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Does Diversification Protect Bank Lending Against Uncertainty?

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Abstract

The paper examines whether bank diversification in multiple dimensions can protect bank lending from uncertainty shocks. We use a panel of Vietnamese commercial banks during 2007 – 2019 for empirical analysis and measure uncertainty in banking by the dispersion of bank-level shocks. Our results confirm that banks may reduce loan growth and experience more credit risk amid greater uncertainty. These adverse impacts of uncertainty on bank lending (both quantity and quality) are significantly alleviated by bank diversification in the loan portfolio, income, and funding aspects. Our findings offer practical implications for regulators and banks themselves: bank diversification can effectively act as a lending shock absorber in periods of high uncertainty.

Keywords: Bank lending, Credit risk, Diversification, Uncertainty

JEL Classification: D81, E50, G21, G32

I. Introduction

In recent years, economic and financial uncertainty has garnered increasing interest from practitioners and academics. Uncertainty has become a crucial concern for economic agents when they decide on how to function properly. In a growing literature stream, many researchers have paid attention to the link between uncertainty and banks' working, and they have formed some significant results. For example, it is evidenced that in response to vaster uncertainty, banks are more likely to build up liquidity buffers (*Berger* et al. 2020), raise loan rates

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(*Ashraf/Shen* 2019), drop market valuations (*He/Niu*, 2018), and face higher financial instability (*Phan* et al. 2021; *Wu* et al. 2020). Notably, most prior studies have investigated the impact of uncertainty on bank lending, which has played a vital part in economic development. Focusing on the quantity aspect of bank lending, almost all existing works reveal that uncertainty tends to limit loan growth (*Bilgin* et al. 2021; *Bordo* et al. 2016; *Buch* et al. 2015; *Danisman* et al. 2020; *Hu/Gong* 2019; *Valencia* 2017); regarding the quality aspect of bank lending, there is a widely-demonstrated pattern that uncertainty may cause more credit risk (*Caglayan/Xu* 2019; *Chi/Li* 2017; *Danisman* et al. 2021; *Ng* et al. 2020).

As an essential business strategy of banks, diversification is also perceived as a shock absorber that could reduce the impact of adverse shocks on banks (*Dang/Dang* 2021; *Simoens/Vander* 2021). With the rapid development of bank diversification, especially when regulatory authorities have repeatedly encouraged banks to diversify banking activities, its role has become increasingly apparent. In the existing literature, many researchers have looked into how diversification drives different aspects of bank safety and soundness (see section 2 for a review). However, very limited attention has been given to the moderating role of diversification in the link between uncertainty and bank lending. Therefore, further analysis for this role of diversification is valuable and worth addressing in this study. Our research question is whether diversification can alleviate the detrimental impact on bank lending caused by uncertainty.

We use bank-level data of commercial banks in Vietnam during 2007 – 2019 to evaluate whether more diversified banks can withstand lending shocks better amid uncertainty. To reflect bank diversification in a broad manner, we take into account three key types that are most interested in the banking literature: loan portfolio diversification, income diversification, and funding diversification. Also for a more comprehensive analysis, we examine two dimensions of bank lending: the lending quantity captured by the loan growth rate and the lending quality gauged by credit risk ratios. Distinct from prior authors, we examine uncertainty in the banking sector, according to the procedure constructed by *Buch* et al. (2015). This micro uncertainty index is based on the mechanism that bank outcomes are less predictable during higher uncertainty and less predictability could be gauged by a wider distribution of bank-level shocks to key variables, at least from banks' perspective. Banking uncertainty indeed has the information content that other popular uncertainty measures (such as economic policy uncertainty that has been extensively explored recently) can not possess. Interestingly, it is computable in any market due to the use of simple bank-level data, so it overcomes the shortcoming of effectively employing an uncertainty indicator in countries with limited data.

Vietnam offers an interesting background for analyzing our research question. When the capital market of Vietnam has still been immature, its economic growth mainly relies on the functioning of the banking sector, especially bank lending (*Dang* 2020). This context highlights the importance of bank lending, making it a key financial indicator that needs to be controlled appropriately. As a typical emerging and transitional economy, Vietnam has issued various economic policy reforms over the past decades. At the same time, the banking sector itself experienced severe fluctuations due to the consequence of the 2008 global crisis and the adoption of new international management standards. These events may initiate and modify the uncertainty degree in the Vietnamese banking sector to a larger extent. Besides, the banking market structure of Vietnam has considerably changed since its participation in the World Trade Organization (WTO) in 2007, which then boosted the market entrance of foreign investors and the schemes of privatization in state-owned banks (*Nguyen* et al. 2016). Under a highly competitive environment, diversification appears to be an essential strategy in risk management and banking operations (*Gambacorta* et al. 2014). Interestingly, various papers indicate a growing interest of Vietnamese banks in diversification strategies in recent years (*Dang* 2020; *Dang/Huynh* 2022; *Huynh/Dang* 2021).

Our paper is related to the one by *Hu/Gong* (2019). These authors examine the influence of economic policy uncertainty on bank credit in 19 major economies. After revealing that uncertainty reduces the growth rate of bank credit, they also complement that the impact is weaker at more diversified banks. Though having a similar interest, our work is considerably different from theirs in multiple ways. Firstly, *Hu/Gong* (2019) only examine asset diversification – not their focus in the study, as calculated by the difference between loans and other earning assets of banks. Differently, we comprehensively pay close attention to bank diversification in the loan portfolio, income, and funding dimensions by using the Herfindahl-Hirschman Index (HHI).[1] Each type of diversification may differently contribute to banks' functioning, and together they can draw a larger picture on the role of bank diversification. Secondly, prior authors only look at credit growth, while we are interested in bank lending quality (cred-

[1] It should be noted that the asset and income diversification aspects of where banks lie along the spectrum from traditional (lending) banks to non-traditional (non-lending) banks could be perfectly correlated. In fact, Vietnamese banks earn most of their interest income from loans; both interest income and loans all make up the largest proportions in the income and asset portfolios. We also checked the correlation between the asset diversification index and the income diversification index, and then we realized that this correlation is significantly high in Vietnamese banks. These arguments encourage us to only report and discuss the results for income diversification – the bank diversification dimension that has been most widely discussed in the banking literature, rather than dealing with both asset and income diversification dimensions. We also attempt the estimation with asset diversification, and our conclusion is unchanged.

it risk) and quantity (loan growth). Thirdly, *Hu/Gong* (2019) explore aggregate economic policy uncertainty by using a text-based mechanism; in contrast, we use bank-level data to calculate disaggregate uncertainty in banking through the dispersion of bank shocks. Fourthly, their sample is from major economies, while we perform our work for an emerging market with a different background and mature level. Lastly, *Hu/Gong* (2019) do not control for the potential endogeneity bias with their empirical strategy, which is fixed in our paper by the use of the GMM estimator.

This paper extends the literature not only by exploring the effect of uncertainty on the quality and quantify aspects of bank lending at the same time but also by comprehensively highlighting the moderating role of bank diversification in the dimensions of the loan portfolio, income, and funding. It also contributes to the extant literature by adopting micro uncertainty explicitly related to the banking sector. While the former related works have considered economic policy uncertainty to denote aggregate uncertainty sources, this paper tries to distinguish uncertainty arising wholly from banking segments. Overall, the findings of this paper could provide helpful recommendations to regulators and banks themselves in Vietnam and possibly in other emerging markets that confront similar situations.

II. Related Literature

1. Uncertainty and Bank Lending

The literature suggests multiple mechanisms that could explain the potential impact of uncertainty on bank lending. In uncertain periods, the probability of borrowers going bankrupt may increase, thus causing banks' asset quality to deteriorate (*Tang/Yan* 2010). On the one hand, being aware of this challenging situation, banks may be more hesitant to lend, leading to a significant drop in loan supply (*Mishkin* 1999). On the other hand, when facing lower credit demands from the borrowers, banks have no way but to cut the volume of credit granted to the economy (*Bloom* 2009).

Another essential mechanism works under the "search for yield" motive. In this vein, banks' reduced profits during uncertainty may be stimulated by two forces: (i) lower lending rates, as a result of decreased credit demands when firms and households postpone their investment and spending (*Hartzmark* 2016), and (ii) higher funding costs, as a result of a higher premium demanded by depositors when they are more exposed to adverse shocks (*Valencia* 2017). If the return target is sticky and cannot be adjusted quickly enough, banks may choose to prioritize "high-risk and high-return" projects to offset lost profits (*Dell'Ariccia* et al. 2014). Hence, banks may increase their loan growth more aggressively but are more likely to confront higher credit risk.

The last mechanism that should be reported is based on the "real option" theory. In the face of higher uncertainty, the likelihood of banks making wrong decisions may arise due to the presence of more severe information asymmetries (*Pindyck* 1988). In response, banks may choose a wait-and-see plan until they realize the level of uncertainty diminishes. With this wait-and-see plan, banks may restrict the quantity of lending generated and spend more effort in upgrading the quality of available loans.

In sharp contrast to the mixed impacts of uncertainty on bank lending as mentioned, empirical works have consistently agreed on the adverse consequences on bank lending caused by uncertainty. Accordingly, banks are found to restraint loan growth (*Bilgin* et al. 2021; *Bordo* et al. 2016; *Buch* et al. 2015; *Danisman* et al. 2020; *Hu/Gong* 2019; *Valencia* 2017) and increase credit risk in periods of higher uncertainty (*Caglayan/Xu* 2019; *Chi/Li* 2017; *Danisman* et al. 2021; *Ng* et al. 2020). Under this stream, many papers indicate that the impact of uncertainty on bank lending depends on different bank-specific characteristics. For example, *Buch* et al. (2015) and *Valencia* (2017) find that banks reduce their loan growth during economic policy uncertainty to a larger extent if they are less liquid and more poorly capitalized. *Bordo* et al. (2016) complement these patterns by showing that the unfavorable impact of economic policy uncertainty on bank loan growth is more pronounced at larger-sized banks. Contrary to these findings, *Danisman* et al. (2020) document that the adverse impact of economic policy uncertainty on bank loan growth is strengthened for well-capitalized banks but weakened for larger banks. One crucial shortcoming in these documents that needs to be noted is that the use of standard indicators (e. g., bank size, capitalization, and liquidity) as moderating factors is not precise enough to allow for the heterogeneity in banks' desire and capacity to alter loan supply (*Altunbas* et al. 2010). Besides, in comparison to multiple works on the heterogeneity in banks' reactions in loan growth to uncertainty, there is still a lack of analysis on how bank-specific characteristics moderate the link between uncertainty and credit risk.

2. The Role of Bank Diversification

As widely witnessed in the literature, banks could diversify in three main dimensions: loan portfolio, income, and funding. We now review the relevant literature to see if bank diversification, in these three dimensions, could protect bank lending activities from the negative influences of uncertainty.

Regarding the role of loan portfolio diversification, existing evidence and arguments are mixed. On the one hand, some works agree on the need to diversify loan portfolios. Lending to many economic sectors could wipe out the impacts of idiosyncratic shocks and weaken the likelihood of bankruptcy (*Beck/*

De Jonghe 2013). A diversification strategy for loan portfolios could also reduce information asymmetries, thus cutting financial intermediation costs for banks (*Diamond* 1984). Supporting the upsides of loan portfolio diversification, *Rossi* et al. (2009) indicate that it may raise bank profit efficiency, and *Shim* (2019) displays that bank stability is improved when banks' loan portfolios are more exposed to various economic sectors. Such findings suggest that loan portfolio diversification could act as a shock absorber during uncertain times.

On the other hand, banks are advised to specialize in only a few economic sectors to effectively utilize their expertise and experience in those sectors (*Denis* et al. 1997). This implies the downside of diversification due to worse screening and monitoring of borrowers, which could harm the working of bank lending activities. From the empirical standpoint, diversification is found to decrease bank profits and increase bank risk simultaneously (*Acharya* et al. 2006; *Tabak* et al. 2011). According to these lines, loan portfolio diversification may amplify the detrimental impact of uncertainty on bank lending.

With respect to income diversification, a rich body of research has discussed why banks should or should not diversify across different products to earn different revenues. Accordingly, various benefits of income diversification are demonstrated in the form of increased financial stability (*Köhler* 2015), stimulated capital savings (*Shim* 2013), and higher cost efficiency (*Doan* et al. 2018). The reasons behind these findings are based on the economies of scope and cross-selling strategies, regulatory capital requirements for non-interest-based segments, and mitigated information asymmetries as well. In a contrasting manner, income diversification may be associated with multiple drawbacks, such as risk booster (*DeYoung/Rice* 2004), lost market values (*Guerry/Wallmeier* 2017), and greater income volatility (*Williams* 2016). These findings could be attributed to the lower switching costs, exaggerated agency costs, and more complicated management when banks shift to non-lending activities. In sum, it is unclear how income diversification should compensate for bank lending in periods of high uncertainty, given its potential benefits and costs.

Regarding diversification in bank funding, many works have looked into the disadvantages of depending on deposits, or in other words, limited funding diversification from the perspective of banks. Due to the "moral hazard" problem, more deposits could encourage banks to take over more risk-taking behaviors (*Lambert* et al. 2017). Under the literature strand on the bank lending channel, it is indirectly indicated that banks with weaker balance sheets (i. e., smaller/less liquid/more poorly capitalized banks) are more sensitive to monetary shocks (*Kashyap/Stein* 2000; *Kishan/Opiela* 2000), based on the core mechanism that these weaker banks are supposed to gain harder access to alternative funds. Recently, *Dang/Huynh* (2022) directly demonstrate that the greater availability of substitute funding or higher funding diversification could reduce banks' vulner-

ability caused by monetary shocks. Notably, banks may store liquid assets and reduce risky loans if they predict potential liquidity shortages caused by difficulties in reaching funds (*Allen/Gale* 2004). All in all, these findings recognize the importance of funding diversification in mitigating the adverse impact of uncertainty on bank lending.

III. Data and Methodology

1. Data Sources

This study obtains financial information on balance sheets and income statements of banks published on their official websites from 2007 to 2019. We drop observations that do not establish disaggregated data for different aspects of bank diversification. The macroeconomic factors are derived from the Global Financial Development and the State Bank of Vietnam. Overall, our research sample covers 31 banks with a total of 383 observations, accounting for the major portion of the Vietnamese banking system in terms of total assets.

2. Uncertainty and Bank Diversification Measures

a) Banking Uncertainty Measure

Our approach is based on the framework that banks' future outcomes are less predictable when the level of banking uncertainty increases and that from the perspective of banks, this less predictability could be reflected by a wider dispersion of bank shocks to key bank-level variables (*Buch* et al. 2015). In line with *Buch* et al. (2015), keeping this framework consistently throughout the paper, we empirically compute the cross-sectional dispersion of bank-specific shocks to denote uncertainty in the banking sector. To this end, we first estimate the following equation to gain bank-year-specific shocks for each bank-level variable:

$$V_{i,t} = \alpha_i + \beta_t + \varepsilon_{i,t} \tag{1}$$

where $V_{i,t}$ denotes the key variable of bank i in year t. As suggested by *Buch* et al. (2015), we approach three key bank-level variables, including the growth rate of total assets, the growth rate of short-term funding, and the level of bank profitability. The use of all three variables is helpful to check the robustness of our results. The above model also accounts for bank fixed effects (α_i) and time fixed effects (β_t). The measure of shocks is displayed in the form of the residuals in the regression model, so we take them to compute the cross-sectional dispersion

across all bank-specific shocks in year *t*. The calculation procedure suggested by *Buch* et al. (2015) wipes out all bank-specific and time-varying constituents, so their micro uncertainty measure could stand for the second moment of the distribution of shocks to key bank-level variables, justifying that it is sufficiently fitted to capture disaggregate uncertainty in the banking system. In more detail, the standard deviation $SD(\varepsilon_{i,t})$ of the residuals is employed:

$$Uncertanty_t = SD(\varepsilon_{i,t}) \tag{2}$$

The outcome gives us the uncertainty proxy from the perspective of the banking sector: a higher value of the dispersion of shocks is interpreted by a higher degree of banking uncertainty.

b) Bank Diversification Measure

Consistent with the former literature, we measure bank diversification in the dimensions of loan portfolio, funding, and income by employing the HHI approach. Our diversification measures are designed by subtracting the HHI from 1, so we have larger measures associated with the higher level of diversification. More precisely, the diversification measure is calculated for bank *i* in year *t* as follows:

$$HHI_{it} = 1 - \sum_{s=1}^{n} x_{sit}^2 \tag{3}$$

where $x_{sit}$is the exposure of income/funding/lending sector *s* in the whole portfolio with *n* exposures. Based on the income/funding/lending sector structures of Vietnamese banks, we define total exposures for each type of diversification as follows. For income diversification, total income of banks contains net interest income, income from commissions/fees, income from foreign exchange transactions, income from investments, and other sources of non-interest income.[2] For funding diversification, total bank funding covers debts from the government and central bank, interbank deposits, customer deposits, equity, issued securities, and other funding sources. For loan portfolio diversification, the procedure is slightly different because in the period under research, Vietnamese banks have exhibited no consensus in arranging sectoral loan portfolios. To tackle the problem, we follow *Acharya* et al. (2006) and categorize banks' loan

[2] It should be noticed that the components of bank income may have negative values, which could make the income diversification proxy not run from 0 to 1. To avoid this phenomenon, we follow *Meslier* et al. (2014) in dropping observations with negative income components.

portfolios into six sectoral exposures, including top five sectoral exposures and a sixth exposure containing the sum of all remaining exposures, and then we treat each sectoral exposure similar to each income/funding component as discussed earlier.

3. Methodology

We identify the impact of diversification on the link between uncertainty and bank lending by using the regression model as follows:

$$\begin{aligned} Y_{i,t} &= \alpha_0 + \alpha_1 \times Uncertainty_{t-1} + \alpha_2 \times Diversification_{i,t-1} \\ &+ \alpha_3 \times Uncertainty_{t-1} \times Diversification_{i,t-1} + \alpha_4 \times X_{i,t-1} + \alpha_5 \times Z_{t-1} \\ &+ v_i + \varepsilon_{i,t} \end{aligned} \tag{4}$$

The dependent variable $Y_{i,t}$ is either bank lending quantity (reflected by the percentage change in bank loans) or bank lending quality (alternatively captured by loan loss reserves and non-performing loans as a share of gross loans) for bank i in year t. The key independent variable $Uncertainty_{t-1}$ is one of the banking uncertainty variables, calculated by the dispersion of shocks to assets (DSA), funding (DSF), and profit (DSP). $Diversification_{i,t-1}$ is the bank diversification indicator, separately obtained from the loan portfolio, income, and funding dimensions. $Unc_{t-1} \times Diversification_{i,t-1}$ is the interaction term of uncertainty and diversification.

We allow for a rich set of control variables to more effectively explain bank lending behaviors: our bank-level controls ($X_{i,t-1}$) include bank size (SIZE), capital (CAP), liquidity (LIQ), and bank return (ROA); our macroeconomic controls (Z_{t-1}) include economic growth (GDP) and policy interest rates (MP).[3] The

[3] Apart from bank-level factors, we allowed two macroeconomic variables to explain bank lending in our model: economic cycles (captured by the growth rate of GDP) and monetary policy (captured by the refinancing rates). It should be stressed that control variables are not our primary interest in this study. If more variables are included, it may negatively affect the number of degrees of freedom and is detrimental to our estimates, given that our research sample size is relatively small. Moreover, extending the model with more control variables, such as the Tier 1 ratio and the credit demand, seems not to be an ideal approach for the data availability reason mainly. Firstly, using the risk-weighted capital ratio (the Tier 1 ratio for the entire market) as a measure of bank capitalization is an interesting idea to perform. However, our model already introduced the ratio of equity to total assets as a bank-level control factor. Furthermore, due to the limited availability of data, we cannot access the risk-weighted capital inspired by the Basel Accords. Secondly, regarding the inclusion of credit demand, separating the credit quantity/quality caused by banks' incentives (supply demand) from the credit demand is also arduous for Vietnam, where we cannot access required data sources (for example, loan-level data of

use of these variables is well supported by the existing literature on the determinants of loan growth and credit risk (*Dang/Dang* 2020; *Vo* 2018). We define them in Table 1. Our model also exhibits bank fixed effects (v_i) and the error term ($\varepsilon_{i,t}$). To tackle the possible reverse causality problem and imply the lagged response of banks to shocks, we utilize the lags of all independent variables in the model.

We regress bank lending aspects on uncertainty and diversification using fixed effects with Driscoll-Kraay standard errors (*Hoechle* 2007). In addition to this standard technique for panel data, we also conduct the two-step system GMM estimator for the persistence of bank lending and better dealing with other potential sources of endogeneity, such as omitted variables and measurement errors. The GMM estimator in the dynamic panel model may improve the results generated by fixed effects regressions since it creates a set of instruments to address the endogeneity bias and considers the lagged dependent variable as a regressor to exhibit the persistence of bank lending over time (*Blundell/Bond* 1998). When using the command "xtabond2" in Stata, we consider the lagged dependent variable and bank-level controls as predetermined or endogenous, and we treat the uncertainty and macroeconomic controls as strictly exogenous that are instrumented by themselves. To control the number of instruments, we restrict the lag range employed in producing instruments at two. Our approach is supported by the former literature (*Danisman* et al. 2020; *Roodman* 2009; *Sáiz* et al. 2018).

borrowers). We thank an anonymous reviewer for this comment on the expansion of macroeconomic controls.

Table 1

Descriptive statistics

	Min	*Max*	*Mean*	*SD*	*Definitions*
Bank-level variables					
LGR	–2.89	108.20	29.81	28.85	Loan growth rate (%)
LLR	0.54	2.50	1.27	0.50	Loan loss reserves/Gross loans (%)
NPL	0.50	5.19	2.16	1.19	Non-performing loans (%)
Loan diversification	0.58	0.82	0.75	0.07	Loan portfolio diversification index
Income diversification	0.10	0.59	0.34	0.14	Income diversification index
Funding diversification	0.26	0.69	0.50	0.12	Funding diversification index
SIZE	30.02	34.27	32.01	1.22	Natural logarithm of total assets
CAP	4.94	20.47	9.87	4.36	Capital equity/Total assets (%)
LIQ	5.57	36.03	17.11	9.18	Liquid assets/Total assets (%)
ROA	0.25	3.15	1.55	0.81	Return/Total assets (%)
Country-level variables					
DSA	13.43	34.09	21.94	6.75	Uncertainty index, based on the dispersion of shocks to total assets
DSF	16.00	40.93	24.23	7.89	Uncertainty index, based on the dispersion of shocks to short-term funding
DSP	0.67	2.06	1.27	0.39	Uncertainty index, based on the dispersion of shocks to profitability
GDP	5.25	7.13	6.25	0.64	Annual GDP growth rate (%)
MP	6.00	15.00	8.02	2.54	Refinancing rates (%)

Sources: Authors' own calculation.

4. Summary Statistics of Variables

Table 1 summarizes the descriptive statistics of all variables in our sample. An average bank has a loan growth rate of 29.81 %, indicating the banking system expanded its loan volume to the economy aggressively during the period under study. The loan loss reserves and non-performing loans ratios exhibit the means of 1.27 % and 2.16 % and the standard deviations of 0.50 % and 1.19 %, respectively, verifying a high level of volatility in credit quality during the time. Regarding loan portfolio diversification, income diversification, and funding diversification, their average values are 0.75, 0.34, and 0.50, respectively. This note implies that Vietnamese banks did not display a high level of diversification, especially with respect to diversification in income and funding sources. Observing the statistical distribution of three uncertainty measures, particularly their minimum-maximum ranges and standard deviations, we realize a sizable fluctuation in banking uncertainty levels as captured by bank-level data.

IV. Results

1. Estimation Results for Loan Growth

For the function of loan growth, in this subsection we report estimation results with corrected Driscoll-Kraay fixed effects and GMM regressions. The results in Tables 2 – 4 indicate that uncertainty in banking (standalone) exerts a statistically significant and negative impact on loan growth across most columns, regardless of the shock dispersions used, implying that banks tend to reduce their loan growth in periods of higher uncertainty in banking. This finding is consistent with the existing literature supporting the unfavorable impact of uncertainty on the quantity of bank lending (*Bilgin* et al. 2021; *Bordo* et al. 2016; *Buch* et al. 2015; *Danisman* et al. 2020; *Hu/Gong* 2019; *Valencia* 2017).

Table 2

Loan growth estimates and the role of loan portfolio diversification

	Dependent variable: The growth rate of bank loans					
	Fixed effect estimation (columns 1–3)			GMM estimation (columns 4–6)		
	(1) DSA	(2) DSF	(3) DSP	(4) DSA	(5) DSF	(6) DSP
Lagged dependent variable				0.114***	0.382***	0.160***
				(0.030)	(0.096)	(0.024)
Uncertainty	–3.571***	–0.062	–3.956**	–0.966***	–0.331*	–4.881***
	(1.064)	(0.295)	(1.293)	(0.156)	(0.170)	(1.124)
Uncertainty*Loan diversification	3.049**	1.555**	6.094	2.647***	1.690***	10.461***
	(1.189)	(0.682)	(3.827)	(0.146)	(0.337)	(1.607)
Loan diversification	–70.163**	–20.420	4.761	–56.666***	–51.194***	–40.303***
	(25.120)	(31.912)	(27.308)	(6.754)	(12.333)	(2.825)
SIZE	–25.805***	–11.065	–23.863***	–1.711	1.913	–1.452
	(4.485)	(6.575)	(4.853)	(1.189)	(1.366)	(1.523)
CAP	0.543	1.011	0.528	0.257	1.393***	0.317
	(0.596)	(0.849)	(0.834)	(0.352)	(0.439)	(0.398)
LIQ	0.515	0.152	0.595**	0.013	0.083	0.563***
	(0.284)	(0.203)	(0.228)	(0.132)	(0.125)	(0.081)
ROA	1.939	–0.844	2.399*	–1.233	–3.085**	2.086
	(2.069)	(1.376)	(1.313)	(1.260)	(1.280)	(1.502)
GDP	–2.406	0.001	4.112	–0.748	–3.058**	–3.996***
	(5.046)	(4.972)	(2.721)	(0.926)	(1.292)	(1.005)
MP	–1.059***	–2.690***	–3.110***	–0.249	–1.758***	–0.234
	(0.326)	(0.660)	(0.205)	(0.229)	(0.615)	(0.398)
Observations	352	352	352	352	352	352
Banks	31	31	31	31	31	31
R-squared	0.374	0.347	0.395			
Instruments				30	30	30
AR(1) test				0.028	0.040	0.026
AR(2) test				0.689	0.530	0.417
Hansen test				0.363	0.359	0.276

Notes: The table reports the loan growth estimates obtained by fixed effect and GMM regressions. The uncertainty index (DSA, DSF, or DSP) is shown at the top of each column. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The figures in parentheses indicate standard errors.

Sources: Authors' own calculation.

We turn to results on the interaction terms of main interest. As reported in Table 2, the coefficient on the interaction term between uncertainty and loan portfolio diversification is significantly positive in most columns. This result suggests that the adverse impact of uncertainty on loan growth is reduced by increasing the diversification level of sectoral loan portfolios. Next, in Table 3, we find that the coefficient on the interaction term between uncertainty and income diversification is statistically significant and positive in most regressions by fixed effect and GMM techniques. This pattern exhibits that when banks diversify their income into multiple sources to a larger extent, their lending quantity is less affected by the increase in uncertainty in the banking sector. Finally, it can be observed in Table 4 that from the model of bank loan growth, the interaction term between uncertainty in banking and diversification in funding is significantly positive across most specifications. This finding implies that when banks reach a higher level of funding diversification, they can alleviate the negative impact of uncertainty on their loan expansion.

Our findings could be explained as follows. In response to uncertainty, banks may choose to "wait and see" due to informational asymmetries, thereby reducing the volume of loans created (*Pindyck* 1988). This process can be relaxed in more diversified banks, where informational asymmetries are less severe due to more exposures to various economic sectors (*Diamond* 1984). Besides, when facing lower credit demands due to the delay in investment and spending by firms and households (*Hartzmark* 2016), banks with access to diversified income sources are more likely to achieve cross-selling opportunities (*Gallo* et al. 1996). Hence, these banks can shield their lending growth from adverse uncertainty shocks. Ultimately, banks may reduce the generation of risky loans because they are afraid of potential liquidity shortages caused by funding difficulties (*Allen/Gale* 2004). In this regard, diversified banks may gain easier access to alternative funding, making their loan supply less dependent on the impact of uncertainty.

Apart from the variables of main interest, some control factors also significantly influence bank lending. We realize a negative link between bank size and loan growth in many regressions. This implies that large banks expand their lending less than small banks, possibly because large banks are more cautious in their lending practice, supporting the work of *Vo* (2018) for Vietnamese banks. Next, we find that bank capital is positively related to bank lending, indicating that banks with larger capital buffers may increase loan growth more. Consistent with previous authors (*Berrospide/Edge* 2010; *Gambacorta/Mistrulli* 2004), well-capitalized banks could absorb the adverse effects of shocks on bank lending more effectively. Besides, in line with *Gennaioli* et al. (2014), we also find that bank liquidity is positively associated with bank loan growth. Accordingly, banks could optimally use liquid assets as liquidity storage to finance their subsequent investments.

Table 3

Loan growth estimates and the role of income diversification

	Dependent variable: The growth rate of bank loans					
	Fixed effect estimation (columns 1 – 3)			GMM estimation (columns 4 – 6)		
	(1) DSA	(2) DSF	(3) DSP	(4) DSA	(5) DSF	(6) DSP
Lagged dependent variable				0.213***	0.156***	0.097**
				(0.049)	(0.046)	(0.041)
Uncertainty	–1.408***	–0.713*	–11.147**	–1.282***	–0.673***	–8.084***
	(0.365)	(0.378)	(3.885)	(0.179)	(0.106)	(0.858)
Uncertainty*Income diversification	0.795*	1.230***	8.345	2.632***	2.517***	28.378***
	(0.388)	(0.361)	(8.109)	(0.378)	(0.434)	(3.845)
Income diversification	6.792	0.855	5.715	3.555	–0.815	10.643**
	(17.829)	(15.282)	(13.581)	(5.286)	(6.336)	(4.492)
SIZE	–13.369***	–7.554**	–14.388***	–1.059	–0.655	–1.223
	(3.398)	(3.329)	(3.966)	(1.324)	(1.189)	(1.434)
CAP	0.475	0.784*	0.710	0.783***	0.874***	0.426**
	(0.403)	(0.381)	(0.450)	(0.270)	(0.263)	(0.193)
LIQ	0.747*	0.643*	0.878**	0.405***	0.340***	0.612***
	(0.340)	(0.326)	(0.335)	(0.065)	(0.115)	(0.082)
ROA	6.011*	4.936	5.808***	–0.589	–1.361	–0.029
	(2.917)	(2.869)	(1.351)	(0.875)	(1.254)	(1.123)
GDP	–8.758	–9.713	5.764**	–7.608***	–9.715***	–9.125***
	(5.150)	(6.222)	(2.200)	(0.678)	(0.719)	(0.807)
MP	–0.535**	–1.016*	–3.263***	0.633***	–0.649***	–0.484*
	(0.218)	(0.493)	(0.809)	(0.167)	(0.225)	(0.270)
Observations	352	352	352	352	352	352
Banks	31	31	31	31	31	31
R-squared	0.341	0.322	0.318			
Instruments				30	30	30
AR(1) test				0.001	0.000	0.000
AR(2) test				0.476	0.451	0.167
Hansen test				0.137	0.124	0.178

Notes: The table reports the loan growth estimates obtained by fixed effect and GMM regressions. The uncertainty index (DSA, DSF, or DSP) is shown at the top of each column. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The figures in parentheses indicate standard errors.

Sources: Authors' own calculation.

Table 4

Loan growth estimates and the role of funding diversification

	Dependent variable: The growth rate of bank loans					
	Fixed effect estimation (columns 1 – 3)			GMM estimation (columns 4 – 6)		
	(1) DSA	(2) DSF	(3) DSP	(4) DSA	(5) DSF	(6) DSP
Lagged dependent variable				0.162***	0.106***	0.045**
				(0.031)	(0.027)	(0.018)
Uncertainty	–0.570**	–0.785***	–10.917**	–1.309***	–1.167***	–27.258***
	(0.247)	(0.139)	(3.652)	(0.147)	(0.397)	(8.337)
Uncertainty*Funding diversification	1.575*	0.620***	8.333	2.087***	1.320*	59.467***
	(0.749)	(0.096)	(8.195)	(0.207)	(0.772)	(17.824)
Funding diversification	–21.503**	–11.203	–3.595	–43.764***	–59.432***	–102.804***
	(9.519)	(12.023)	(11.694)	(3.582)	(18.255)	(23.579)
SIZE	–12.439	–13.900**	–17.495***	–0.391	–4.173**	–1.867*
	(7.003)	(5.140)	(4.721)	(1.354)	(1.786)	(1.094)
CAP	0.398	0.360	0.445	0.565**	0.044	0.595**
	(0.437)	(0.352)	(0.491)	(0.266)	(0.506)	(0.280)
LIQ	0.688**	–0.155	0.833**	0.619***	0.750***	0.715***
	(0.296)	(0.105)	(0.320)	(0.077)	(0.058)	(0.077)
ROA	3.238**	–0.496	4.474***	–0.267	2.211*	0.107
	(1.219)	(2.222)	(0.841)	(1.357)	(1.219)	(1.179)
GDP	2.498	1.881	8.492**	–6.921***	–10.960***	–6.851***
	(3.147)	(2.989)	(2.867)	(1.235)	(1.150)	(0.909)
MP	–3.351***	–0.030	–3.647***	0.138	0.107	0.448*
	(0.551)	(0.504)	(0.580)	(0.170)	(0.276)	(0.231)
Observations	352	352	352	352	352	352
Banks	31	31	31	31	31	31
R-squared	0.319	0.142	0.299			
Instruments				30	30	30
AR(1) test				0.000	0.000	0.000
AR(2) test				0.745	0.120	0.128
Hansen test				0.160	0.172	0.145

Notes: The table reports the loan growth estimates obtained by fixed effect and GMM regressions. The uncertainty index (DSA, DSF, or DSP) is shown at the top of each column. ***, **, and * denote significance at the 1 %, 5 %, and 10 % levels, respectively. The figures in parentheses indicate standard errors.

Sources: Authors' own calculation.

2. Estimation Results for Credit Risk

Tables 5 – 7 explore how uncertainty drives bank lending quality in the static and dynamic specification models of credit risk, captured by loan loss reserves and non-performing loans. Through most significant positive coefficients on alternative standalone uncertainty measures, our regression results show uncertainty leads banks to take more credit risk. In other words, the quality of bank lending tends to decrease in times of greater uncertainty, in line with the literature highlighting the harmful impact of uncertainty on banks' credit quality (*Caglayan/Xu* 2019; *Chi/Li* 2017; *Danisman* et al. 2021; *Ng* et al. 2020).

We now look at the results for the interaction terms. From the perspective of loan portfolio diversification, the interaction term between uncertainty and diversification in Table 5 is mostly significantly negative in the equation of loan loss reserves and non-performing loans, indicating that loan portfolio diversification can mitigate the negative impact of uncertainty on credit risk to some extent. Besides that, since the coefficient on the interaction term is significantly negative in most columns from the perspective of income diversification in Table 6, regardless of the uncertainty measures employed, it signals that income diversification has a significant moderating effect of reducing the detrimental impact on credit risk caused by uncertainty. Furthermore, from the perspective of funding diversification, the variable interacting uncertainty with diversification is significantly negative in most columns of Table 7, displaying that the unfavorable impact of uncertainty on credit risk is smaller as banks increase funding diversification.

Though our empirical model cannot detect the exact channel through which diversification could be associated with the uncertainty-lending nexus, some potential mechanisms could be used to interpret our findings. Banks' asset quality may decrease in uncertain times because their borrowers may encounter more financial burdens and a higher probability of bankruptcy (*Tang/Yan* 2010). However, thanks to competitive advantages from reduced asymmetric information, diversified banks that lend to many economic sectors and offer multiple banking products yielding various income sources could improve their asset quality (*Diamond* 1984). Thus, it is more likely for these banks to shield the quality of loans from uncertainty shocks. Additionally, as discussed earlier, the lending behavior of banks with less diversified funding patterns is riskier (*Lambert* et al. 2017). So, it would be reasonable to claim that banks with diversified funding can better protect their lending from credit risk during periods of higher uncertainty.

Overall, combining the results on lending quality with the ones obtained earlier for lending quantity, our analyses constitute an important pattern that banks reduce the growth rate of loans and increase the level of credit risk when uncer-

Table 5

Credit risk estimates and the role of loan portfolio diversification

	Dependent variable: The ratio of loan loss reserves to gross loans						Dependent variable: The ratio of non-performing loans to gross loans					
	Fixed effect estimation (columns 1 – 3)			GMM estimation (columns 4 – 6)			Fixed effect estimation (columns 7 – 9)			GMM estimation (columns 10 – 12)		
	(1) DSA	(2) DSF	(3) DSP	(4) DSA	(5) DSF	(6) DSP	(7) DSA	(8) DSF	(9) DSP	(10) DSA	(11) DSF	(12) DSP
Lagged dependent variable				0.497***	0.537***	0.564***				0.385***	0.416***	0.342***
				(0.029)	(0.021)	(0.043)				(0.045)	(0.034)	(0.035)
Uncertainty	0.013***	0.012***	0.087***	0.071***	0.063***	0.973*	0.140***	0.117***	0.289**	0.015***	0.018***	0.129**
	(0.003)	(0.002)	(0.017)	(0.021)	(0.019)	(0.513)	(0.020)	(0.036)	(0.101)	(0.003)	(0.003)	(0.056)
Uncertainty*Loan diversification	−0.006***	−0.011***	−0.078*	−0.081***	−0.076***	−1.313**	−0.155***	−0.119**	−0.285	−0.029***	−0.052***	−0.019
	(0.002)	(0.002)	(0.039)	(0.027)	(0.024)	(0.650)	(0.030)	(0.051)	(0.175)	(0.011)	(0.006)	(0.086)
Loan diversification	1.494***	−0.470	1.150***	1.657***	1.797***	1.404**	4.640***	4.370***	1.056	1.403*	1.497**	1.199
	(0.261)	(0.500)	(0.353)	(0.520)	(0.464)	(0.593)	(1.056)	(1.041)	(1.125)	(0.727)	(0.712)	(0.901)
SIZE	−0.044	0.128	0.013	−0.002	−0.006	−0.050***	0.384***	0.417***	0.318**	−0.218***	−0.233***	−0.253***
	(0.026)	(0.116)	(0.027)	(0.010)	(0.009)	(0.013)	(0.108)	(0.122)	(0.101)	(0.050)	(0.041)	(0.057)
CAP	−0.006	0.010	−0.021**	−0.017***	−0.015***	−0.025***	0.038**	0.037**	0.032	−0.015	−0.017	−0.008
	(0.015)	(0.011)	(0.008)	(0.003)	(0.003)	(0.004)	(0.017)	(0.016)	(0.022)	(0.017)	(0.015)	(0.015)
LIQ	−0.013***	−0.015	−0.014***	−0.006***	−0.005***	−0.005*	−0.043***	−0.043***	−0.042***	−0.019***	−0.013***	−0.020***
	(0.002)	(0.009)	(0.002)	(0.002)	(0.001)	(0.003)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)

ROA	−0.020	−0.085**	0.009	0.043***	0.034***	0.061***	−0.326***	−0.356***	−0.376***	−0.103	−0.112	−0.203***
	(0.047)	(0.032)	(0.020)	(0.008)	(0.013)	(0.016)	(0.047)	(0.054)	(0.066)	(0.085)	(0.080)	(0.074)
GDP	0.011	−0.047	−0.098***	0.058***	0.062***	−0.005	−0.082	−0.033	−0.178***	0.147***	0.249***	0.162***
	(0.025)	(0.055)	(0.020)	(0.007)	(0.014)	(0.019)	(0.090)	(0.087)	(0.051)	(0.047)	(0.026)	(0.050)
MP	0.041***	0.035**	0.065***	0.031***	0.035***	0.033***	0.219***	0.218***	0.254***	0.157***	0.206***	0.165***
	(0.006)	(0.014)	(0.004)	(0.005)	(0.006)	(0.005)	(0.022)	(0.013)	(0.018)	(0.020)	(0.016)	(0.013)
Observations	352	352	352	352	352	352	352	352	352	352	352	352
Banks	31	31	31	31	31	31	31	31	31	31	31	31
R-squared	0.168	0.181	0.215				0.301	0.316	0.304			
Instruments				30	30	30				30	30	30
AR(1) test				0.000	0.000	0.000				0.001	0.002	0.005
AR(2) test				0.914	0.834	0.799				0.156	0.198	0.180
Hansen test				0.683	0.573	0.670				0.381	0.346	0.504

Notes: The table reports the credit risk estimates obtained by fixed effect and GMM regressions. The uncertainty index (DSA, DSF, or DSP) is shown at the top of each column. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The figures in parentheses indicate standard errors.

Sources: Authors' own calculation.

Table 6

Credit risk estimates and the role of income diversification

	Dependent variable: The ratio of loan loss reserves to gross loans						Dependent variable: The ratio of non-performing loans to gross loans					
	Fixed effect estimation (columns 1 – 3)			GMM estimation (columns 4 – 6)			Fixed effect estimation (columns 7 – 9)			GMM estimation (columns 10 – 12)		
	(1) DSA	(2) DSF	(3) DSP	(4) DSA	(5) DSF	(6) DSP	(7) DSA	(8) DSF	(9) DSP	(10) DSA	(11) DSF	(12) DSP
Lagged dependent variable				0.646***	0.608***	0.612***				0.562***	0.615***	0.532***
				(0.032)	(0.040)	(0.027)				(0.020)	(0.028)	(0.026)
Uncertainty	0.009***	0.012***	0.104*	0.057***	0.044***	0.504***	0.048***	0.046***	0.405***	0.049***	0.047***	0.231***
	(0.003)	(0.003)	(0.050)	(0.009)	(0.009)	(0.073)	(0.008)	(0.010)	(0.083)	(0.004)	(0.003)	(0.052)
Uncertainty*Income diversification	−0.009*	−0.001	−0.519**	−0.142***	−0.122***	−1.544***	−0.026*	−0.054**	−0.417*	−0.033**	−0.077***	−0.712***
	(0.005)	(0.013)	(0.231)	(0.026)	(0.024)	(0.222)	(0.014)	(0.023)	(0.209)	(0.014)	(0.014)	(0.130)
Income diversification	0.235**	0.018	0.579*	3.282***	3.096***	2.231***	0.148	1.378	−0.186	0.159	0.595***	0.212
	(0.086)	(0.334)	(0.283)	(0.553)	(0.567)	(0.339)	(0.708)	(0.789)	(0.708)	(0.244)	(0.159)	(0.269)
SIZE	0.055	0.220***	0.030	−0.060***	−0.039***	0.006	0.651***	−0.045	0.324***	−0.113	−0.110**	−0.122
	(0.052)	(0.046)	(0.025)	(0.023)	(0.015)	(0.013)	(0.173)	(0.149)	(0.096)	(0.121)	(0.053)	(0.088)
CAP	−0.017*	−0.005	−0.015**	−0.030***	−0.024***	−0.016***	0.077**	0.027	0.023	−0.021	−0.025*	−0.029
	(0.008)	(0.007)	(0.007)	(0.005)	(0.004)	(0.003)	(0.026)	(0.018)	(0.021)	(0.026)	(0.014)	(0.020)
LIQ	−0.017***	−0.017***	−0.016***	−0.001	0.001	−0.001	−0.033**	−0.040***	−0.031***	−0.013	−0.010**	−0.005
	(0.003)	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)	(0.011)	(0.007)	(0.009)	(0.008)	(0.005)	(0.008)

ROA	0.029	0.013	0.047	0.050***	0.040***	0.041***	−0.548***	−0.337***	−0.239***	−0.118*	−0.137***	−0.058
	(0.028)	(0.031)	(0.031)	(0.013)	(0.010)	(0.013)	(0.070)	(0.058)	(0.053)	(0.063)	(0.039)	(0.060)
GDP	−0.162***	−0.188***	−0.034	0.011	−0.015	0.048***	−0.054	0.175	−0.714***	0.375***	0.474***	0.263***
	(0.050)	(0.049)	(0.055)	(0.016)	(0.009)	(0.011)	(0.082)	(0.224)	(0.147)	(0.026)	(0.043)	(0.043)
MP	0.044***	0.041***	0.067***	0.024***	0.020**	0.039***	0.152***	0.158***	0.124***	0.103***	0.146***	0.125***
	(0.005)	(0.003)	(0.007)	(0.006)	(0.008)	(0.006)	(0.038)	(0.016)	(0.014)	(0.015)	(0.019)	(0.014)
Observations	352	352	352	352	352	352	352	352	352	352	352	352
Banks	31	31	31	31	31	31	31	31	31	31	31	31
R-squared	0.193	0.206	0.209				0.270	0.217	0.178			
Instruments				30	30	30				30	30	30
AR(1) test				0.000	0.000	0.001				0.001	0.002	0.001
AR(2) test				0.893	0.448	0.440				0.145	0.151	0.178
Hansen test				0.348	0.498	0.380				0.280	0.259	0.191

Notes: The table reports the credit risk estimates obtained by fixed effect and GMM regressions. The uncertainty index (DSA, DSF, or DSP) is shown at the top of each column. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The figures in parentheses indicate standard errors.

Sources: Authors' own calculation.

Table 7

Credit risk estimates and the role of funding diversification

	Dependent variable: The ratio of loan loss reserves to gross loans						Dependent variable: The ratio of non-performing loans to gross loans					
	Fixed effect estimation (columns 1–3)			GMM estimation (columns 4–6)			Fixed effect estimation (columns 7–9)			GMM estimation (columns 10–12)		
	(1) DSA	(2) DSF	(3) DSP	(4) DSA	(5) DSF	(6) DSP	(7) DSA	(8) DSF	(9) DSP	(10) DSA	(11) DSF	(12) DSP
Lagged dependent variable				0.410***	0.778***	0.563***				0.443***	0.509***	0.434***
				(0.040)	(0.043)	(0.032)				(0.036)	(0.039)	(0.034)
Uncertainty	0.049***	0.010**	0.077	0.021***	0.012***	0.525**	0.171***	0.043***	0.188*	0.136***	0.041***	1.071***
	(0.015)	(0.003)	(0.049)	(0.008)	(0.001)	(0.235)	(0.035)	(0.012)	(0.086)	(0.023)	(0.004)	(0.259)
Uncertainty*Funding diversification	−0.049*	−0.022*	−0.313**	−0.011	−0.019***	−1.196**	−0.226***	−0.052***	−0.804**	−0.185***	−0.050***	−2.130***
	(0.024)	(0.012)	(0.124)	(0.014)	(0.007)	(0.496)	(0.052)	(0.012)	(0.336)	(0.041)	(0.016)	(0.465)
Funding diversification	1.155	0.912*	0.479	0.404	0.507***	1.761***	5.188***	0.965**	0.709	5.584***	1.684***	3.443***
	(0.669)	(0.489)	(0.269)	(0.304)	(0.188)	(0.602)	(0.907)	(0.380)	(0.465)	(0.859)	(0.168)	(0.414)
SIZE	0.183***	0.049	0.035	0.073***	−0.098***	−0.026	0.209*	−0.056	0.071	−0.001	−0.051	−0.167***
	(0.028)	(0.068)	(0.030)	(0.016)	(0.031)	(0.022)	(0.103)	(0.109)	(0.149)	(0.061)	(0.054)	(0.053)
CAP	−0.006	0.002	−0.016***	−0.005***	−0.042***	−0.023***	0.040**	0.025	0.030	0.011	−0.001	−0.022***
	(0.006)	(0.005)	(0.005)	(0.002)	(0.007)	(0.005)	(0.017)	(0.014)	(0.017)	(0.008)	(0.011)	(0.007)
LIQ	−0.016***	−0.014***	−0.015***	−0.007***	0.001	−0.002	−0.041***	−0.036***	−0.029**	−0.025***	−0.012*	−0.020***
	(0.004)	(0.002)	(0.004)	(0.002)	(0.006)	(0.002)	(0.007)	(0.007)	(0.010)	(0.004)	(0.006)	(0.005)

ROA	−0.002	−0.006	0.051**	−0.019**	0.085**	0.047***	−0.382***	−0.305***	−0.340***	−0.273***	−0.214***	−0.102***
	(0.032)	(0.038)	(0.022)	(0.008)	(0.041)	(0.011)	(0.058)	(0.045)	(0.042)	(0.029)	(0.041)	(0.032)
GDP	−0.007	0.009	−0.048	0.056***	0.121***	−0.002	0.151	0.179	−0.226**	0.308***	0.366***	0.162***
	(0.046)	(0.040)	(0.040)	(0.015)	(0.013)	(0.018)	(0.184)	(0.186)	(0.077)	(0.040)	(0.051)	(0.041)
MP	0.057***	0.065***	0.064***	0.045***	0.055***	0.022**	0.152***	0.189***	0.237***	0.074***	0.104***	0.072***
	(0.004)	(0.009)	(0.008)	(0.006)	(0.009)	(0.011)	(0.016)	(0.014)	(0.025)	(0.012)	(0.019)	(0.012)
Observations	352	352	352	352	352	352	352	352	352	352	352	352
Banks	31	31	31	31	31	31	31	31	31	31	31	31
R-squared	0.256	0.228	0.223				0.237	0.241	0.272			
Instruments				30	30	30				30	30	30
AR(1) test				0.000	0.000	0.000				0.000	0.000	0.000
AR(2) test				0.253	0.319	0.253				0.192	0.146	0.133
Hansen test				0.669	0.535	0.561				0.180	0.184	0.237

Notes: The table reports the credit risk estimates obtained by fixed effect and GMM regressions. The uncertainty index (DSA, DSF, or DSP) is shown at the top of each column. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The figures in parentheses indicate standard errors.

Sources: Authors' own calculation.

tainty rises, strongly confirming that uncertainty is harmful to bank lending. Our finding complements those obtained in previous papers by comprehensively shedding light on the mitigating role of bank diversification in alleviating the adverse impacts of uncertainty on bank lending. We can conclude that more diversified banks are better positioned to shield their lending activities against a harmful rise of banking uncertainty.[4]

We now also pay some attention to interpreting the control variables' results that hold significant coefficients. Among control variables, the significantly negative coefficient for bank liquidity suggests that more liquid banks face less credit risk. *Williams* (2016) claims that banks with less liquid assets are more risk-seeking. Additionally, consistent with *Dang/Dang* (2020), we document that monetary policy tightening through increased interest rates is detrimental to Vietnamese banks' credit portfolios, illustrated by the significantly positive coefficient on policy interest rates.

3. Robustness Checks

In addition to utilizing alternative variables of credit risk, uncertainty in banking, as well as different specifications regressed by fixed effects and GMM estimators, we further present in this part some additional checks to strengthen our results. We first modify the definitions of the diversification index. Concretely, (i) we introduce the income diversification between non-interest income and net interest income; (ii) we approach the funding diversification between deposits and non-deposit funds; (iii) we generate ten sectoral exposures while calculating loan portfolio diversification, with the metrics similar to the one elaborated previously with six sectoral exposures.[5] We then alter the estimation method by using the least squares dummy variable corrected (LSDVC) estimator. This method functions considerably effectively in case the number of cross-section units in the sample is small, and the data panel is massively unbalanced (*Bruno* 2005), which is all the case of our dataset. This explains why even in some re-

[4] There are several reasons why we do not discuss which diversification dimension has the strongest dampening effect. (i) It is not supportive of assessing and comparing the effects of different diversification dimensions, because of their calculations and statistical distributions. For example, we cannot relate and compare the change of one unit in loan portfolio diversification and in income diversification. (ii) In terms of research objectives, we are only interested in the significance of the impact, not in exploiting the magnitude of the impact. (iii) Most importantly, we use many different uncertainty variables and various estimation models, and we have found that it is feasible to determine the estimates of the strongest impact based on our current results' face values. No consensus has been found.

[5] We also attempt regressions with eight sectoral exposures and yield unchanged results.

cent papers, the LSDVC estimator is treated as superior to the GMM estimation (*Dahir* et al. 2019; *Dang/Huynh* 2022; *Wang* et al. 2019).[6]

The robustness test results of the loan growth regression are exhibited in Table 8, and those of the credit risk model are reported in Table 9. As we can observe, the standalone uncertainty variables are statistically significant in all columns, and the interaction term of uncertainty and bank diversification remains statistically significant in almost all regressions. The signs of the significant coefficients are consistent with those presented earlier, thus validating the robustness of our results. Overall, using the LSDVC estimator with alternative diversification variables, we still document that the adverse impacts of uncertainty on bank lending can be mitigated by different diversification dimensions of the loan portfolio, income, and funding sources.

V. Conclusion

Based on bank-level data in the Vietnamese banking market during 2007–2019, we document consistent evidence that bank lending is significantly hurt by increased uncertainty in banking, in line with the arguments of theoretical works and the investigation of recent empirical papers. In particular, banks tend to reduce their loan growth and experience more credit quality deterioration amid higher uncertainty in banking. Furthermore, we find that bank diversification may dampen the adverse impact of uncertainty on the quantity and quality of bank lending. This result firmly holds across three key dimensions of bank diversification, namely loan portfolio, income, and funding. Our findings survive when changing alternative econometric techniques and employing different variables of primary interest.

Some important policy implications are displayed in the paper. Regulators need to be aware of the adverse consequences of banking uncertainty on the quantity and quality of bank lending so that they can take necessary actions to reduce the level of uncertainty in the banking system. Regulatory actions to reduce banking uncertainty could effectively improve the real economy, given that bank lending extensively dominates economic growth, particularly in emerging markets. In this regard, governments could rely on developing communication channels with the public and clarifying their policy intentions, which may support forming more predictable and stable financial sectors and economic envi-

[6] The LSDVC estimator was fully extended by *Bruno* (2005). Specifically, this method performs better when the sample of cross-section units is small and panel data are unbalanced (*Bruno* 2005). This is the case in our study, given that the N dimension of our study is small (N = 31) and the T dimension is relatively long (T = 13), which may go against a consistent GMM estimation (one could rely on this issue to underestimate our GMM approach).

Table 8

Robustness checks for loan growth estimates

	Dependent variable: The growth rate of bank loans								
	(1) DSA	(2) DSF	(3) DSP	(4) DSA	(5) DSF	(6) DSP	(7) DSA	(8) DSF	(9) DSP
Lagged dependent variable	0.117***	0.396***	0.171***	0.153***	0.072**	0.156***	0.498***	0.531***	0.568***
	(0.031)	(0.100)	(0.029)	(0.031)	(0.032)	(0.043)	(0.028)	(0.023)	(0.039)
Uncertainty	−0.956***	−0.344**	−5.046***	−1.766***	−0.537***	−57.658***	−0.079***	−0.059***	−1.570**
	(0.148)	(0.172)	(1.087)	(0.240)	(0.105)	(9.729)	(0.022)	(0.020)	(0.633)
Uncertainty*Loan diversification (alternative)	2.520***	1.621***	10.214***						
	(0.144)	(0.333)	(1.642)						
Uncertainty*Income diversification (alternative)				1.887**	1.346***	214.817***			
				(0.877)	(0.241)	(32.281)			
Uncertainty*Funding diversification (alternative)							0.072***	0.051***	1.239**
							(0.018)	(0.017)	(0.511)
Loan diversification (alternative)	−45.621***	−41.157***	−27.271***						
	(6.239)	(10.829)	(3.435)						
Income diversification (alternative)				−6.954	23.241***	−254.068***			
				(19.603)	(5.443)	(40.688)			
Funding diversification (alternative)							1.599***	1.400***	1.482**
							(0.431)	(0.396)	(0.603)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	352	352	352	352	352	352	352	352	352
Banks	31	31	31	31	31	31	31	31	31

Notes: The table reports the loan growth estimates obtained by LSDVC (Anderson-Hsiao) regressions. The uncertainty index (DSA, DSF, or DSP) is shown at the top of each column. *** and ** denote significance at the 1% and 5% levels, respectively. The figures in parentheses indicate bootstrapped standard errors (50 iterations). Other LSDVC (Arellano-Bond) and LSDVC (Blundell-Bond) regressions yield identical results but are not reported for brevity.

Sources: Authors' own calculation.

Table 9

Robustness checks for credit risk estimates

	Dependent variable: The ratio of non-performing loans to gross loans								
	(1) DSA	(2) DSF	(3) DSP	(4) DSA	(5) DSF	(6) DSP	(7) DSA	(8) DSF	(9) DSP
Lagged dependent variable	0.386***	0.420***	0.339***	0.544***	0.595***	0.506***	0.674***	0.646***	0.622***
	(0.044)	(0.035)	(0.036)	(0.019)	(0.018)	(0.027)	(0.040)	(0.050)	(0.033)
Uncertainty	0.015***	0.018***	0.134**	0.049***	0.044***	0.134**	0.068***	0.042***	0.446***
	(0.004)	(0.003)	(0.056)	(0.004)	(0.005)	(0.053)	(0.011)	(0.008)	(0.095)
Uncertainty*Loan diversification (alternative)	−0.028***	−0.052***	−0.043						
	(0.010)	(0.006)	(0.079)						
Uncertainty*Income diversification (alternative)				−0.036**	−0.076***	−0.563***			
				(0.017)	(0.010)	(0.144)			
Uncertainty*Funding diversification (alternative)							−0.179***	−0.125***	−1.472***
							(0.033)	(0.024)	(0.302)
Loan diversification (alternative)	1.193*	1.268**	1.004						
	(0.653)	(0.629)	(0.836)						
Income diversification (alternative)				0.083	0.690***	0.087			
				(0.328)	(0.254)	(0.334)			
Funding diversification (alternative)							4.063***	3.278***	1.996***
							(0.720)	(0.644)	(0.535)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	352	352	352	352	352	352	352	352	352
Banks	31	31	31	31	31	31	31	31	31

Notes: The table reports the loan growth estimates obtained by LSDVC (Arellano-Bond) regressions. The uncertainty index (DSA, DSF, or DSP) is shown at the top of each column. *** and ** denote significance at the 1% and 5% levels, respectively. The figures in parentheses indicate bootstrapped standard errors (50 iterations). Other LSDVC (Anderson-Hsiao) and LSDVC (Blundell-Bond) regressions in the equation of loan loss reserves yield identical results but are not reported for brevity.

Sources: Authors' own calculation.

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ronments. Besides, given the finding that self-insurance through diversification becomes stronger for banks that exhibit a higher level of diversification, complementary actions should be regarded by regulators and banks themselves as reliable shock absorbers. Under this line, we emphasize the importance of bank diversification in protecting bank lending amid increased uncertainty in the banking system. Specialized banks are the most vulnerable bank type amid the period of great uncertainty, and thus those banks' managers should be more cautious. A greater reliance on a more diversified business model, in particular in the markets which are still featured by a low level of diversification in banking activities, may be encouraged to mitigate the adverse impact of uncertainty in the credit market.

We acknowledge that our research only looks into a single market with data limitations. We expect future work to expand our tests to other markets and/or cross-country samples. Forthcoming outcomes might either validate or oppose our patterns and thus advance the understanding of the present issue.

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