilinear phenomena occur with the selected estimators.

The results of the variance change test which are detailed in Table 5 show that FEM and REM estimation methods experience variable variance, while the OLS method does not. However, the p-values of F and χ^2 are smaller than 0.05 (Appendix 3), meaning that either FEM and REM models are more efficient than OLS or there is a heteroskedasticity phenomenon. Secondly, the Wooldridge test for autocorrelation in panel data is also performed (Appendix 4). The results obtained statistical values F of 37.304 and p-value of 0.0000 which is smaller than 0.05, meaning that there is an autocorrelation in the panel data. Finally, Breusch-Pagan LM, Pesaran scaled LM, Bias-corrected scaled LM, and Pesaran CD tests are applied with estimated p-values of less than 5% to ensure the existence of a cross-sectional dependence defect in most variables (Appendix 5). Based on the above test, a PCSE regression estimator is used in the panel data settings with the smaller time interval (T) and large cross-section (N), while an FGLS estimator is also executed to ensure the robustness of results.

4.3. Moderating role of shadow banking for the impact of bank competition on bank stability in Vietnam

Table 6 shows hierarchical PCSE regression results. Firstly, the Lerner index has a positive effect on the bank stability index at statistically significant levels of 1%, 5%, and 10%. This indicates that the higher bank competition is, the higher bank stability is. Therefore, **hypothesis (H1) is accepted**.

The shadow banking variable is represented by two proxies, SB1 and SB2. The PCSE estimate indicates that SB1 positively affects BS at a significant 1%. Furthermore, the interaction variable ($BC \times SB1$) was statistically significant at 1%, meaning a negative impact on BS. In particular, the more banks engage in shadow banking activities, the less BC impacts BS. In other words, shadow banking activities moderate the impact of bank competitiveness and bank stability, and thus **hypothesis (H2) is accepted**. As regards to SB2, there is no relationship with BS.

Furthermore, most of the variables related to bank characteristics affect bank stability. To be precise, SIZE and ETA positively impact BS at a statistically significant level of 1%, while the inverse influence can be seen in STO at a level of 1%. For factors of financial structure, a positive relationship between BSD and BS is found at a level of 1%, which is not the case in respect of SMD. In addition, there is a negative relationship between INF and BS, while there is no evidence of a relationship between GDP and BS.

To check the model robustness, Feasible Generalized Least Squares Regression (FGLS) is substituted to test the sensitivity of the generated results (Appendix 6). There are some differences in the results. Firstly, bank competition has a positive impact on bank stability at statistically significant levels of 1% and 5%, but there is no impact on the participation of interactive variables ($BC \times SB1$). Shadow banking (SB1) still has a positive influence on bank stability at 5%, while shadow banking's interactive role in the competition-stability relationship has not been detected as PCSE estimates. Moreover, the group of bank characteristics retains the same dimension of impact as the main result. Meanwhile, banking sector development (BSD) has a positive influence on bank stability in model (1) with a statistically significant level of 10%. By contrast, the remaining controlled variables have no correlation with bank stability.

Table 4. Results for Pearson correlations and multicollinearity

Variables	BS	BC	SB1	SB2	SIZE	ETA	STO	BSD	SMD	GDP	INF	VIF
BS	1											
BC	0.1476	1										1.74
SB1	0.2697*	0.4447*	1									1.65
SB2	0.1965*	0.055	0.0761	1								1.2
SIZE	0.0445	0.5725*	0.3652*	0.0272	1							3.65
ETA	0.5047*	0.1221	0.2226*	0.0625	0.2325*	1						1.55
STO	0.2488*	0.4416*	0.3317*	0.1874*	0.7729*	0.4093*	1					3.67
BSD	0.0805	0.1128	0.0324	0.0254	0.1832*	0.1123	0.0142	1				2.62
SMD	0.1892*	0.1896*	0.025	0.1745	0.2209*	0.113	0.0161	0.7055*	1			5.1
GDP	0.1980*	0.1546	0.0433	0.1178	0.1932*	0.1072	0.0169	0.3940*	0.7731*	1		2.98
INF	0.1725	0.1863*	0.0117	0.0731	0.1201	0.106	0.0114	0.5993*	0.6533*	0.5317*	1	1.98

Notes: The sign * represents significance at 5% level of significance.

Source: Authors extracted information from Stata 17.

Table 5. Results for heteroskedasticity test

Estimation methods	Test	Statistics	Results
OLS	White	0.89	Reject
FEM	Modified Wald	183.26*	Accept
REM	Breusch and Pagan Lagrangian	152.03*	Accept

Notes: The sign * represents significance at 5% level of significance.

Source: Authors extracted information from Stata 17.

Table 6. Hierarchical PCSE regression results

Model	(1)	(2)	(3)	(4)	(5)
Independent variable					
Bank competition (BC)	0.355** (2.51)	0.220* (1.82)	0.728*** (3.23)	0.351** (2.51)	0.512** (2.51)
Moderated variables					
Shadow banking (SB1)		0.456*** (3.26)	2.805*** (2.83)		
Bank competition* Shadow banking (SB1)			-5.639** (-2.38)		
Shadow banking (SB2)				0.872 (0.69)	14.04 (1.63)
Bank competition* Shadow banking (SB2)					-29.25 (-1.58)
Control variables					
Bank size (SIZE)	0.0861*** (6.97)	0.0832*** (6.93)	0.0690*** (6.97)	0.0815*** (6.11)	0.0698*** (4.44)
Equity to total assets (ETA)	3.174*** (6.75)	2.668*** (6.07)	2.922*** (5.85)	3.197*** (7.00)	3.450*** (6.51)
Stated ownership (STO)	-0.279*** (-7.43)	-0.307*** (-7.62)	-0.258*** (-6.21)	-0.262*** (-7.56)	-0.237*** (-6.29)
Banking sector development (BSD)	0.195*** (3.07)	0.179*** (3.11)	0.180*** (3.12)	0.179*** (2.60)	0.188*** (2.84)
Stock market development (SMD)	0.000725 (0.84)	0.000739 (0.95)	0.000936 (1.20)	0.000503 (0.52)	0.000683 (0.75)
GDP Growth (GDP)	0.0000246 (0.00)	-0.00188 (-0.34)	-0.00172 (-0.31)	-0.000879 (-0.14)	0.000313 (0.05)
Inflation rate (INF)	-0.0355** (-2.01)	-0.0346** (-2.16)	-0.0333** (-2.07)	-0.0352** (-2.05)	-0.0317* (-1.84)
Constant	-1.318*** (-5.64)	-1.191*** (-5.46)	-1.253*** (-5.84)	-1.227*** (-4.93)	-1.217*** (-4.98)
Number of observations	120	120	120	120	120
R-squared	0.392	0.409	0.426	0.395	0.403
Prob > chi ²	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: The sign *, ** & *** represents significance at 10%, 5% and 1% level of significance, and values within parenthesis represent standard errors.

Source: Authors extracted information from Stata 17.

5. Discussions

The research results indicate that bank competition, shadow banking with SB1-proxy, bank size, equity to total assets, and banking sector development have a positive impact on bank stability, while impacts of state ownership and inflation on bank stability are negative. Furthermore, there is no evidence of a relationship between bank stability and shadow banking with SB2-proxy, stock market development, or GDP growth. In particular, shadow banking, which is measured as the ratio of loans to other credit institutions, payment on behalf of customers, contingent liabilities, and long-term investments to total assets, reduces the impact of bank competition on bank stability.

5.1. Firstly

This paper indicates that shadow banking reduces the bank competition-stability nexus. This result is completely consistent with the conclusion of Zhang et al. (2022) who argue that in the long run, unsupervised shadow banking poses relatively high risks in the investment and financing sector, causing losses for banks or damaging bank stability. In Vietnam, shadow banking activities, which rely heavily on trust between organizations, easily create moral hazard, weakening the financial stability of banks.

- (i) Vodova (2011) argues that reliance on capital from the interbank market increases liquidity risk when banks have to borrow at high-interest rates, increasing debt ratios. Moreover, the fact that commercial banks borrow externally to meet the borrowing needs of customers can increase the debt-to-equity ratio, thereby affecting banks' efforts to maintain an optimal capital structure (Arif & Anees, 2012). In addition, Shen et al. (2020) argue that shadow banking carried out by commercial banks converts risky corporate loans into risk-weighted interbank loans that carry much smaller risk weights in calculating capital ratios and liquidity measures, resulting in skewed bank ratings. In Vietnam, banks have close relationships with each other through transactions in the interbank market. Data from the Vietnamese banking system show that the figures for 2017 and 2021 are VND 231,438.73 billion and VND 279,212.28 billion, recording growth rates of 31.38% and 59.45%, respectively. The speed and scale showed signs of slowing down from 2018 to 2020 due to the impact of the COVID-19 epidemic. During this period, many businesses disappeared and the number of non-performing loans increased rapidly, causing credit and liquidity risks for banks and the whole banking sector.
- (ii) Entrusted loans are viewed as bank off-balance sheet business or complex funding sources. In fact, since this fiduciary activity often goes through many parties and is recorded off-balance sheet, it is difficult to access information, leading to an asymmetry of information between lenders and borrowers (Zhang et al., 2023). Consequently, the wrong selections can be made, and moral hazard can easily occur. In Vietnam, accounts payable on behalf of customers experience a gradual growth over the period from 2018 to 2020 and a decrease in 2021. Starting at VND 371.88 billion in 2018, the figures increased to VND 782,345 billion in 2019 and VND 1186,175 billion in 2020, which resulted largely from losses of business during the COVID-19 pandemic. There were also some cases in which commercial banks, on behalf of their clients, had to fulfil obligations to a third party. For instance, AGRIBANK pays VND 38.5 billion on behalf of Cao Truong Son Co., Ltd for Industrial and Construction Equipment Joint Stock Company or SEABANK must fulfil the obligation to guarantee the payment of Vina Megastar bonds worth VND 150 billion to VVF financial company.
- (iii) Data from 20 examined banks show that financial products or investment receivables are the largest share of shadow banking in commercial banks. To be precise, latent debt growth reached a peak of 43.35% in 2017, followed by a growth rate of 22.59% in 2021. Moreover, liabilities experienced a significant growth with the figure of VND 986,334.09 billion in 2021, compared to only VND 668,036.57 billion in 2017, leading to credit risks, where such credit risk from contingent liabilities has a negative effect on bank profitability (Aktan et al., 2013), damaging bank stability (Kashian & Tao, 2014).

5.2. Secondly

Bank competition increases bank stability, which is totally consistent with the market position theory proposed by Boyd and De Nicolo (2005) as well as the conclusions of Noman et al. (2017), Goetz (2018), and Islam et al. (2020). In the context of international economic integration, Vietnamese banks have had to deal with an increase in competition pressure from both domestic and foreign financial institutions, which has required them to implement various strategies not only to maintain their market share and power but also to get higher profits and improve their performance or financial stability (Fiordelisi & Mare, 2014).

5.3. Thirdly

The research result provides evidence of a positive impact of shadow banking on bank stability only when shadow banking is measured by the ratio of loans to other credit institutions, payment on behalf of customers, contingent liabilities, and long-term investments to total assets, which is consistent with findings of Ding et al. (2020), and Zhang et al. (2023). This finding also supports the Trade-off theory proposed by Rose (1989). In theory, shadow banking is a kind of portfolio diversification activity outside traditional banking activities. This is a clever strategy in which banks can cut loan rates in typical company operations to grow their market share thanks to non-interest income (Maudos & Solís, 2009). However, this result is totally different from the conclusions of Shen et al. (2020), Ding et al. (2020), and Bashir (2022), which argue that shadow banking activities significantly reduced bank stability.

However, the shadow banking scale of income from agency and brokerage services to total income of banks does not affect bank stability. This result can be originated from the fact that this research can not access detailed data about income from sales of corporate bonds specifically, and the activity of selling corporate bonds can have lagged impacts on bank stability. In fact, various problems related to corporate bonds have only appeared since 2022, while the study period is from 2016 to 2021, causing a decrease in confidence in the banking system in Vietnam.

5.4. Finally

All variables related to bank characteristics influence bank stability in different aspects. Firstly, bank size and equity to total assets have a positive effect on bank stability, which is totally consistent with the findings of Laeven et al. (2016), and Diaconu and Oanea (2014). Secondly, state ownership reduces bank stability, which is totally different from the conclusions of Bashir (2022). Quoc Trung and Abdul Wahab (2021) argues that in general, state-owned banks have lower profits and higher costs than private banks, due to asymmetric information, state-owned banks ineffectively control agency costs, affecting their operational efficiency and financial stability.

Related to banking system factors, banking sector development has a positive impact on bank stability, which confirms the findings of Mirzaei et al. (2013) and Goetz (2018). However, there is no evidence of an impact of stock market development on bank stability, while Mirzaei et al. (2013) claim that a higher stock market development ratio indicates a more efficient capital market, in which banks may obtain perfect information about firms, reducing moral hazard and adverse selection risks, and engender greater bank stability. Furthermore, inflation has an inverse relationship with bank stability, while GDP growth has no effect on competitive stability, which does not support the findings of Goetz (2018) or Bashir (2022).

6. Conclusions and recommendations

By analyzing panel data of 20 commercial banks in Vietnam using a Hierarchical Multiple Regression Approach using PCSE regression, this paper shows a positive effect of bank competition on bank stability. It also shows that shadow banking plays a role in reducing this positive relation. To the best of our knowledge this is the first quantitative study on the moderating role of shadow banking in the relationship between bank competition and bank stability, and therefore this research potentially has important theoretical and practical contributions.

In terms of theory, this paper provides support to theories of competitive-banking stability such as the charter value theory (Keeley, 1990; Marcus, 1984), and the market position theory (Boyd & De Nicolo, 2005), by giving evidence on the negative impact of shadow banking on the bank competition-stability nexus in Vietnam. Furthermore, the study tries to build a bank stability index based on CAMELS ratings and Principal Component Analysis (PCA), as well as indicators measuring shadow banking in emerging countries like Vietnam.

As regards to practical aspects, this paper argues that although shadow banking is a type of non-traditional banking service that contributes to reducing competitive pressure among banks, it can still lead to serious risks or bank instability in Vietnam. Therefore, bank managers should be careful when developing non-traditional banking activities in general, and shadow banking services in particular. For authorities like the State Bank of Vietnam, it is necessary to strictly supervise these activities.

In spite of the above-mentioned contributions, this paper still has certain limitations. The first one stems from the proposed model, which does not account for the non-linear relationship between bank competition and bank stability. The second concern is that the endogenous problem of bank competition's impact on bank stability has not been addressed. Finally, the data is not as up to date as it could be, as the audited consolidated statements will not be released until April 2023. These gaps are expected to be filled in future studies.

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Appendix1: The process for calculating the weights

Table A1. KMO and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.623
Bartlett's Test of Sphericity	Approx. Chi-Square	94.605
	Df	15
	Sig.	.000

Source: SPSS 26.

Table A2. Weight calculation for different dimensions of bank stability index

Dimension	Components		Eigenvalues		Weights	
	1	2	2.096	1.133	Absolute	Percent
C	0.518	-0.615	1.085554	-0.69638	0.38917	0.096749
A	-0.013	0.360	-0.02634	0.407992	0.381655	0.094881
M	0.818	-0.096	1.714965	-0.10895	1.60601	0.399259
E	0.785	0.104	1.646012	0.117239	1.763251	0.438349
L	-0.623	0.108	-1.30567	0.122129	-1.18354	-0.29423
S	0.042	0.863	0.08801	0.97792	1.06593	0.264993
Total					4.022479	100%

Source: SPSS 26.

Table A3. Bank stability index of 20 commercial banks in Vietnam

	2016	2017	2018	2019	2020	2021	Average	RANK
VPB	0.809473409	0.752727263	0.627167595	0.619045837	0.71763462	0.662127993	0.70	1
TCB	0.567357899	0.534735939	0.479006144	0.648372275	0.703170345	0.932065151	0.64	2
TPB	0.459963829	0.462752447	0.511154404	0.549840035	0.706768191	0.705639789	0.57	3
VIB	0.409921332	0.462565829	0.494828415	0.556444111	0.667605486	0.673096016	0.54	4
MSB	0.527213058	0.37944274	0.439120361	0.403602553	0.630146524	0.787421378	0.53	5
MBB	0.387011801	0.375819534	0.465400138	0.489669774	0.526705612	0.766364208	0.50	6
HDB	0.49426856	0.458605851	0.365054136	0.385409148	0.472606591	0.545039956	0.45	7
LPB	0.511250932	0.456156515	0.299459279	0.308749738	0.434605212	0.514256817	0.42	8
ACB	0.365913477	0.409390394	0.430444026	0.400129591	0.4131056	0.414701307	0.41	9
VCB	0.260600026	0.244171231	0.349679821	0.356361778	0.351946926	0.430025385	0.33	10
STB	0.209763488	0.256239006	0.282637873	0.294455152	0.371268062	0.361206192	0.30	11
NAB	0.222611254	0.272230869	0.210038914	0.134157152	0.280499937	0.372301975	0.25	12
ABB	0.27230003	0.271506801	0.220647786	0.163163673	0.202878837	0.247093903	0.23	13
AGRIB	0.228567474	0.227475302	0.208042225	0.222186735	0.24585043	0.210844622	0.22	14
CTG	0.22205471	0.226913857	0.04671767	0.122319665	0.212232471	0.338353481	0.19	15
SHB	0.12306288	0.188196351	0.109400262	0.189337589	0.207067809	0.293987047	0.19	16
BID	0.246803644	0.237434083	0.12985184	0.087537813	0.106459923	0.200995193	0.17	17
BAB	0.306569883	0.230728927	0.145519126	0.116657108	0.08452118	0.071851014	0.16	18
KLB	0.223266286	0.307599242	0.168207816	0.016036393	-0.027460723	0.163328078	0.14	19
EIB	0.170395108	0.185584959	0.05930295	0.046806555	0.005586574	0.143193091	0.10	20

Source: Authors.

Appendix 2: Calculating the Lerner index

	2016	2017	2018	2019	2020	2021	Average	RANK
VCB	0.570864197	0.58104247	0.584204477	0.577927996	0.584182395	0.604263565	0.58	1
TCB	0.437882174	0.521110877	0.511781585	0.50393663	0.508622659	0.613407385	0.52	2
CTG	0.50748288	0.481996482	0.461885241	0.460676666	0.491456919	0.555717555	0.49	3
BID	0.476745702	0.475078354	0.464504706	0.464736083	0.43599266	0.480279326	0.47	4
SHB	0.455862205	0.478044635	0.460951319	0.432875399	0.419460584	0.479110366	0.45	5
ACB	0.439404494	0.391361768	0.456999914	0.461098573	0.470803333	0.499494708	0.45	6
TPB	0.517359319	0.45057956	0.403503448	0.400955145	0.397020386	0.487828945	0.44	7
MBB	0.491520856	0.427767836	0.40995795	0.394326486	0.427968328	0.481395686	0.44	8
BAB	0.494643502	0.497898135	0.450130223	0.406068676	0.358105924	0.346745863	0.43	9
AGRIB	0.386001123	0.384768564	0.358796039	0.406972723	0.406420215	0.536676819	0.41	10
VIB	0.380872873	0.401858819	0.400956529	0.400166171	0.415458191	0.480051896	0.41	11
HDB	0.361997097	0.356668843	0.362748972	0.397773147	0.418279385	0.456745085	0.39	12
ABB	0.358432949	0.380003375	0.366048228	0.383619	0.404604352	0.435123457	0.39	13
LPB	0.477872809	0.3780483	0.318402715	0.359070855	0.35696615	0.373626254	0.38	14
NAB	0.319545842	0.339000632	0.395664872	0.355684105	0.433032636	0.381100622	0.37	15
MSB	0.275164987	0.308767079	0.357144879	0.340807229	0.337405776	0.445876118	0.34	16
STB	0.384261941	0.362803376	0.336908658	0.323740955	0.319522533	0.337883435	0.34	17
EIB	0.340895721	0.367874887	0.320325028	0.286686998	0.318371432	0.296046349	0.32	18
VPB	0.312608	0.293732212	0.280592173	0.252994439	0.303746433	0.381069309	0.30	19
KLB	0.241224025	0.267080694	0.253290748	0.205419009	0.221207414	0.372393248	0.26	20

Source: Authors.

Appendix 3: Heteroskedasticity test

Fixed-effects (within) regression				Number of obs =		120
Group variable: MH				Number of groups =		20
R-sq:				Obs per group:		
within = 0.3624				min =		6
between = 0.2435				avg =		6.0
overall = 0.2613				max =		6
				F(10,90) =		5.12
corr(u_i, Xb) = -0.2119				Prob > F =		0.0000
BS	Coef.	Std. Err.	t	P> t 	[95% Conf.	Interval]
BC	.5723088	.2238558	2.56	0.012	.1275803	1.017037
SB1	.1605287	.3100066	0.52	0.606	-.4553534	.7764109
SB2	.6240492	.7943086	0.79	0.434	-.9539836	2.202082
SIZE	.0544675	.0582866	0.93	0.353	-.061329	.170264
ETA	.729173	.6145868	1.19	0.239	-.4918109	1.950157
STO	-.4887719	.3566097	-1.37	0.174	-1.197239	.2196956
BSD	.1304683	.0715487	1.82	0.072	-.0116757	.2726124
SMD	.0004531	.0009433	0.48	0.632	-.001421	.0023272
GDP	-.0045418	.0066646	-0.68	0.497	-.0177822	.0086986
INF	-.0304195	.0192936	-1.58	0.118	-.0687496	.0079106
_cons	-.6677823	.7777909	-0.86	0.393	-2.213	.8774351
sigma_u	.16336696					
sigma_e	.08023417					
rho	.80566725	(fraction of variance due to u_i)				

F test that all u_i = 0: F(19, 90) = 18.03 Prob > F = 0.0000

Source: Authors extracted information from Stata 17.

Random-effects GLS regression				Number of obs =		120
Group variable: MH				Number of groups =		20
R-sq:				Obs per group:		
within = 0.3581				min =		6
between = 0.3525				avg =		6.0
overall = 0.3526				max =		6
				Wald chi2(10) =		60.42
corr(u_i, Xb) = 0 (assumed)				Prob > chi2(10) =		0.0000
BS	Coef.	Std. Err.	z	P> z	[95% Conf.	Interval]
BC	.4998551	.2057225	2.43	0.015	.0966464	.9030637
SB1	.2701229	.2768599	0.98	0.329	-.2725125	.8127584
SB2	.6754883	.763181	0.89	0.376	-.8203189	2.171296
SIZE	.0716819	.0413752	1.73	0.083	-.0094121	.1527759
ETA	1.046737	.5736559	1.82	0.068	-.0776078	2.171082
STO	-.357523	.1362992	-2.62	0.009	-.6246645	-.0903814
BSD	.1397812	.0676746	2.07	0.039	-.0071415	.272421
SMD	.0003765	.0008942	0.42	0.674	-.001376	.002129
GDP	-.0040639	.0063446	-0.64	0.522	-.0164991	.0083713
INF	-.0322685	.0183202	-1.76	0.078	-.0681754	.0036384
_cons	-.9226521	.5490252	-1.68	0.093	-1.998722	.1534174
sigma_u	.15958985					
sigma_e	.08023417					
rho	.79823754	(fraction of variance due to u_i)				

Source: Authors extracted information from Stata 17 Breusch and Pagan Lagrangian multiplier test for random effects $BS(MH,t) = Xb + u[MH] + e[MH,t]$.

Breusch and Pagan Lagrangian multiplier test for random effects

$$BS(MH,t) = Xb + u[MH] + e[MH,t]$$

Estimated results:

	Var	SD= sqrt (Var)
BS	.039648	.199118
e	.0064378	.0802342
u	.0254689	.1595898

Test: $Var(u) = 0$ Chibar2(01) = 152.03 Prob > chibar 2 = 0.0000 Source: Authors extracted information from Stata 17.

Appendix 4: Autocorrelation test

Wooldridge test for autocorrelation in panel data

H0: no first – order autocorrelation

$$F(1, 19) = 37.304$$

$$Prob > F = 0.0000$$

Appendix 5: Cross-sectional dependence test

Test	Breusch-Pagan LM	Pesaran scaled LM	Bias-corrected scaled LM	Pesaran CD	Results
BS	368.6598*	9.165056*	7.165056*	7.735463*	Accept
BC	390.7566*	10.2986*	8.298597*	8.849904*	Accept
SB1	339.7353*	7.681259*	5.681259*	2.013609*	Accept
SB2	287.665*	5.010111*	3.010111*	-0.727787	Accept
SIZE	1070.078*	45.14707*	43.14707*	32.68518*	Accept
ETA	346.4648*	8.026475*	6.026475*	5.590998*	Accept
BSD	1140*	48.73397*	46.73397*	33.76389*	Accept
SMD	1140*	48.73397*	46.73397*	33.76389*	Accept
GDP	1140*	48.73397*	46.73397*	33.76389*	Accept
INF	1140*	48.73397*	46.73397*	33.76389*	Accept

Notes: The sign * represents significance at 5% level of significance. Source: Eviews 12.

Appendix 6: Robustness check: Alternative with Feasible Generalized Least Squares Regression

Model	(1)	(2)	(3)	(4)	(5)
Independent variable					
Bank competition (BC)	0.502*** (2.79)	0.407** (2.21)	0.402 (1.63)	0.464*** (2.58)	0.481** (2.52)
Moderated variables					
Shadow banking (SB1)		0.469** (1.99)	0.402 (0.39)		
Bank competition* Shadow banking (SB1)			0.163 (0.07)		
Shadow banking (SB2)				0.589 (0.81)	2.092 (0.33)
Bank competition* Shadow banking (SB2)					-3.183 (-0.23)
Control variables					
Bank size (SIZE)	0.0479* (1.66)	0.0502* (1.80)	0.0489* (1.75)	0.0490* (1.69)	0.0488* (1.67)
Equity to total assets (ETA)	1.336** (1.97)	1.185* (1.79)	1.220* (1.81)	1.439** (2.12)	1.508** (2.23)
Stated ownership (STO)	-0.263*** (-3.29)	-0.294*** (-3.76)	-0.293*** (-3.68)	-0.254*** (-3.16)	-0.252*** (-3.15)
Banking sector development (BSD)	0.0779* (1.83)	0.0626 (1.43)	0.0625 (1.42)	0.0694 (1.60)	0.0704 (1.61)
Stock market development (SMD)	0.000734 (1.28)	0.000717 (1.23)	0.000733 (1.24)	0.000576 (0.98)	0.000577 (0.97)
GDP Growth (GDP)	-0.00651 (-1.43)	-0.00753 (-1.62)	-0.00756 (-1.61)	-0.00690 (-1.51)	-0.00657 (-1.42)
Inflation rate (INF)	-0.00992 (-0.75)	-0.00958 (-0.71)	-0.00913 (-0.68)	-0.0101 (-0.76)	-0.00985 (-0.73)
Constant	-0.610* (-1.70)	-0.587* (-1.68)	-0.573 (-1.64)	-0.595 (-1.64)	-0.610* (-1.70)
Number of observations	120	120	120	120	120
Wald chi ²	54.26	63.14	63.23	54.22	55.23
Prob > chi ²	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: The sign *, ** & *** represents significance at 10%, 5% and 1% level of significance and values within parenthesis represent standard errors.

Source: Authors extracted information from Stata 17.