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Article

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Cogent Business & Management

Provided in Cooperation with:

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Suggested Citation: Ho, Tin H.; Le, Tu D. Q.; Nguyen, Dat T. (2021) : Abnormal loan growth and bank risk-taking in Vietnam: A quantile regression approach, Cogent Business & Management, ISSN 2331-1975, Taylor & Francis, Abingdon, Vol. 8, Iss. 1, pp. 1-11, <https://doi.org/10.1080/23311975.2021.1908004>

This Version is available at:

<https://hdl.handle.net/10419/270258>

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To cite this article: Tin H Ho, Tu DQ Le & Dat T Nguyen | (2021) Abnormal loan growth and bank risk-taking in Vietnam: A quantile regression approach, Cogent Business & Management, 8:1, 1908004, DOI: [10.1080/23311975.2021.1908004](https://doi.org/10.1080/23311975.2021.1908004)

To link to this article: <https://doi.org/10.1080/23311975.2021.1908004>



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Received: 31 August 2020
Accepted: 19 March 2021

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BANKING & FINANCE | RESEARCH ARTICLE

Abnormal loan growth and bank risk-taking in Vietnam: A quantile regression approach

Tin H Ho^{1,3*}, Tu DQ Le^{1,3} and Dat T Nguyen^{2,3}

Abstract: We empirically investigate and present evidence of nonlinearity and heterogeneity in the impact of abnormal loan growth on risk-taking in the Vietnamese banking system between 2007 and 2019, using a quantile regression method. Our results showed that abnormal loan growth initially helped banks to reduce risk-taking. However, this relationship was U-shaped and heterogeneous. The effect of abnormal loan growth was more significant for banks at the upper tail of the risk-taking distribution. Our findings also demonstrated that the turning point of abnormal loan growth increased throughout the risk-taking distribution. Hence, our findings suggest that the pursuit of excessive lending is more likely to result in greater bank risk-taking.

Subjects: Economics; Finance; Banking

Keywords: abnormal loan growth; bank risk-taking; Vietnam; quantile regression; nonlinearity

GEL classifications: G21; G32

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PUBLIC INTEREST STATEMENT

It is said that finance is good for economic growth, but many scenarios of financial crises have been preceded by episodes of abnormal credit growth. Nowadays, Vietnamese banks tend to increase their lending activities with the encouragement of the government and the State Bank of Vietnam. However, whether credit expansions may help banks earn more profits or have adverse effects on their stability is still questionable. This study is the first attempt to examine the effect of abnormal loan growth on bank risk-taking. More importantly, our study strives to figure out whether this effect may be inverse at a certain point, which shows a non-linear relationship.

1. Introduction

The banking system plays an important role in financing economic growth through allocating their savings to competitive firms, entrepreneurs, individuals, and governments to enhance capital accumulation and profitability. As the modern economic theory proposes that *finance is essential for growth* (Cecchetti & Kharroubi, 2012), the rapid growth in credit has resulted in well-known advantages as greater corporate leveraging, increased capital market access, the introduction of new products, and credit risk management methodologies, and increased foreign bank entry. Moreover, it has also brought many important benefits, including helping channel savings to households, investors, companies, and entrepreneurs to develop new businesses as well as supporting financial sector development and economic growth and employment on the whole in the long-run (Gosh, 2010). From the business perspectives, lending growth allows banks to seize new profitable lending opportunities, expand to new geographic market or gain more market share with existing products and markets, and diversify the loan portfolios or cross-selling (Lepetit et al., 2008; Rossi et al., 2009).

However, the literature also indicates that the benefit of lending booms is questionable and this critical issue is reemphasized by the consequence of the global financial crisis 2007–08. The theory of *biased expectations* argues that at the early stage, the intertemporal relation between loan growth and riskiness may exist at the macroeconomic level because lenders and market participants become too optimistic about the risks of new lending opportunities (Kindleberger, 1978; Minsky, 1997). Episodes of excessive loan growth (or so-called abnormal loan growth) may negatively affect the financial system and the whole economy at large (Amador et al., 2013). Especially in the case of expansionary periods, banks tend to underestimate risk and take actions that may increase the probability of facing financial difficulties in the future (Altunbas et al., 2012, 2010; Amador et al., 2013; Gorton, 2009). From a policymaker's perspective, it is critical to disengage the effects of a bank's balance-sheet expansion on its future financial health. Hence, it is essential to identify whether loan growth is associated with riskiness among individual banks (Amador et al., 2013). Some authors state that in case of aggressive credit expansion, increase lending may potentially come from lowering interest rates, relaxing collateral requirements, loosening credit standards, or a combination of them. This growth from these mechanisms, consequently, may have adverse effects on bank risks (Dell'Ariccia & Marquez, 2006; Ogura, 2006; Soedarmono et al., 2017). Until now, there are relatively few works that study this major topic from an individual bank perspective (Foos et al., 2010) or/and in emerging markets (Amador et al., 2013; Gosh, 2010; Kashif et al., 2016). One may argue that because the regulatory and economic environments faced by banks are likely to differ importantly across nations and because the level and quality of service associated with deposits and loans in different countries may differ, the effect of abnormal loan growth on bank risk-taking in other markets would be different. This paper revisits this issue by taking the context of Vietnam.

Since joining the World Trade Organization (WTO) in 2007, Vietnam has boasted one of the fastest-growing economies in the world, with an estimated annual growth of around 6.2% Gross Domestic Product (GDP) per year in real terms. In which, the Vietnamese banking system is the backbone of the economy because of underdeveloped capital markets (Le, 2019). The external source of funding in financial-based economies is bank credit, and credit has contributed significantly to the growth of the economy on the whole like many other countries worldwide by making it possible for manufacturers and industries to enhance their field of operation and potential markets for their products. Due to the vital role of credit, Vietnam's lending policy has changed from time to time under the State Bank of Vietnam's (SBV) control and the Government directives, which is suitable for each stage of the country's economy. After the transitional economy period 1986–2000, bank lending is more liberal and has got some fulfillment. For example, banks are no longer subject to the loan ceiling interest rate but use the rate based on market supply and demand of loans, SBV only applies the ceiling lending rate for short-term loans in five priority areas. Additionally, through Circular 22/2019/TT-NHNN, banks are also encouraged to grow credit activities but still must control risk-taking through regulations on the ratio of short-term funds for

medium and long-term loans (SFMLLR) and loan-to-deposit ratio (LDR). Particularly, SBV has increased the LDR from 80% to 85% and reduced the SFMLLR from 45% to 40%, which goals to decline the pressures on medium and long-term loans. Further, the banking system restructuring process since 2012 has been considered to achieve certain achievements, of which the typical one is non-performing loan ratio gradually reduces from 3.43% (in 2012) to 1.80% (in 2018) while domestic credit to the private sector (as % of GDP) continues to grow gradually over the same period, from 94.83% to 133.14% (World Bank, 2020).

Our focus on the Vietnamese market is motivated by several circumstances. At first, with diverse legislative and regulatory changes aimed at encouraging credit expansion, abnormal loan growth may appear and directly benefit banks (and even push GDP growth) as *finance-economic growth theory*. Nonetheless, it may then threaten bank stability via rapidly increasing non-performing loans as the theory of *biased expectations*. The benefits of excessive credit expansion, therefore, are still an empirical question in the banking sector in Vietnam. Hence, a comprehensive study as this paper is expected to clarify this debate.

Our study adds to the banking literature in several ways. Firstly, different from previous research, we analyze the relationship between abnormal loan growth and bank risk-taking using a quantile regression approach. Studies mentioned above all share a common assumption that the marginal impact of loan growth, abnormal loan growth on bank risk-taking is identical, regardless of risk-taking distribution. Further, while comparing to the traditional Ordinary Least Squares (OLS) approach, the quantile approach allows us to report the full conditional distribution of bank risk-taking, and thus enables us to assess how policy variables affect banks at each quantile of risk-taking's conditional distribution, with a focus on the highest and the lowest risk-taking banks. This is also the case that the characteristics of banks that affect the bank risk-taking above or below the conditional mean are substantially different. Hence, our findings have important implications for regulators and policymakers in strengthening the banking system through understanding what happens at both extremes of the risk-taking distribution given a certain level of abnormal loan growth.

Secondly, we follow Foos et al. (2010) and Amador et al. (2013) to use the abnormal loan growth measure instead of annual loan growth. This takes into account the fact that high rates of loan growth do not necessarily reflect excessive risk-taking if all other banks have similarly high growth rates (Kohler, 2012). Also, this study is the first attempt to investigate whether the nonlinear relationship of loan growth on bank stability is heterogeneous across the risk-taking distribution with the adoption of quadratic estimation. Given that the Vietnamese banking system is rapidly supported for credit growth by a vast majority of changes in regulations, banks, therefore, expand as many as possible their loan portfolios. As a result, the long-run linkage between abnormal loan growth and bank risk-taking is non-linear and dependent on the level of abnormal loan growth.

Lastly, only a few studies have examined this topic in the Vietnamese market in recent years. In contrast to the study of Sarath and Pham (2015) which shows the determinants of Vietnamese bank's lending behaviors or the study of Le (2020) investigates the association between the annual loan growth and bank stability, we explore the impacts of abnormal loan growth on bank risk-taking by using a panel data from 30 Vietnamese banks over a relatively long period (2007–2019). This aims to provide more comprehensive evidence of the influence of excessive lending in Vietnam as an emerging market. In addition, to increase the reliability of the quantile regression results, the study also applies alternative techniques to check robustness.

Our findings show that a U-shaped relationship between abnormal loan growth and bank risk-taking, suggesting that continuously increasing abnormal loan growth does not persistently help to reduce risk-taking. Furthermore, the turning point of abnormal loan growth increases across conditional quantiles of bank risk-taking distribution. The effect of abnormal loan growth on bank risk-taking is more significant in higher-risk banks than lower-risk banks. These findings have several important policy implications. Of which, within a certain range, banks with higher abnormal

loan growth take lower risks, instead, an aggressive strategy of lending growth is more likely to result in higher credit risk and less bank stability in the long term.

The rest of this paper is structured as follows: Section 2 provides a literature review on the relationship between abnormal loan growth and bank risk-taking. Section 3 lays out our data and methodology. Section 4 interprets the empirical results. Finally, Section 5 gives some discussions and conclusions.

2. Literature review

There appear two main strands in the literature that investigate the relationship between loan growth and bank risk-taking. The early studies focus on the macroeconomic determinants of bank loan growth while the second strand concentrates on loan growth and bank risk. Along with these divergent approaches, the empirical evidence of this major topic is still ambiguous. In the scope of this paper, we briefly review the first strand, then deliberate on the second one with both annual and abnormal loan growth.

In the early stage, most of the studies focused on macroeconomics determinants of loan growth and found the link between economic cycles, loan growth, and loan losses at the aggregate level (Borio et al., 2001; Keeton, 1999). Specifically, the growth in subprime mortgage lending, fuelled by low-interest rates, booming housing markets, credit securitization, and lax credit standards, has led to unprecedented credit losses and serious consequences for the global economy (Dell'Ariccia et al., 2008; Gorton, 2009). Following *biased expectations* theory, recent literature also supports these findings by showing that not only financial crises are typically preceded by credit booms (Schularick & Taylor, 2012), but also that excessive credit growth is the main predictor of financial distress over a twelve-month time-window (Allesi & Detken, 2011; Borio, 2009). Some studies, in contrast, find a weak relationship between lending booms and crises outside Latin America and state that lending growth enhances financial deepening and competition, which raises efficiency and reduces the cost of borrowing (Gourinchas et al., 2001). Thus, these support the idea of *finance and economic growth* (Cecchetti & Kharroubi, 2012).

Regarding the latter strand, there are several theoretical views on the relationship between loan growth and bank risk-taking. As per the *herd behavior* hypothesis, banks could make the same or similar risk-taking management, in particular, in banks' lending decisions Rajan (1994) and Guttentag and Herring (1986) argue that banks tend to compete with other competitors in lending with the expectation that they will be the winner by improving performance through fully understanding the markets, economic industries, and borrower's information. This competition facilitates them in applying a more liberal credit policy as extending the borrowing limits and loosening lending conditions, hence explaining the increased risk for banks to expand credit activities. Secondly, the *agency problem* may exist where there are heterogeneous in terms of goals and benefits between shareholders and bank managers. The rapid loan growth in the short term could create benefits for bank managers as criteria to measure manager performance, while in the long-term risk is usually hidden for bank shareholders (Saunders et al., 1990). The value of collaterals is also considered to be an explanation of this case. When banks extend the borrowing limit for borrowers, the collateral is valued up (and vice versa), which causes banks to ultimately grant loans for one who originally does not meet the lending requirements. Since then, whenever there is a decrease in collateral price, banks immediately face risks. Adrian and Shin (2010) state that in lending booms, banks that rely too much on collateral often seek more and more borrowers as their existing loans are guaranteed by collaterals, which in turn makes banks encounter higher risk since they may finance bad borrowers.

The empirical studies on the relationship between loan growth and riskiness of individual banks start early in developed countries and show debatable results. For instance, several studies in the US find the significant and positive relationship between average loan growth and rate of loan losses (Sinkey & Greenawalt, 1991), or detects a negative impact of loan growth on non-performing loan in the first year after for credit expansion, but in subsequent years, a positive relationship is partly found (Clair, 1992).

Outside the US, Laeven and Majnoni (2003) notice a significantly negative contemporaneous relation between loan growth and loan losses, suggesting an imprudent provisioning behavior of banks, which is too little in good times but is overreacted in bad times. On the other hand, opposite results are found in OECD countries during the period of 1991–2000 when a positive link between loan growth and loan loss provisioning is investigated (Bikker & Metzmakers, 2005). Additionally, one may argue that there should be a time-lag effect of loan growth on bank risk-taking. Some studies show that loan growth significantly creates loan losses with three or four years in Spain (Salas & Saurina, 2002) or with a lag of two or four years in Australasian banks (Hess et al., 2009). Others present a similar result, showing past excessive loan growth (up to 3 years) may lead to an increase of credit loss (or non-performing loans) and a decrease of bank solvency (Z-score) in EU countries (Laidroo & Kadri, 2017), and in Swedish financial institutions (Papadamou et al., 2018). Contrary to these findings, Brei et al. (2020) used a dataset of 32 economies (15 advanced and 17 emerging countries) during 2007–2015 and found that higher growth in SME lending is associated with greater banking system stability, measured by greater distance to default, but only in emerging market economies.

In the past decade, more and more studies focus on “abnormal loan growth” instead of annual loan growth. As defined by Foos et al. (2010), abnormal loan growth is the difference between an individual bank’s loan growth and the median loan growth of all banks from the same country and year. This allows us to take into account the fact that high rates of credit growth do not inherently represent excessive risk-taking when all other banks have equally high growth rates (Kohler, 2012). Until now, there are, however, not many studies in the intertemporal relation between abnormal loan growth and individual banking performance for emerging economies. A few researchers have conducted this issue in Colombia, Pakistan, and some Asian countries, but their results are inconsistent. For example, using data of 16,000 individual banks during 1997–2007 in 16 OECD countries, Foos et al. (2010) suggest that abnormal loan growth contributes to an increase in loan loss provisions in the following two to four years, to a fall in relative interest income (and even risk-adjusted interest income), and to lower capital ratios. Kohler (2012) find similar results in 15 EU countries, in which banks with high abnormal loan growth are riskier. Further, Colombian banks point out abnormal loan growth leads to a notable increase in the ratio of non-performing loans to total loans (NPL) and affects bank solvency in the long run (Amador et al., 2013). A similar result is also found by the study of Kashif et al. (2016) using the Pakistan data, or by the study of Shahzard et al. (2019) in Turkish banks. All indicate the significant results for the effect of abnormal loan growth on NPL and solvency. More specifically, NPL rises from the previous year’s abnormal loan growth, which tends to reduce solvency. Besides, with regards to systematic risk, Soedarmono et al. (2017) show that abnormal credit growth increases the bank systemic risk one year ahead in 9 Asian countries. Hitherto, there are still many conflicting results between abnormal loan growth and bank risk-taking in developing countries. Therefore, it is necessary to perform a similar examination but more profound and deeper into banks in Vietnam where continuous credit growth has been recorded in recent years, so we conduct this study to further verify whether loan growth has any impact on bank stability using quantile regression, and the first null hypothesis is:

H₁: There is no impact of abnormal loan growth on bank risk-taking.

Furthermore, following the study of Le (2020) in which a quadratic relationship between loan growth and bank stability exists in the Vietnamese banking system, we argue that when abnormal loan growth goes beyond a certain threshold, similarly, it may have an inverse effect on bank risk-taking. Thus, for capturing the U-shaped relationship, the second null hypothesis is:

H₂: There is a non-existence of the non-linear relationship between abnormal loan growth and bank risk-taking.

3. Methodology and Data

3.1. Methodology

3.1.1. Quantile regression framework

Following prior studies in banking literature, we employ the quantile regression method as proposed by Roger Koenker and Gilbert Bassett (1978), which is a robust estimator that takes into account the heterogeneity of bank risk. Hanson et al. (2008) state that when neglecting the heterogeneity in the outcome variables, this might lead to inconsistent estimation results. Rather than estimating a single measure of central tendency for the abnormal loan growth-bank risk relationship, quantile regression facilitates the estimation of several coefficients at various points across the conditional distribution of bank risk (De-ramon et al., 2019). As comprehensively discussed by Jiang et al. (2019) and Le and Nguyen (2020), the τ -th quantile of the conditional distribution of Y_i given X_i is:

$$Q(Y_i|X_i) = X_i'\beta_\tau \quad (1)$$

and the parameter vector of the τ -th quantile of the conditional distribution is estimated by:

$$= \arg \min \sum_{i=1}^N \rho_\tau(Y_i - X_i'\beta_\tau) \quad (2)$$

in which quantile loss function ρ_τ is defined as:

$$\rho_\tau(u) = \begin{cases} (\tau - 1)u & \text{for } u < 0 \\ \tau u & \text{for } u \geq 0 \end{cases} \quad (3)$$

Equation (2) shows that the quantile regression approach allows for parameter heterogeneity with different values for τ in the interval (0,1), enabling us to obtain a complete picture of the relationship between independent variable and outcome variable (Jiang et al., 2019). This helps quantile regression outperforms the linear model because it provides a more appropriate quantile analysis, which is less sensitive to outliers and elongated (or extreme distributions) due to the ability to adjust the weight through the loss function (Jawadi et al., 2017). Hence, the quantile regression does not restrict to the standard error term assumption of OLS estimation. Due to a huge of its advantages, the quantile regression is employed in many practical applications when the variables of interest potentially have different effects on the dependent variable's conditional distribution, especially when this distribution is heavy-tailed (Jiang et al., 2019; Lee & Li, 2012; Mello & Perrelli, 2003; Pires et al., 2015).

We also combine the benefit of both quantile regression and fixed-effect models by using panel quantile regression, which commonly reduces the time-invariant unobservable endogeneity (Jiang et al., 2019). According to Koenker et al. (2004), Canay (2011), and Kato et al. (2012), a panel quantile regression model with fixed effects is given,

$$Q_{Y_{it}}(\tau_j|X_{it}, \alpha_i) = X_{it}'\beta(\tau_j) + \alpha_i \quad (4)$$

where ρ_τ is the τ_j quantile conditional function, and ρ_τ is the individual fixed effect. Koenker et al. (2004) also suggest a penalized quantile regression estimator that can be used to overcome the potential issue of including many fixed effects so that we can acquire the coefficients of conditional quantile function (4) as follows:

$$(\hat{\beta}(\tau_j, \lambda), \hat{\alpha}_i(\lambda)) = \arg \min \sum_{j=1}^J \sum_{t=1}^T \sum_{i=1}^N \omega_j \rho_{\tau_j}(Y_{it} - X_{it}'\beta(\tau_j) - \alpha_i) + \lambda \sum_{i=1}^N |\alpha_i| \quad (5)$$

where ρ_τ is the quantile loss function similar to Equation (3), ρ_τ is the relative weight given to the j -th quantile, and ρ_τ is the tuning parameter which controls the degree of shrinkage of the penalty

term. For example, if $\rho_\tau = 0$, the penalty term disappears and the usual fixed effects are obtained. Meanwhile ρ_τ is infinity, we have pooled quantile regression estimator as,

$$\hat{\beta}(\tau) = \arg \min \sum_{i=1}^N \sum_{t=1}^T \rho_\tau(Y_{it} - X'_{it}\beta) \quad (6)$$

The pooled quantile regression estimator is generally handy to estimate the time-variant effects of interest that are related to the differential of bank risk-taking at different quantile levels of the conditional distribution. However, ρ_τ and ρ_τ might not be independent, resulting in the estimator can be biased. To avoid this, we followed a consistent and asymptotically normal two-step estimator of estimating a panel quantile regression model with fixed effects as developed by Canay (2011). In the first step, we calculated the fixed effects and utilize the estimated parameters to acquire the individual fixed effect variable ρ_τ . The second step was to construct a new dependent variable by subtracting the estimated individual effect ρ_τ , and run a standard quantile regression.

3.1.2. Empirical model

Based on the quantile regression framework discussed above, we specify the following model to examine whether the measure of abnormal loan growth has a heterogeneous effect on bank's risk-taking as well as their nonlinear relationship.

$$Q_\tau(RISK_{i,t}|X_{i,t}) = \alpha_i + \beta_{1\tau}ALG_{i,t} + \beta_{2\tau}ALG_{i,t}^2 + \gamma_\tau B_{i,t} + \theta_\tau M_t + \varepsilon_{it,t} \quad (7)$$

where ρ_τ is the ρ_τ quantile-regression function. ρ_τ is risk-taking behavior of a bank ρ_τ during year ρ_τ and is measured by either credit risk or bank stability. Following Le et al. (2019), Le et al. (2020), and among others, bank stability is measured as ρ_τ where ρ_τ is the return on assets, ρ_τ is the ratio of total equity to total assets, and ρ_τ is the standard deviation of return on assets over the examined period. A higher value of ρ_τ argues a greater bank stability. Moreover, we use the growth rate of the ratio of non-performing loans to total loan, ρ_τ , as a proxy of bank credit risk (Alihodzic & Eksi, 2018; Le & Ngo, 2020) of bank i at time t . It is noticeable that, in our study, an inverse of ρ_τ is used as a proxy of bank insolvency, denoted by $Z_{i,t}$. Hence, a greater value of both ρ_τ and ρ_τ implies a higher level of risk-taking or less bank stability.

However, the dependent variable NPL is naturally lagged. For example, non-performing loans observed at time t were not caused by business and economic conditions at time t , as it may take many months (or years) for borrowers to exhaust other means of funding and becoming delinquent on loan repayments. Therefore, for this variable, we include a number of regressors that are lagged by one year as proposed by Cornelli et al. (2020). As a result, our baseline regressions take the following forms:

$$Z_{i,t} = \alpha_i + \beta_{1\tau}ALG_{i,t} + \beta_{2\tau}ALG_{i,t}^2 + \gamma_\tau B_{i,t} + \theta_\tau M_t + \varepsilon_{it,t} \quad (8)$$

$$NPL_{i,t} = \alpha_i + \beta_{1\tau}ALG_{i,t-1} + \beta_{2\tau}ALG_{i,t-1}^2 + \gamma_\tau B_{i,t-1} + \theta_\tau M_{t-1} + \varepsilon_{it,t-1} \quad (9)$$

The consequences of a bank's extreme loan growth are not only determined by its absolute level but depend crucially on the relative growth rate compared to its competitors under similar conditions, in the same country and year. Therefore, $ALG_{i,t}$, the abnormal loan growth rate of bank i at time t , is used as our main analysis.¹ It is defined as the difference between an individual bank's loan growth and the median loan growth of the Vietnamese entire banking system from the same year. This approach permits to control of the macroeconomic and competitive conditions in each country and year (Foos et al., 2010). The higher loan growth is believed to lead to an increase of both credit risk and bank insolvency by rising non-performing loans from lowering interest rates, relaxing collateral requirements, loosening credit standards, or a combination of them. In addition, as suggested in the study of Le (2020), we also include the quadratic term of abnormal loan growth (ρ_τ) in the model to capture the U-shaped feature of the nonlinear relationship between excessive lending and risk-taking behavior of the banks.

$B_{i,t}$ is a set of bank-specific and market-specific control variables of bank i at time t . For instance, ρ_t , a natural logarithm of total assets is used to control for the effect of bank size. Small banks may have lower risk management since they face constraints on investing in advanced technology. Smaller size reduces the bank's ability to expand into a wide range of business lines and with a limited scope of customers. Large banks, however, may invest more in risky assets because of the too-big-to-fail effect. Smaller banks may have more flexibility in operating in terms of changing their strategies more quickly as a response to a change in economic condition and have lower fixed operating costs (Amador et al., 2013; García-Suaza et al., 2012).

Bank liquidity is proxied by the ratio of liquid assets to total assets (ρ_t). As per the expected bankruptcy cost hypothesis, a lower probability of default is associated with a higher level of liquid asset that banks hold. On the other hand, banks that invest more funds in liquid assets tend to have lower bank profitability due to these assets often yield lower returns compared to other assets. Bank inefficiency is measured by a cost-to-income ratio (ρ_t). More efficient banks may control operating or monitor borrowers efficiently thus having lower risk. Alternatively, banks may skimp on operating costs by relaxing the procedure of credit monitoring and collateral valuation to accomplish short-run economic efficiency. These activities may in turn reduce loan quality, thus leading to higher risk (Gosh, 2010).

For market-specific conditions, the Herfindahl-Hirschman concentration index (ρ_t) in terms of total assets is used to account for the effect of bank concentration (García-Herrero et al., 2009). HHI is estimated by the sum of squared of banks' market share in total assets. A greater value of ρ_t implies greater market concentration. An increase in bank profits and the franchise value is related to a highly concentrated market due to reduced competitive pressure and higher market power. Therefore, bank managers are less incentive to take more risky investments.

Finally, we also follow Diaconu and Oanea (2014) to incorporate two variables annual economic growth rate (ρ_t) and annual inflation rate (ρ_t), represented by Mt (a set of time-varying macro-economic control variables or country variables), in the model to capture the possible effect of the business cycle on bank risk-taking.

3.2. Data

The data was manually gathered from the audited financial reports of individual banks from 2007 to 2019 on a consolidated basis according to Vietnamese Accounting Standards. It is worth noting that only 30 domestic commercial banks were considered in our study due to 100% foreign-owned banks, joint-venture banks, and foreign affiliates have faced some limitations on operating activities in the Vietnamese financial market. These banks together accounted for approximately 80% of total assets in the whole banking system. Due to several merger and acquisition activities in the examined period, an unbalanced panel data of 353 observations were obtained. Furthermore, the data on macroeconomic conditions were collected from the World Bank database. Table 1 provides the descriptive statistics of the variables used in this study.

In order to capture the effects of lending policy on bank risk-taking, we also calculate the ratio of short-term funds for medium and long-term loans. The results seem to be more interesting when all 30 banks have this rate exceeding the ceiling rate, which is more than 40%.

Table 1 provides the descriptive statistics of variables. It shows that the 10th and 90th quantiles of Z are approximately 0.0% and 5.7% while these figures of NPL are -46.4% and 95.2%, respectively. This indicates that risk-taking, measured by bank insolvency and credit risk, varies a lot from lower quantile to higher quantile. Moreover, the histogram of both Z and NPL (presented in Figure 1) shows the skewed and heavily right-tail distribution. Such fact further reinforces the necessity of a quantile approach. Though the standard conditional mean method can be appropriate to model average risk, it cannot provide an accurate description of risk spread (Le & Nguyen, 2020; Pires et al., 2015).

Table 1. The descriptive statistics of variables

Variables	Obs.	Mean	S.D.	Min	Q (10)	Median	Q (90)	Max
Z	353	0.027	0.079	0.000	0.000	0.012	0.057	0.934
NPL	353	0.293	1.640	-1.000	-0.464	-0.043	0.952	16.852
ALG	353	0.120	0.407	-1.162	-0.202	0.035	0.819	1.374
SIZE	353	31.975	1.347	27.520	30.347	32.034	33.726	34.937
LIQ	353	0.323	0.128	0.062	0.177	0.312	0.513	0.816
CIR	353	0.154	0.076	0.040	0.080	0.140	0.22	0.640
HHI	353	0.003	0.007	0.000	0.000	0.000	0.013	0.059
GDP	353	0.062	0.007	0.052	0.054	0.062	0.071	0.071
INF	353	0.0761	0.062	0.006	0.026	6.593	0.186	0.231

Figure 1. Histogram for NPL and inverse of Z-score.

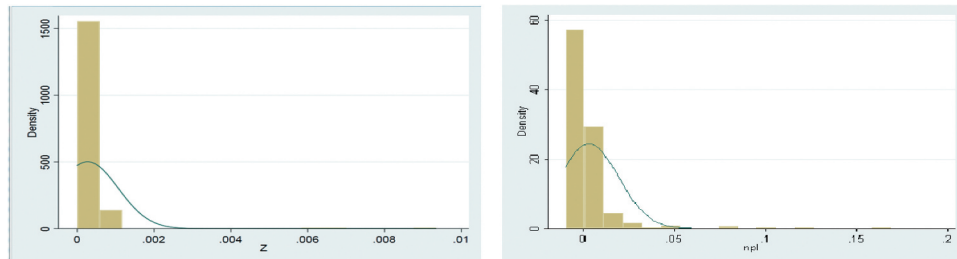


Figure 2. Abnormal and annual loan growth in the Vietnamese banking system.

Note: Abnormal loan growth is defined as the difference between an individual bank's loan growth and the median loan growth of the Vietnamese entire banking system from the same year. Meanwhile, annual loan growth is the annual growth rate of loans to customers. Both abnormal and annual loan growth are yearly averaged based on the number of banks researched.

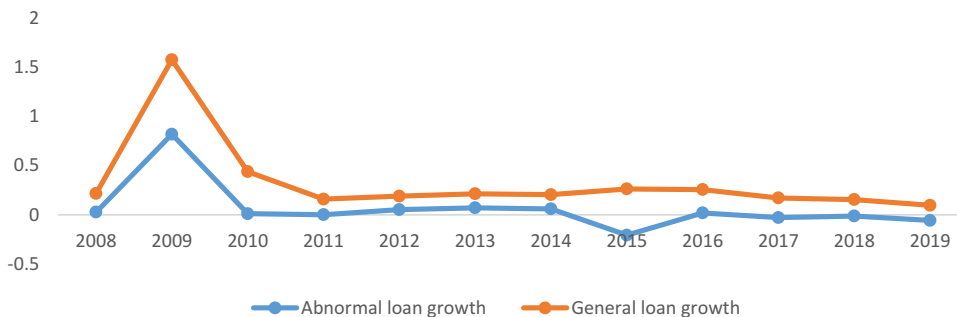


Table 1 also shows the average abnormal loan growth in the Vietnamese banking sector is 12%. While the minimum figure stays very far below the mean, up to -116.2%. Similarly, the maximum one reaches the peak of 137.4%. Most of the banks (between 10% quantile to 90% quantile) have abnormal loan growth from -20.2% to 81.9%. This fact indicates the effects of abnormal loan growth vary at the different points across the conditional risk-taking distribution. Further, Figure 2 shows that even though abnormal loan growth has the same pattern, it is much lower than annual loan growth during the studied period. And as suggested by Kohler (2012), high rates of credit growth do not inherently interpret uncontrolled risk-taking when all other banks have equally high growth rates. Again, this reconfirms the appropriate of using abnormal loan growth in our study.

Finally, Table 2 presents the correlation matrix among independent variables and shows that there is no multicollinearity among them.

4. Empirical results

4.1. Quantile regression analysis

It is important to note that the OLS regression might have seriously under or overestimate effects in heterogeneous distributions (Cade & Noon, 2003; Tu DQ Le & Nguyen, 2020). Therefore, the results of pooled OLS and panel OLS with fixed effects are not presented here for the want of space. The previous traditional regressions have not strongly explained the impacts of abnormal loan growth on bank insolvency though they can provide a good estimation of the bank credit risk. Moreover, neither of them can capture the whole distribution of conditional bank stability. Hence,

Table 2. The correlation matrix of variables

	Z	NPL	ALG	SIZ	LIQ	CIR	HHI	GDP	INF
Z	1.000								
NPL	-0.028	1.000							
ALG	-0.050	-0.030	1.000						
SIZ	0.248	-0.141	0.100	1.000					
LIQ	-0.174	0.102	0.004	-0.117	1.000				
CIR	0.014	-0.048	-0.088	0.690	-0.195	1.000			
HHI	-0.007	-0.033	0.011	0.121	-0.006	0.224	1.000		
GDP	-0.054	-0.195	0.292	0.229	-0.251	-0.036	0.111	1.000	
INF	0.008	0.309	-0.140	-0.189	0.196	0.031	-0.276	-0.418	1.000

we employ quantile regression to address the heterogeneity effects among variables along with the quantile distribution.

For the ease of exposition, we only focus on interpreting our main interest variables. Table 3 and Table 4 present baseline results using panel quantile regression methods when bank risk-taking is proxied by both Z and NPL, respectively. Following the quantile regression literature, estimated coefficients are reported for the 10th, 20th, 25th, 50th, 75th, 80th, and 90th quantiles of the conditional distribution of bank risk-taking. From these two tables, some interesting findings can be drawn as the following.

Regarding bank insolvency (ρ_τ), the coefficient of ALG is generally negative and significant at the 75th quantile, implying that abnormal loan growth tends to improve bank stability. This is in line with the early findings of T. D. Le (2018) in the Vietnamese banking system that bank loans are more highly valued than other assets such as long-term investments and securities. This further supports the view of Brei et al. (2020) that higher lending may contribute to financing profitable projects, potentially improving banks' asset quality and reducing the distance to default, in emerging markets. Likewise, in terms of credit risk (ρ_τ), ALG is in general negatively and statistically significant at 75th and 80th quantiles, suggesting that banks with greater credit risk are associated with lower loan growth in either expansion or contraction period. These results are comparable with Lepetit et al. (2008), and Bovatier and Lepetit (2012).

Prior studies in the banking literature however suggest that there may be the adverse effect of abnormal loan growth on bank risk-taking beyond a certain threshold. Accordingly, we include the quadratic term of the abnormal loan growth to capture the U-shaped relationship between excessive lending and bank risk-taking. The data shown in Tables 3 and 4 also present that the coefficients of ρ_τ are significant and positive at the same quantiles in both models of bank risk-taking measures. That means that the inverted U-shaped relationship is only significant at higher quantiles of bank risk-taking distribution. More specifically, the findings suggest that bank stability may not hold at a certain rate of abnormal loan growth. These findings concur with Gosh (2010), Foos et al. (2010), Le (2020), and Amador et al. (2013), who claimed that excessive credit growth may induce bank fragility.

Additionally, we also find that the absolute values of estimated coefficients are different for each quantile. The magnitude is increasing from lower to higher quantiles in the distribution. Such variation validates our concerns of heterogeneity among coefficients. For the case of credit risk (NPL), Table 4 shows that the estimated coefficient of ρ_τ at 80th quantile is -0.013, which is slightly higher the value at 75th quantile (-0.012). Similarly, the estimated coefficient of ρ_τ at 80th quantile (0.261) is greater than that at the 75th quantile (0.254).

Table 3. Baseline results for Z: Quantile regression

Quantiles	0.1	0.2	0.25	0.5	0.75	0.8	0.9
ALG	-0.000 (0.000)	0.000 (0.004)	0.002 (0.007)	0.005 (0.011)	-0.041** (0.018)	-0.026 (0.020)	-0.022 (0.019)
ALG ²	0.000 (0.000)	0.000 (0.004)	-0.003 (0.007)	-0.007 (0.011)	0.034* (0.017)	0.017 (0.020)	0.012 (0.018)
SIZE	-0.000 (0.000)	0.001 (0.001)	0.003** (0.001)	0.014*** (0.002)	0.017*** (0.003)	0.017*** (0.004)	0.018*** (0.004)
LIQ	-0.000** (0.000)	-0.003 (0.005)	-0.008 (0.009)	-0.048*** (0.014)	-0.064*** (0.022)	-0.079*** (0.025)	-0.060*** (0.023)
CIR	0.000 (0.000)	-0.002 (0.009)	-0.013 (0.016)	-0.004*** (0.024)	-2.800*** (0.691)	-3.063*** (0.790)	-3.346*** (0.732)
HHI	-0.000 (0.000)	-0.099 (0.164)	-0.022 (0.274)	-1.563 (0.422)	0.144*** (0.040)	0.136*** (0.045)	0.186*** (0.042)
GDP	-0.000 (0.000)	-0.039 (0.109)	-0.156 (0.181)	-0.672 (0.280)	-1.060** (0.458)	-1.057** (0.524)	-1.130** (0.485)
INF	0.000 (0.000)	0.002 (0.014)	0.008 (0.023)	0.055 (0.035)	0.067 (0.058)	0.140** (0.066)	0.188*** (0.061)
Constant	0.000 (0.000)	-0.026 (0.025)	-0.092 (0.042)	-0.367 (0.065)	-0.442 (0.107)	-0.453 (0.122)	-0.471 (0.113)
No. Obs.	262	262	262	262	262	262	262
Pseudo R ²	0.000	0.002	0.012	0.183	0.169	0.195	0.218

Note: This table presents pooled quantile regression for the 10th, 20th, 25th, 5th, 75th, 80th, and 90th quantiles. The dependent variable is Z. Standard errors are in parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

In order to provide further insights into the non-linear relationship between abnormal loan growth and bank insolvency as well as credit risk, we need to estimate the turning points. It should be noted that evidence would support the inverted U-shaped relationship at the τ quantile if ρ_τ and ρ_τ (or vice versa) where ρ_τ and ρ_τ denote the coefficients of linear and quadratic terms of ALG at τ quantile, respectively. The turning point level of ALG is calculated as ρ_τ .

More specifically, the value of turning points of the U-shaped impact tends to be relatively slow at lower quantiles and then starts to go up at the higher quantiles. For example, at the 75th quantile level of conditional credit risk (ρ_τ), the turning point is 0.02362. This argues that the effect of abnormal loan growth on credit risk will turn from negative to positive when the ALG exceeds around 2.36%. This critical level will increase to 2.49% at the 80th quantile, implying that the higher level of abnormal loan growth a bank experiences, the higher the credit risk they may encounter. Meanwhile, the turning point of ALG in Equation (8) is 0.6029, stating that banks may fall into insolvency status if the ALG surpasses 60.29%. We also find that the turning point obtained from a quantile regression is greater than those obtained from Pooled OLS and Fixed Effects. This somewhat supports the early findings of Le and Nguyen (2020) and Jiang et al. (2019) who argue that quantile regression can provide a more comprehensive picture of the entire distribution of bank risk-taking whereas the OLS fails to capture this such heterogeneity.

4.2. Inter-quantile difference

Our findings specify whether the impact of abnormal loan growth on bank risk-taking is heterogeneous across the ρ_τ and ρ_τ distribution. To test whether or not these differences are statistically significant, following Koenker and Bassett (1978) the inter-quantile regressions are utilized to check for slope equality throughout the quantiles. The estimated coefficients of inter-quantile regressions are exactly the difference in coefficients of two quantiles regressions estimated separately, and the estimated variance-covariance matrixes are obtained using bootstrapping

Table 4. Baseline results for NPL: Quantile regression

Quantiles	0.1	0.2	0.25	0.5	0.75	0.8	0.9
L.ALG	−0.004 (0.005)	−0.001 (0.005)	−0.002 (0.003)	−0.005 (0.003)	−0.012** (0.005)	−0.013** (0.006)	−0.002 (0.012)
L.ALG ²	0.005 (0.071)	0.088 (0.065)	0.113 (0.052)	0.148** (0.118)	0.254*** (0.085)	0.261*** (0.091)	0.069 (0.183)
L.SIZE	−0.012 (0.025)	−0.050 (0.023)	−0.033 (0.018)	−0.036 (0.017)	−0.057 (0.030)	−0.060 (0.033)	−0.109 (0.066)
L.LIQ	−0.160 (0.194)	0.010 (0.178)	0.027 (0.143)	−0.036 (0.130)	0.132 (0.233)	0.199 (0.250)	0.091 (0.500)
L.CIR	−0.366 (0.328)	0.068 (0.300)	0.045 (0.242)	−0.055 (0.220)	0.091 (0.394)	0.293 (0.423)	0.114 (0.846)
L.HHI	2.815 (4.467)	4.513 (4.082)	1.760 (3.302)	0.413 (2.998)	5.604 (5.304)	8.473 (5.761)	10.702 (11.511)
L.GDP	14.348*** (10.763)	9.324** (3.771)	8.025** (3.050)	6.329** (2.769)	5.718 (4.955)	5.430 (5.321)	7.409 (10.632)
L.INF	0.452 (0.455)	0.364 (0.416)	0.413 (0.336)	1.065*** (0.305)	2.174*** (0.547)	2.635*** (0.587)	3.652*** (1.174)
Constant	−0.649 (0.802)	0.850 (0.733)	0.429 (0.592)	0.714 (0.538)	1.427 (0.963)	1.504 (1.034)	3.094 (2.066)
No. Obs.	311	311	311	311	311	311	311
Pseudo R ²	0.096	0.057	0.068	0.079	0.141	0.156	0.216

Note: This table presents pooled quantile regression for the 10th, 20th, 25th, 50th, 75th, 80th, and 90th quantiles. The dependent variable is NPL. Standard errors are in parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

methods. We run a rang of the inter-quantile regression; however, to save space, we only present statistically significant results.

Table 5 reemphasizes that the effect of abnormal loan growth on bank risk-taking is U-shaped on the conditional mean. Regarding bank insolvency, the differences in the quantile ρ_{τ} for ρ_{τ} and ρ_{τ} are −0.043 and 0.036, which are statistically significant at the 5% and 10% level, respectively. For credit risk, the differences in the quantile ρ_{τ} for ρ_{τ} (−0.009) and ρ_{τ} (1.140) are statistically significant at the 5% level.

It is important to note that we only focus on our main interest variables that show significant impacts on bank risk-taking in both quantile and inter-quantile models. The data in **Tables 3 and 5** show a positive relationship between bank size (ρ_{τ}) and bank instability (ρ_{τ}) at the higher and inter-quantiles, demonstrating that larger banks may invest more in risky assets due to the “too-big-to-fail” effect. This finding is in line with those of Le et al. (2019) and Beck et al. (2006). Nonetheless, this somewhat does not support the findings of Kashif et al. (2016), Baradwaj et al. (2014), and Marijana et al. (2013). The coefficient of ρ_{τ} , on the other hand, is negative and significant in one model, thus supporting the view that the more liquid assets banks hold, the less probability of default they face.

Further, ρ_{τ} is only positively and significantly associated with Z at the higher quantiles (in **Tables 4 and 5**), thus the skimp costs hypothesis may hold. Accordingly, banks may skip on operating costs through a lax approach to credit monitoring and collateral valuation to achieve short-run economic efficiency, which, in turn, reduces loan quality, and thus leading to higher insolvency (Gosh, 2010). The findings indicate a positive relationship between ρ_{τ} and ρ_{τ} , implying that a more competitive banking system is related to lower bank risk-taking. This confirms the early view of Le and Ngo (2020) and Mirzaei et al. (2013).

Table 5. The results of inter-quantile regression

	Z		NPL
Quantiles	(75–25)	Quantiles	(75–25)
ALG	−0.043** (0.021)	L.ALG	−0.009*** (0.101)
ALG ²	0.036* (0.021)	L.ALG ²	1.140* (0.120)
SIZE	0.013*** (0.004)	L.SIZE	−0.024 (0.028)
LIQ	−0.056** (0.024)	L.LIQ	0.104 (0.196)
CIR	−2.779*** (0.651)	L.CIR	0.045 (0.448)
HHI	0.157** (0.078)	L.HHI	3.844 (6.658)
GDP	−0.904* (0.464)	L.GDP	−2.306 (4.780)
INF	0.059 (0.064)	L.INF	1.760** (0.679)
Constant	−0.350 (0.111)	Constant	0.997 (0.913)
No. Obs.	262	No. Obs.	311

Notes: This table shows the difference in quantile regression estimates for an inter-quantile regression: ρ_{τ} . The bootstrapped cluster standard errors (in parentheses) are obtained with 200 bootstrap replications. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

Finally, a negative impact of GDP on Z supports the traditional opinion that there appears an increasing demand for banks' services and products during the cyclical upswings of the economy, which results in higher bank profitability. This is in line with the findings of Le et al. (2020) in cross-country. Nevertheless, a positive relationship between ρ_{τ} and ρ_{τ} (Tables 4 and 5) implies that a greater inflation rate may increase the risk of loan repayment since it may affect the borrowers' budgets—threatening their liquidity and reducing their repayment ability (Pervan et al., 2015).

4.3. Robustness checks

To provide robustness checks, several regressions are run. Firstly, unlike the banking system in developed countries, Vietnam has many banks, totally comprising of 35 commercial banks, but the banking market is dominated by the four state-owned banks (also called big 4 banks). Therefore, it is important to test whether our results are sensitive to excluding state-owned banks from the sample in the context that abnormal loan growth or excessive lending is not really a serious problem for state-owned banks when they have some backup from the government or the SBV. Aside from that, in some cases, they have to grant loans to “certain borrowers” at the request of the government or the SBV for the purposes of economic growth.

As a result, we re-estimate our models by excluding state-owned banks. For the sake of brevity, we only report our main interest variables as shown in Table 6–8. The findings show a negative impact of abnormal loan growth on bank risk-taking and the U-shaped relationship between them in higher quantiles (i.e., 50th and 75th). Moreover, heterogeneity is also detected among banks with different risk levels. Overall, adjustment of the sample does not alter our main result that the abnormal loan growth may help to reduce bank risk-taking initially, then raise its risk-taking when the abnormal loan growth exceeds certain points.

Secondly, it may be concerned that our study of the relationship between abnormal loan growth and bank risk-taking may suffer from potential and endogeneity. More specifically, omitted variables and reverse causality are the most important and pervasive issues that may lead to biased

Table 6. Baseline results for Z: quantile regression with subsample

Quantiles	0.10	0.20	0.25	0.50	0.75	0.80	0.90
ALG	0.000 (0.000)	0.001 (0.005)	0.001 (0.005)	-0.006 (0.012)	-0.049** (0.019)	-0.022 (0.018)	-0.027 (0.019)
ALG ²	0.000 (0.000)	0.000 (0.005)	-0.001 (0.005)	0.006 (0.012)	0.043** (0.019)	0.017 (0.017)	0.028 (0.019)
Constant	0.004 (0.003)	0.028 (0.043)	0.038 (0.045)	-0.071 (0.110)	-0.171 (0.175)	-0.173 (0.160)	-0.261 (0.171)
No. Obs.	231	231	231	231	231	231	231
Pseudo R ²	0.007	0.030	0.058	0.212	0.238	0.253	0.253

Note: This table presents pooled quantile regression for the 10th, 20th, 25th, 50th, 75th, 80th, and 90th quantiles. The dependent variable is Z. Standard errors are in parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively. The same set of variables in Equation (8) is used.

Table 7. Baseline results for NPL: quantile regression with subsample

Quantiles	0.10	0.20	0.25	0.50	0.75	0.80	0.90
L.ALG	-0.086 (0.079)	-0.001 (0.004)	-0.003 (0.004)	-0.005** (0.003)	-0.009* (0.005)	-0.008 (0.008)	-0.001 (0.188)
L.ALG ²	0.010 (0.005)	0.067 (0.059)	0.067 (0.057)	0.147*** (0.053)	0.200** (0.077)	0.185 (0.117)	0.001 (0.012)
Constant	1.236 (1.272)	2.115 (0.952)	1.521 (0.923)	1.493 (0.848)	1.827 (1.245)	2.231 (1.880)	6.974 (3.011)
No. Obs.	271	271	271	271	271	271	271
Pseudo R ²	0.132	0.101	0.098	0.098	0.162	0.183	0.255

Note: This table presents pooled quantile regression for the 10th, 20th, 25th, 50th, 75th, 80th, and 90th quantiles. The dependent variable is NPL. Standard errors are in parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively. The same set of variables in Equation (9) is used.

inconsistent parameter estimates. Thus, following Foos et al. (2010), Kashif et al. (2016), and Kohler (2012), we re-estimate the model in a two-step system Generalized Method of Moments (GMM) framework, as proposed by Arellano and Bover (1995) and Blundell and Bond (1998) with a finite sample correction of Windmeijer (2005). This estimation technique is particularly suitable for small T and large N samples such as the case of the Vietnamese banking system. The use of system GMM is appropriate for at least two reasons. First, data used in this study are extracted from financial statements of commercial banks in Vietnam, which primarily revolves around the balance sheet and hence may exist endogenous phenomenon. Second, first differencing the regression equation to eliminate the bank-specific effects would lead to a correlation between the lagged dependent variable and the error term. To solve these problems, we instrument the one-year-lagged endogenous variable and the two-year-lagged bank-specific variables, while the market-specific and country variables are treated as exogenous. The results shown in Table 9 confirm our above findings again. Note that the coefficient of NPLt-1 is negative because the higher credit risk in the previous year is required to lower their risk according to the requirement on the cap of NPL proposed by the SBV.

In short, after many robustness checks, our study confirms that in the first stage, the appearance of abnormal loan growth could help banks to reduce risk-taking. These could be explained by the following reasons. Even though the regulatory changes have encouraged credit growth, the SBV also limits excessive growth of loans through NPL cap whereby the NPL of banks must not exceed 3% (as regulated in Circular 22/200 whereby the NPL of banks must not exceed 3% (as regulated in Circular 22/200 whereby the NPL of banks must not exceed 3% (as regulated in

Table 8. Baseline results for Z and NPL: inter-quantile regression with subsample

	Z		NPL
Quantiles	(75–25)	Quantiles	(75–25)
ALG	–0.050*** (0.017)	L.ALG	–0.909** (0.831)
ALG ²	0.043** (0.018)	L.ALG ²	0.132* (0.118)
Constant	–0.209 (0.109)	Constant	0.305 (1.611)
No. Obs.	231	No. Obs.	271

Notes: This table shows the difference in quantile regression estimates for an inter-quantile regression: ρ_t . The bootstrapped cluster standard errors (in parentheses) are obtained with 200 bootstrap replications. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively. The same set of variables in Equations (8) and (9) is used.

Table 9. Abnormal loan growth and bank risk-taking, using system GMM

	Z	NPL
$\pi t-1$	0.566*** (0.149)	–0.033*** (0.009)
ALG	–0.041** (0.017)	–0.753** (0.293)
ALG ²	0.038** (0.016)	0.524* (0.288)
Constant	–0.042 (0.203)	–4.786 (2.271)
No. Obs.	233	265
No. of Groups	33	30
AR1 (p-value)	0.089	0.086
AR2 (p-value)	0.162	0.082
Hansen test (p-value)	0.187	0.378

Notes: This table presents a two-step GMM estimator to control for potential endogeneity between abnormal loan growth and bank risk-taking. The same set of variables in Equations (8) and (9) is used although they are not reported here due to the length constraints. Robust standard errors are reported in parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

Decision No. 339/QD-TTg for the period of 2013–2020). Thus, when banks stay at the median loan growth of the entire banking system, any abnormal loans incurred must be carefully selected (i.e., they must be highly valued than other assets) or even banks could reduce loan growth in either expansion or contraction period in the following periods to ensure meeting the SBV's requirements. Nevertheless, if abnormal loan growth continues in the long-run, it may affect the risk-taking in a reverse way. In more details, abnormal credit growth during a prolonged period of time leads to an increase in banks' riskiness, followed by an increase in both insolvency and credit risk, which in turn supports the results of most studies in emerging markets (Amador et al., 2013; Kashif et al., 2016; Shahzard et al., 2019). Our exciting findings are expected to add more evidence to the banking literature about the relationship between abnormal loan growth and risk-taking with heavy regulation contexts like Vietnam.

5. Conclusions

This paper presents new evidence of the effect of abnormal loan growth on bank risk-taking in the Vietnamese banking sector, which uses the dataset of 30 banks from 2007 to 2019 with a quantile regression approach. Our study contributes to the literature by uncovering a nonlinear U-shaped feature of abnormal

loan growth and bank risk-taking. Only in a certain range, banks with higher abnormal loan growth take lower risks, while beyond that range, any additional percentage point of abnormal loan growth may induce excessive risk-taking. Our main results also highlight the heterogeneity of sensitivity to abnormal loan growth across banks in higher quantiles. For instance, higher-risk banks might have larger turning points of adverse effect to the positive effect of abnormal loan growth, compared to lower-risk banks.

These results also pass a bunch of robustness tests, including estimation with subsample and sensitivity test of potential endogeneity. The nonlinearity and heterogeneity remain significant and robust, hence providing strong evidence for our hypotheses. Our findings provide some directions for policymakers and bank managers. Firstly, banks should not be encouraged to lend excessively since abnormal loan growth exceeding a turning point will stimulate bank risk instead of reducing risk. Secondly, different bank risk levels should be taken into consideration due to the heterogeneous impact of abnormal loan growth. There is strong evidence of high-risk banks having higher abnormal loan growth will face a higher risk than low-risk ones. Last but not least, all of these results are in the case of all banks that have exceeds the ceiling rate of short-term funds for medium and long-term loans, as mentioned above. For this reason, the adoption of reducing this ratio needs not to delay when the capital mobilization structure of banks is still inclined to short-term funds because customers are concerned about the fluctuation of interest and exchange rate in the long term. In the absence of liquidity, banks tend to rely on the interbank market, so increase risk-taking.

The study has some limitations. The alternative measures of abnormal loan growth and risk-taking may be used to confirm our main findings. Furthermore, our study covers one emerging market and a limited period of study, suggesting that the need for future research in other emerging nations that have similar banking structures for the robustness of the results. Further research may also extend data to examine whether the relationship between abnormal loan growth and bank stability is different among bank ownership structures, or listed and non-listed banks using quantile regression.

Citation information

Cite this article as: Abnormal loan growth and bank risk-taking in Vietnam: A quantile regression approach, Tin H Ho, Tu DQ Le & Dat T Nguyen, *Cogent Business & Management* (2021), 8: 1908004.

Note

1. The paper inherits previous studies that state the lag effect of abnormal loan growth on bank risk-taking when running the model with one-year and two-year lags. Though the coefficients of ALG are generally negative, they are not statistically significant in some cases. Thus, we rebuild the research model as Equation (8) and (9).

Acknowledgements

This research is funded by the University of Economics and Law, Vietnam National University, Ho Chi Minh City, Vietnam.

Funding

This research is funded by University of Economics and Law, Vietnam National University, Ho Chi Minh City, Vietnam.

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