# Indonesia Deposit Insurance Corporation
# Research Working Paper

## *Excess Loan Growth, Funding Liquidity and Credit Risk*


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**Abstract**

This paper sheds light on the interplay of loan growth, funding liquidity and credit risk in banking. Our empirical results highlight that above average loan growth (excess loan growth) is associated with higher credit risk. However, this behavior is mitigated if banks have more funding liquidity or are less dependent on non-core funding sources (non-deposits funding). Our further analyses show that the effect of interaction between excess loan growth and funding liquidity to credit risk is more pronounced for banks that have more exposure to market discipline by depositors, i.e. small, and non-government-owned banks. These findings align with the hypothesis that market discipline by depositors induce prudent risk-taking behavior by banks. Our empirical results are robust to different econometric specifications. As a policy reflection, our findings provide a support on the importance of limited deposit insurance scheme that balance between market discipline and protection to depositors, in order to promote banking system stability through a prudent lending behavior.

**Keywords**: Excess loan growth, funding liquidity, credit risk.

**JEL Classification**: G21, G28

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## 1. Introduction

Excessive lending behavior in banking is perceived as one of the triggers of the 2008 global financial crisis (GFC) and a large number of literature has emphasized on the negative link between loan growth and bank stability (e.g. Demyanyk and van Hermet, 2011; Foos et al. 2010). Likewise, the GFC has also called for the refinement of the Basel III regulation by imposing minimum liquidity standards in addition to strengthening credit risk management. Specifically, banks are required to maintain sufficient funding liquidity to enhance the benefits of capital requirements (DeYoung et al., 2018).

Meanwhile, the nexus between excessive lending and bank riskiness seems to converge in the direction of which excessive lending behavior is detrimental for bank stability, because bank behavior tends to suffer from procyclicality (e.g. Borio et al., 2001; Berger and Udell, 2004). In other words, banks tend to underestimate credit risk and boost lending during economic booms, which may in turn trigger non-performing loans. However, the impact of liquidity on bank risk taking remains unclear. Some studies find that higher liquidity is detrimental for bank stability in developed countries (e.g. Wagner, 2007; Acharya and Naqvi, 2012; Khan et al., 2017), while the opposite also occur in emerging markets (e.g. Rokhim and Min, 2018; Nguyen and Boateng, 2015).

This paper aims to assess the interplay of excess loan growth, funding liquidity and bank credit risk using a single country setting from the Indonesian banking industry, while previous literature conduct cross-country studies that mostly use a sample from developed countries[2]. To the best of our knowledge, we are the first to investigate this issue and hence, we contribute to establish an empirical link between the bank lending-risk literature and the liquidity-risk literature in banking. As an additional contribution, we also assess whether the interplay of excess loan growth, funding liquidity and credit risk is also conditional on some bank-specific characteristics.

With regards to the bank lending-risk literature, Demyanyk and van Hermet (2011) are the first to document that in the US credit market, loans originated in 2006 and 2007 exhibit higher actual and adjusted delinquency rates than loans made before 2006. These findings hold for different types of loan characteristics (i.e. fixed-rate, hybrid, purchase-money, cash-out refinancing, low-documentation or full-documentation loans). Meanwhile, using a sample of

[2] We focus on credit risk issues because bank excess loan growth is directly linked to credit risk (e.g. Sobarsyah et al., 2020; Foos et al., 2010).

banks from OECD countries, Foos et al. (2010) document that higher excess loan growth (i.e. the extent to which bank-level loan growth exceeds country-level loan growth in banking) exacerbates loan loss provisions during the subsequent three years and reduces capital ratios along with a decline in relative interest income. Festić et al. (2011) also find that higher loan growth deteriorates bank performance and increases non-performing loans in five new EU member states from Central and Eastern Europe after controlling for macroeconomic factors. For emerging markets, Soedarmono et al. (2017) highlight that excess loan growth exacerbates systemic risk in the case of Asian banks, although this relationship is conditional on the quality of credit reporting system at the country level.

In the liquidity-risk literature in banking, recent studies emphasize that managers in banks with higher liquidity can indeed spur risky loans, not only to offset higher cost of funds, but also to pursue managerial compensation. Wagner (2007) postulates that higher liquidity indeed exacerbates bank financial distress. During economic downturns, Acharya and Naqvi (2012) also find that investors tend to shift their investment into bank deposits. In turn, bank funding liquidity increases and exacerbates bank risk taking in the credit markets, triggering asset price bubbles and non-performing loans.

Moreover, Ivashina and Scharfstein (2010) document that banks with greater access to longer-term deposits during the GFC tend to lend more than banks relying on short-term debts, implying that banks with higher funding liquidity may reduce bank lending standards and increase credit risk. Meanwhile, Calomiris et al. (2013) point out that banks with higher cash holdings tend to have lower liquidity risk, but such banks are also more inclined to undertake investment in riskier assets. Finally, Khan et al. (2017) find that banks with higher deposit ratio also exhibit higher risk taking.

On the contrary, Rokhim and Min (2018) find that from a sample of Southeast Asian banks, higher funding liquidity measured by the deposit-to-asset ratio is negatively linked to bank riskiness. Nguyen and Boateng (2015) also document that Chinese banks with higher liquidity reserves tend to reduce risk taking, particularly in the monetary tightening regime. This is because banks with higher funding liquidity may also be associated with higher market power as emphasized by Nguyen et al. (2017), while higher bank market power as a proxy of bank charter value tends to enhance financial stability (e.g. Ariefianto et al., 2020; Yusgiantoro et al., 2019).

To assess whether funding liquidity matters in the bank lending-risk nexus, we focus on Indonesian banking for several reasons. First, Indonesian banking exhibits higher performance than other banking systems in the world, particularly after the GFC. Vinayak et al. (2016) document that ROEs (return on equities) in Indonesian banking has reached more than 20% after the GFC, which is the highest in the Asia-Pacific region. Because Asian banking also provides an economically noteworthy contribution to global banking performance (Vinayak et al., 2016), Indonesian banking may also influence global banking stability. Second, Indonesian banking industry has many commercial banks with diversity in size and ownership type. Consequently, assessing the interplay of excess loan growth, funding liquidity and credit risk in Indonesian banking is contextually relevant with recent trends.

Likewise, Indonesian banking is subject to various macroprudential policies stipulated as of 2010 to mitigate the procyclicality of bank lending behavior[3]. While the role of macroprudential regulation was effective in reducing lending expansions in Asia (Kim et al., 2019), the risk implication of higher bank lending activities in Indonesia remains unexplored. Yet, the role of liquidity in affecting bank risk is also far less understood in the Indonesian context, although Naiborhu (2020) highlights the importance of bank liquidity in influencing the lending channel of monetary policy.

Using a sample of 98 commercial banks in Indonesia from 2004 to 2018, our empirical findings using the two-step system GMM (generalized methods of moment) estimation show that higher excess loan growth exacerbates non-performing loans. A deeper analysis, however, reveals that such relationship is mitigated if banks have more funding liquidity or are less dependent on non-core funding sources (non-deposits funding). Furthermore, we find that the effect of interaction between excess loan growth and funding liquidity to credit risk is more pronounced for banks that have more exposure to market discipline by depositors, i.e. small, and non-government-owned banks. These findings align with the hypothesis that market discipline by depositors induce prudent risk-taking behavior by banks. Our empirical results are robust to different econometric specifications.

The rest of this paper is organized as follows. Section 2 describes our dataset, variables and empirical method. Section 3 discusses empirical results, while Section 4 concludes.

[3] See Naiborhu (2020) who summarizes various macroprudential policies in Indonesia.

## 2. Data, variables and methodology

### *2.1. Data*

We retrieve balance-sheet and income statement data from 98 conventional banks' annual reports in Indonesia from 2004 to 2018. We exclude Islamic banks from the sample, because the structure of deposits and assets in Islamic banks is different compared to conventional banks. Meanwhile, the asset size of Islamic banks in Indonesia is relatively small compared to conventional banks in which the share of Islamic banks' total assets only reaches around 6% of the banking system's total assets in 2019.

### *2.2. Variables*

As dependent variables, we use the ratio of non-performing loans to total loans (NPLL) and the ratio of non-performing loans to total assets (NPLTA). Higher NPLL and NPLTA are associated with higher credit risk. As explanatory variables of interest, we calculate several measures of excess loan growth.

Foos et al. (2010) and Soedarmono et al. (2017) calculate excess loan growth using the following formula:

$$ALG_{i,t} = LOANG_{i,t} - ALOANG_{i,t} \quad (1)$$

For bank *i* at year *t*, ALG refers to bank-level excess loan growth, while LOANG is bank-level loan growth and ALOANG is aggregate loan growth of the banking industry. LOANG is measured by total loans at year *t* minus total loans at year *t* – 1, which is then divided by total loans at year *t* – 1. Unlike Foos et al. (2010) and Soedarmono et al. (2017) who use a cross-country setting and calculate ALOANG based on all banks in each country, our study uses a single country setting with different types of banks.

In this paper, we introduce a novel variant of ALOANG measure that is not based on all banks as a benchmark. Instead, we calculate ALOANG based on banks with comparable characteristics (peer groups), because banks in a certain group are more likely to compete in the same loans and deposits markets compared to banks in other groups. To enrich our analyses, we use two kinds of bank groupings, i.e. based on ownership type and core capitalization size. These groupings are commonly used by the Indonesian banking sector regulators to define banks' peer groups, e.g. Yusgiantoro et al. (2019).

With regards to bank grouping based on ownership type, banks are classified into state-owned banks (SOB), regional development banks (RDB), privately-owned banks (POB), joint-venture banks (JVB) and foreign-owned banks (FOB). Therefore, we also construct five measures of aggregate loan growth based on these ownership types (ALOANGO), while our first indicator of excess loan growth at the bank level is formulated as follows:

$$ALGO_{i,t} = LOANGO_{i,t} - ALOANGO_{i,t} \quad (2)$$

From Eq. (2), if a bank is classified into a SOB group, for instance, its excess loan growth is calculated from subtracting its loan growth (LOANGO) with aggregate loan growth of all banks in a SOB group only. The similar mechanism is undertaken for banks in RDP, POB, JVB and FOB groups.

Our second indicator of bank-level excess loan growth is based on bank grouping according to the size of core capitalization, which is shown in Eq. (3)[4].

$$ALGB_{i,t} = LOANGB_{i,t} - ALOANGB_{i,t} \quad (3)$$

As in Eq. (2), if a bank is classified into a group (either BUKU1, BUKU2, BUKU3 or BUKU4), its excess loan growth comes from its loan growth (LOANGB) subtracted by aggregate loan growth of all banks in a similar group (ALOANGB).

Although we use ALGO and ALGB as excess loan growth indicators, we also use an alternative measure of excess loan growth based on Foos et al. (2010) and Soedarmono et al. (2017)

[4] Banks are classified into four groups (BUKU1, BUKU2, BUKU3 and BUKU4) based on the central bank regulation PBI No. 14/26/2012. BUKU1 consists of banks having core capital of less than IDR 1 trillion. Banks are grouped into BUKU2 if their core capital exceeds IDR 1 trillion, but does not exceed IDR 5 trillion. Banks in BUKU3 are those having core capital of more than IDR 5 trillion and less than IDR 30 trillion. Finally, banks in BUKU 4 are those having core capital of more than IDR 30 trillion.

as shown in Eq. (1). This consideration is to ensure that our empirical results are robust on several measures of excess loan growth.

For control variables that affect bank credit risk, we include the following independent variables: (1) the ratio of total operating cost to operating income (CTI); (2) the ratio of total deposits to total assets (DTA); (3) the ratio of total equity to total assets (EQTA); (4) the ratio of non-interest income to total assets (NNI); and (4) the logarithm of bank total assets (SIZE). Higher inefficiency (CTI) is expected to increase credit risk, because income is lower to offset potential loan losses. Meanwhile, the role of deposits-to-asset ratio (DTA) as a funding liquidity indicator remains unclear in affecting bank riskiness (e.g. Rokhim and Min, 2018; Khan et al., 2017). Yet, the role of capital ratio (EQTA) also remains unclear, given the fact there might be agency conflicts between bank managers and shareholders in response to an increase in capital (e.g. Bitar et al., 2018, Sobarsyah et al., 2020). The role of income diversification into non-interest income activities is also ambiguous. Higher non-interest income (NNI) may increase bank riskiness if cross-selling activities occur by relaxing credit standards (e.g. Hidayat et al., 2012; Meslier et al. 2017), but some banks might also benefit from higher non-interest income activities (Meslier et al., 2017). SIZE is also considered as an independent variable that affects credit risk, because large banks tend to have the "too big to fail" effects, which may precipitate moral hazard and risk taking (Beck et al., 2013).

### *2.3. Methodology*

Regarding our methodology, we proceed this study in three stages. In the first stage, we conduct regressions of bank credit risk on excess loan growth and control variables. This is to examine whether excess loan growth affects credit risk in general. In the second stage, we incorporate the interaction term between excess loan growth and funding liquidity as an independent variable, in order to assess whether bank funding liquidity matters in affecting the loan growth-risk nexus. In the next stage, we repeat the second stage but we run regressions for different sub-samples according to bank ownership types or asset size. This stage builds on the work of Yusgiantoro et al. (2019), because government ownership and asset size affect bank risk-taking incentive, although they do not specifically assess the issue of excess loan growth[5].

[5] We also conduct regressions on the interplay of excess loan growth, funding liquidity and credit risk for different sub-groups of banks according to the size of core capital using BUKU classifications as described earlier. Our results

To identify sub-samples of banks according to ownership types, we classify banks into two categories (i.e. government-owned banks and non-government-owned banks). Government-owned banks consist of state-owned banks and regional development banks. Regional development banks are considered as government-owned banks, because the ownership of regional development banks is dominated by provincial governments. Incorporating regional development banks as government-owned banks is also necessary to add the number of banks in our sub-sample, because only four state-owned banks in Indonesia. To construct sub-samples of banks according to asset size, we calculate the average value of total assets of each bank from 2004 to 2018. A bank is categorized as a large bank, if its average value of total assets exceeds the 75-percentile of the average value of total assets for all banks in the sample calculated during the 2004-2018 period.

In terms of econometric specifications, following Rokhim and Min (2018) and Sobarsyah et al. (2020), we consider one-year lagged values of independent variables in order to avoid potential reverse causality problems between independent and dependent variables. In addition, the impact of excess loan growth on bank credit risk might need time before loan losses materialize as in Foos et al. (2010).

In order to estimate all these stages, we use a two-step system GMM (generalized methods of moments) technique developed by Arrelano and Bover (1995) and Blundell and Bond (1998). The system GMM estimation is the extension of the standard GMM estimation developed by Arellano and Bond (1991). Baltagi (2005) emphasizes that system GMM models are more efficient in order to deal with heteroscedasticity problems. To account for plausible cross-sectional fixed effects, we take into account orthogonal transformation of instruments. Meanwhile, Windmeijer's (2005) finite sample correction is also taken into consdieration to ensure the robustness of standard errors of coefficient estimates. Yet, Roodman (2009) also highlights plausible problems related to too many instruments in the GMM estimation. Hence, we also collapse the number of our instruments using Roodman's (2009) technique to avoid these problems. Finally, we provide validity tests of the system GMM estimation using the AR(2) test and the Hansen-J test. The system GMM estimation is valid when the AR(2) test and the Hansen-J test are not statistically significant.

suggest that funding liquidity matters in mitigating credit risk due to excess loan growthm while this finding is not altered for all banks of different sizes of core capital. In other words, classifying banks based on BUKU does not provide different information regarding the role of funding liquidity on the excess loan growth-risk nexus. Hence, we do not present these results here, but the results are available upon request.

## 3. Empirical results

### *3.1. Excess loan growth, funding liquidity and credit risk*

Summary statistics of all variables used in this study are shown in Table 1. We exclude zero values in all variables before we run regressions. In Table 2, we also show that all independent variables are not strongly correlated and hence, no potential multicollinearity issues can be detected.

[Table 1 and Table 2]

In Table 3, we present empirical results to assess the link between excess loan growth and bank credit risk for all banks in our sample. We find that higher excess loan growth is associated with higher non-performing loans one year ahead regardless of the measure of non-performing loans (NPLL or NPLA). However, this finding only holds when ALGO and ALG are used as a measure of excess loan growth. The positive association between excess loan growth and credit risk is consistent with previous studies the notion that higher financial intermediation may deteriorate bank stability (e.g. Foos et al., 2010; Demyanyk and Van Hermet, 2011; Soedarmono et al., 2017; Sobarsyah et al., 2020). Our regressions models in Table 3 are also valid, because the AR(2) test and the Hansen-J test are not significant.

[Table 3]

Table 4 shows our empirical results regarding the role of funding liquidity on the link between excess loan growth and credit risk. Regardless of the measurement of non-performing loans and excess loan growth, we find that the positive association between excess loan growth and credit risk is more pronounced for banks with lower deposit-to-asset ratio. Meanwhile, a negative association between excess loan growth and credit risk occurs for banks with higher deposit-to-asset ratio. Hence, higher excess loan growth is associated with lower credit risk, particularly for banks higher funding liquidity. This finding is somehow related to Rokhim and Min (2018) who document the positive impact of funding liquidity on bank stability. Our two-step system GMM estimation in Table 4 is also valid, because the AR(2) and Hansen-J tests are not statistically significant.

[Table 4]

In the next turn, we assess the joint-impact of excess loan growth and funding liquidity on non-performing loans for different types of banks based on ownership. Table 5 presents our results for government-owned banks consisting of state-owned banks and regional development banks,[6] while Table 6 documents our results for a sample of non-government-owned banks (i.e. privately-owned, joint-venture, and foreign-owned banks). From Table 5, the interaction terms between excess loan growth and funding liquidity are not statistically significant, while Table 6 documents that higher funding liquidity matters in mitigating non-performing loans due to an increase in excess loan growth. Our regression models in Table 5 and Table 6 are generally valid from the AR(2) test and the Hansen-J test, which are not signficant at least at the 5% level.

[Table 5 and Table 6]

Moreover, Table 7 and Table 8 present our empirical findings when we observe banks of different sizes. From these tables, we find that the importance of funding liquidity in mitigating credit risk due to an increase in excess loan growth is more pronounced for small banks as shown in Table 8. Specifically, the interaction terms between excess loan growth and funding liquidity are significant for small banks when we use ALGO and ALGB as explanatory variables of interest measuring excess loan growth. The AR(2) test and the Hansen-J test are also not significant at the 5% level.

[Table 7 and Table 8]

From Table 4 to Table 8, our coefficients on the interaction term between excess loan growth and funding liquidity are statistically significant when only ALGO and ALGB are used as a proxy

[6] A regional development bank is a bank that is owned by a regional government.

for excess loan growth. This means that the use of excess loan growth measure (ALG) based on Foos et al. (2010) is not relevant for the Indonesian context when banks have different characteristics.

To this end, we also provide some robustness checks in order to ensure that our findings presented from Table 3 to Table 8 are not altered with different model specifications[7]. First, we use the logarithm of NPLL and the logarithm of NPLA as alternative measures of credit risk. Using this specification does not alter our findings presented earlier. Second, we conduct the one-step system GMM estimation instead of the two-step system GMM estimation and using this modification also does not change our previous findings from Table 3 to Table 8.

## 4. Conclusion

In this paper, we shed light on the empirical link between the lending-risk nexus and the liquidity-risk nexus in banking. Using a sample of 98 conventional banks in Indonesia from 2004 to 2018, we find that excess loan growth is associated with higher nonperforming loans. However, this relation is mitigated if banks have more funding liquidity or are less dependent on non-deposits funding. Our further analyses show that the effect of interaction between excess loan growth and funding liquidity to credit risk is especially pronounced for banks that have more exposure to market discipline by depositors, i.e. small, and non-government-owned banks. These findings are in line with the hypothesis that market discipline by depositors induce prudent risk-taking behavior by banks. As a policy reflection, our findings provide a support on the importance of limited deposit insurance scheme that balance between market discipline and protection to depositors.

[7] The results of these robustness checks are not presented in this paper, but are available upon request.

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**Appendix**

**Table 1.** Summary statistics

| Variable | Definition | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| NPLL | Ratio of non-performing loans to total gross loans | 1,391 | 0.03094 | 0.035781 | 0.0002 | 0.51 |
| NPLA | Ratio of non-performing loans to total assets | 1,391 | 0.018602 | 0.022127 | 6.12E-05 | 0.329597 |
| ALGO | Excess loan growth measured from ownership-based grouping | 1,368 | 0.185059 | 0.122034 | -0.79372 | 0.815133 |
| ALGB | Excess loan growth measured from core capital-based grouping | 1,223 | 0.129896 | 0.246613 | -0.73046 | 0.925446 |
| ALG | Excess loan growth measured from all banks as a benchmark | 1,299 | -0.00999 | 0.183314 | -1.03358 | 0.668461 |
| CTI | Ratio of total expenses to total gross revenue | 1,451 | 0.812488 | 0.166505 | 0.0831 | 1.5918 |
| DTA | Ratio of total deposits to total assets | 1,463 | 0.705718 | 0.165227 | 0.039395 | 0.993047 |
| EQTA | Ratio of total equity to total assets | 1,466 | 0.147638 | 0.104019 | -0.27488 | 0.955286 |
| NNI | Ratio of non-interest revenue to total assets | 1,466 | 0.019615 | 0.051498 | 0.000182 | 0.977984 |
| SIZE | Logarithm of total assets | 1,466 | 15.78211 | 1.827204 | 9.875242 | 20.93369 |

**Source and notes:** Authors' calculation.

**Table 2.** Correlation structure

| **Variables** | NPLL | NPLA | ALGO | ALGB | ALG | CTI | DTA | EQTA | NNI | SIZE |
|---|---|---|---|---|---|---|---|---|---|---|
| NPLL | 1 | | | | | | | | | |
| NPLA | 0.9453 | 1 | | | | | | | | |
| ALGO | -0.0147 | -0.0456 | 1 | | | | | | | |
| ALGB | -0.1831 | -0.1661 | 0.1112 | 1 | | | | | | |
| ALG | -0.2549 | -0.2445 | 0.0452 | 0.659 | 1 | | | | | |
| CTI | 0.3006 | 0.3096 | -0.1416 | -0.0429 | -0.1962 | 1 | | | | |
| DTA | -0.0054 | -0.0066 | 0.074 | 0.1104 | 0.0561 | 0.226 | 1 | | | |
| EQTA | -0.0317 | -0.0267 | -0.0721 | -0.0209 | -0.1369 | -0.0303 | -0.419 | 1 | | |
| NNI | 0.0394 | 0.0059 | -0.101 | -0.1479 | -0.0643 | 0.0326 | -0.2686 | -0.0713 | 1 | |
| SIZE | -0.0182 | -0.0191 | -0.1977 | -0.2822 | 0.0763 | -0.1957 | -0.0361 | -0.3624 | 0.2373 | 1 |

**Source and notes:** Authors' calculation.

**Table 3.** Excess loan growth and credit risk

| Expl.variables | Dependent variables | | | | | |
|---|---|---|---|---|---|---|
| | NPLL | NPLL | NPLL | NPLA | NPLA | NPLA |
| L1.Dep.var | 0.54391*** | 0.54965*** | 0.55576*** | 0.54127*** | 0.55930*** | 0.56406*** |
| | (0.054) | (0.057) | (0.059) | (0.089) | (0.104) | (0.127) |
| L1.ALGO | 0.01317** | | | 0.00908** | | |
| | (0.006) | | | (0.005) | | |
| L1.ALGB | | 0.00160 | | | 0.00132 | |
| | | (0.002) | | | (0.001) | |
| L1.ALG | | | 0.00605** | | | 0.00439* |
| | | | (0.003) | | | (0.003) |
| L1.DTA | -0.00442 | -0.00713 | -0.00428 | 0.00114 | 0.00087 | 0.00066 |
| | (0.006) | (0.006) | (0.005) | (0.003) | (0.004) | (0.004) |
| L1.CTI | 0.00646 | 0.00906* | 0.00644 | 0.00197 | 0.00447 | 0.00329 |
| | (0.006) | (0.005) | (0.005) | (0.004) | (0.004) | (0.004) |
| L1.EQTA | -0.02083 | -0.02883 | -0.02624* | -0.01120 | -0.01346 | -0.01212 |
| | (0.014) | (0.017) | (0.015) | (0.007) | (0.010) | (0.010) |
| L1.NNI | -0.03532** | -0.03365** | -0.03579** | -0.02234** | -0.02662** | -0.02236** |
| | (0.016) | (0.013) | (0.014) | (0.009) | (0.011) | (0.009) |
| L1.SIZE | 0.00023 | 0.00014 | 0.00006 | 0.00005 | -0.00004 | -0.00004 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Observations | 1,179 | 1,071 | 1,137 | 1,179 | 1,071 | 1,137 |
| Number of banks | 96 | 96 | 96 | 96 | 96 | 96 |
| AR(2) test: *p*-value | 0.462 | 0.331 | 0.397 | 0.721 | 0.901 | 0.864 |
| Hansen-J test: *p*-value | 0.205 | 0.197 | 0.327 | 0.111 | 0.0819 | 0.107 |

**Source and notes:** Authors' calculation. All independent variables are lagged by one year. The two-step system GMM estimation is used. We take into account orthogonal deviation transformations of instruments, Windmeijer's (2005) finite sample correction, and Roodman's (2009) technique to collapse instruments. Robust standard errors are in parentheses. Time-specific dummy variables and constant are included, but not recorded. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Table 4.** Excess loan growth, funding liquidity and credit risk

| Expl.variables | Dependent variables | | | | | |
|---|---|---|---|---|---|---|
| | NPLL | NPLL | NPLL | NPLA | NPLA | NPLA |
| L1.Dep.var | 0.54258*** | 0.55066*** | 0.55353*** | 0.53335*** | 0.55179*** | 0.55976*** |
| | (0.054) | (0.057) | (0.060) | (0.093) | (0.107) | (0.125) |
| L1.ALGO | 0.09686*** | | | 0.04068** | | |
| | (0.031) | | | (0.017) | | |
| L1.ALGO*L1.DTA | -0.13835*** | | | -0.05431** | | |
| | (0.043) | | | (0.022) | | |
| L1.ALGB | | 0.03660*** | | | 0.01736** | |
| | | (0.011) | | | (0.007) | |
| L1.ALGB*L1.DTA | | -0.04879*** | | | -0.02282** | |
| | | (0.015) | | | (0.010) | |
| L1.ALG | | | 0.02854 | | | 0.01642 |
| | | | (0.016) | | | (0.012) |
| L1.ALG*L1.DTA | | | -0.03185 | | | -0.01707 |
| | | | (0.022) | | | (0.015) |
| L1.DTA | 0.02226* | -0.00125 | -0.00355 | 0.01085* | 0.00407 | 0.00068 |
| | (0.011) | (0.006) | (0.005) | (0.006) | (0.004) | (0.004) |
| L1.CTI | 0.00522 | 0.00808 | 0.00621 | 0.00136 | 0.00434 | 0.00330 |
| | (0.006) | (0.005) | (0.005) | (0.004) | (0.004) | (0.004) |
| L1.EQTA | -0.02253 | -0.03203* | -0.02528* | -0.01233 | -0.01544 | -0.01151 |
| | (0.015) | (0.017) | (0.014) | (0.008) | (0.010) | (0.010) |
| L1.NNI | -0.02153 | -0.02557** | -0.03305** | -0.01663* | -0.02164** | -0.02043** |
| | (0.015) | (0.012) | (0.014) | (0.009) | (0.009) | (0.009) |
| L1.SIZE | 0.00020 | 0.00001 | 0.00009 | 0.00007 | -0.00014 | -0.00002 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Observations | 1,179 | 1,071 | 1,137 | 1,179 | 1,071 | 1,137 |
| Number of banks | 96 | 96 | 96 | 96 | 96 | 96 |
| AR(2) test: *p*-value | 0.367 | 0.343 | 0.403 | 0.715 | 0.881 | 0.880 |
| Hansen-J test: *p*-value | 0.203 | 0.143 | 0.339 | 0.0708 | 0.0776 | 0.103 |

**Source and notes:** Authors' calculation. All independent variables are lagged by one year. The two-step system GMM estimation is used. We take into account orthogonal deviation transformations of instruments, Windmeijer's (2005) finite sample correction, and Roodman's (2009) technique to collapse instruments. Robust standard errors are in parentheses. Time-specific dummy variables and constant are included, but not recorded. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Table 5.** Excess loan growth, funding liquidity and credit risk: State-owned and regional development banks

| | **Dependent variables** | | | | | |
|---|---|---|---|---|---|---|
| **Expl.variables** | NPLL | NPLL | NPLL | NPLA | NPLA | NPLA |
| L1.Dep.var | 0.79771*** | 0.77844*** | 0.79731*** | 0.88372*** | 0.93344*** | 0.91834*** |
| | (0.157) | (0.261) | (0.195) | (0.093) | (0.121) | (0.119) |
| L1.ALGO | 0.18381 | | | 0.06882 | | |
| | (0.139) | | | (0.092) | | |
| L1.ALGO*L1.DTA | -0.15014 | | | -0.05712 | | |
| | (0.105) | | | (0.071) | | |
| L1.ALGB | | -0.00381 | | | 0.00516 | |
| | | (0.023) | | | (0.016) | |
| L1.ALGB*L1.DTA | | 0.00352 | | | -0.00405 | |
| | | (0.025) | | | (0.019) | |
| L1.ALG | | | 0.06348 | | | 0.02436 |
| | | | (0.066) | | | (0.041) |
| L1.ALG*L1.DTA | | | -0.07367 | | | -0.02336 |
| | | | (0.082) | | | (0.053) |
| L1.DTA | 0.02070 | -0.01059 | -0.00828 | 0.00712 | -0.00383 | -0.00517 |
| | (0.028) | (0.012) | (0.012) | (0.014) | (0.007) | (0.007) |
| L1.CTI | -0.01977 | -0.01214 | -0.01568 | -0.01811 | -0.02203* | -0.02065 |
| | (0.020) | (0.029) | (0.029) | (0.011) | (0.011) | (0.014) |
| L1.EQTA | -0.04521 | -0.03558 | -0.03446 | -0.04965** | -0.05545*** | -0.05024** |
| | (0.041) | (0.050) | (0.042) | (0.021) | (0.019) | (0.021) |
| L1.NNI | -0.19168** | -0.23351*** | -0.18948** | -0.07935 | -0.11393** | -0.07766 |
| | (0.077) | (0.069) | (0.092) | (0.059) | (0.043) | (0.054) |
| L1.SIZE | 0.00034 | 0.00047 | 0.00048 | -0.00002 | 0.00015 | 0.00004 |
| | (0.001) | (0.001) | (0.001) | (0.000) | (0.000) | (0.000) |
| Observations | 384 | 359 | 382 | 384 | 359 | 382 |
| Number of banks | 31 | 31 | 31 | 31 | 31 | 31 |
| AR(2) test: *p*-value | 0.630 | 0.366 | 0.342 | 0.643 | 0.175 | 0.551 |
| Hansen-J test: *p*-value | 0.264 | 0.376 | 0.548 | 0.125 | 0.388 | 0.183 |

**Source and notes:** Authors' calculation. All independent variables are lagged by one year. The two-step system GMM estimation is used. We take into account orthogonal deviation transformations of instruments, Windmeijer's (2005) finite sample correction, and Roodman's (2009) technique to collapse instruments. Robust standard errors are in parentheses. Time-specific dummy variables and constant are included, but not recorded. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Table 6.** Excess loan growth, funding liquidity and credit risk: Privately-owned, joint-venture and foreign-owned banks

| Expl.variables | Dependent variables | | | | | |
|---|---|---|---|---|---|---|
| | NPLL | NPLL | NPLL | NPLA | NPLA | NPLA |
| L1.Dep.var | 0.47641*** | 0.48279*** | 0.49572*** | 0.44042*** | 0.44483*** | 0.45894*** |
| | (0.036) | (0.044) | (0.046) | (0.091) | (0.083) | (0.092) |
| L1.ALGO | 0.08582*** | | | 0.03512** | | |
| | (0.026) | | | (0.015) | | |
| L1.ALGO*L1.DTA | -0.12293*** | | | -0.05018** | | |
| | (0.038) | | | (0.021) | | |
| L1.ALGB | | 0.03477*** | | | 0.01154* | |
| | | (0.013) | | | (0.006) | |
| L1.ALGB*L1.DTA | | -0.04212** | | | -0.01303* | |
| | | (0.017) | | | (0.009) | |
| L1.ALG | | | 0.01419 | | | 0.00321 |
| | | | (0.013) | | | (0.012) |
| L1.ALG*L1.DTA | | | -0.00778 | | | 0.00262 |
| | | | (0.020) | | | (0.015) |
| L1.DTA | 0.01843* | -0.00296 | -0.00385 | 0.01129* | 0.00243 | 0.00099 |
| | (0.010) | (0.007) | (0.006) | (0.006) | (0.004) | (0.004) |
| L1.CTI | 0.00714 | 0.00822 | 0.00744 | -0.00067 | 0.00412 | 0.00229 |
| | (0.005) | (0.005) | (0.005) | (0.003) | (0.003) | (0.003) |
| L1.EQTA | -0.03062* | -0.04091** | -0.03312* | -0.01172 | -0.01175 | -0.01018 |
| | (0.017) | (0.020) | (0.017) | (0.009) | (0.009) | (0.008) |
| L1.NNI | -0.02567** | -0.02377** | -0.03607*** | -0.01920* | -0.02089** | -0.02211** |
| | (0.012) | (0.010) | (0.013) | (0.010) | (0.008) | (0.009) |
| L1.SIZE | -0.00009 | -0.00019 | -0.00019 | -0.00005 | -0.00003 | -0.00004 |
| | (0.001) | (0.001) | (0.001) | (0.000) | (0.000) | (0.000) |
| Observations | 795 | 712 | 755 | 795 | 712 | 755 |
| Number of banks | 66 | 66 | 66 | 66 | 66 | 66 |
| AR(2) test: *p*-value | 0.632 | 0.294 | 0.355 | 0.997 | 0.454 | 0.741 |
| Hansen-J test: *p*-value | 0.224 | 0.189 | 0.477 | 0.157 | 0.273 | 0.464 |

**Source and notes:** Authors' calculation. All independent variables are lagged by one year. The two-step system GMM estimation is used. We take into account orthogonal deviation transformations of instruments, Windmeijer's (2005) finite sample correction, and Roodman's (2009) technique to collapse instruments. Robust standard errors are in parentheses. Time-specific dummy variables and constant are included, but not recorded. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Table 7.** Excess loan growth, funding liquidity and credit risk: Large banks

| | Dependent variables | | | | | |
|---|---|---|---|---|---|---|
| **Expl.variables** | NPLL | NPLL | NPLL | NPLA | NPLA | NPLA |
| L1.Dep.var | 0.55879** | 0.47882** | 0.60868** | 0.68357*** | 0.70673*** | 0.72870*** |
| | (0.228) | (0.230) | (0.239) | (0.177) | (0.094) | (0.118) |
| L1.ALGO | 0.05320* | | | 0.02404 | | |
| | (0.030) | | | (0.014) | | |
| L1.ALGO*L1.DTA | -0.09564 | | | -0.03959 | | |
| | (0.060) | | | (0.032) | | |
| L1.ALGB | | 0.00483 | | | 0.01039 | |
| | | (0.012) | | | (0.010) | |
| L1.ALGB*L1.DTA | | -0.01124 | | | -0.01385 | |
| | | (0.015) | | | (0.013) | |
| L1.ALG | | | 0.01296 | | | 0.01289 |
| | | | (0.023) | | | (0.013) |
| L1.ALG*L1.DTA | | | -0.00812 | | | -0.01055 |
| | | | (0.032) | | | (0.019) |
| L1.DTA | 0.02077 | 0.00403 | -0.00188 | 0.00639 | -0.00136 | 0.00037 |
| | (0.016) | (0.010) | (0.012) | (0.008) | (0.004) | (0.005) |
| L1.CTI | 0.00856 | 0.02103 | 0.01259 | 0.00356 | 0.00637 | 0.00496 |
| | (0.013) | (0.016) | (0.014) | (0.005) | (0.005) | (0.005) |
| L1.EQTA | -0.05601* | 0.00032 | -0.03365 | -0.01574 | -0.00983 | -0.00888 |
| | (0.032) | (0.070) | (0.056) | (0.018) | (0.020) | (0.019) |
| L1.NNI | -0.02145** | -0.03094* | -0.03299** | -0.01505** | -0.01626** | -0.01566* |
| | (0.009) | (0.016) | (0.014) | (0.006) | (0.007) | (0.008) |
| L1.SIZE | -0.00028 | 0.00054 | -0.00022 | 0.00001 | 0.00018 | 0.00007 |
| | (0.002) | (0.002) | (0.002) | (0.001) | (0.001) | (0.001) |
| Observations | 321 | 296 | 314 | 321 | 296 | 314 |
| Number of banks | 25 | 25 | 25 | 25 | 25 | 25 |
| AR(2) test: *p*-value | 0.212 | 0.346 | 0.252 | 0.390 | 0.389 | 0.488 |
| Hansen-J test: *p*-value | 0.739 | 0.846 | 0.801 | 0.923 | 0.971 | 0.976 |

**Source and notes:** Authors' calculation. All independent variables are lagged by one year. The two-step system GMM estimation is used. We take into account orthogonal deviation transformations of instruments, Windmeijer's (2005) finite sample correction, and Roodman's (2009) technique to collapse instruments. Robust standard errors are in parentheses. Time-specific dummy variables and constant are included, but not recorded. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Table 8.** Excess loan growth, funding liquidity and credit risk: Small banks

| | Dependent variables | | | | | |
|---|---|---|---|---|---|---|
| **Expl.variables** | NPLL | NPLL | NPLL | NPLA | NPLA | NPLA |
| L1.Dep.var | 0.53350*** | 0.54898*** | 0.54191*** | 0.52070*** | 0.55743*** | 0.55783*** |
| | (0.054) | (0.063) | (0.060) | (0.098) | (0.103) | (0.113) |
| L1.ALGO | 0.07542** | | | 0.03641* | | |
| | (0.031) | | | (0.020) | | |
| L1.ALGO*L1.DTA | -0.11262** | | | -0.04604* | | |
| | (0.043) | | | (0.026) | | |
| L1.ALGB | | 0.03794** | | | 0.01570** | |
| | | (0.015) | | | (0.007) | |
| L1.ALGB*L1.DTA | | -0.04879** | | | -0.01916** | |
| | | (0.021) | | | (0.009) | |
| L1.ALG | | | 0.01218 | | | 0.01417 |
| | | | (0.013) | | | (0.010) |
| L1.ALG*L1.DTA | | | -0.01106 | | | -0.01434 |
| | | | (0.020) | | | (0.013) |
| L1.DTA | 0.01593 | -0.00155 | -0.00664 | 0.00882 | 0.00443 | 0.00074 |
| | (0.011) | (0.008) | (0.006) | (0.007) | (0.004) | (0.004) |
| L1.CTI | 0.00481 | 0.00779 | 0.00702 | 0.00068 | 0.00362 | 0.00232 |
| | (0.006) | (0.006) | (0.006) | (0.004) | (0.004) | (0.005) |
| L1.EQTA | -0.01762 | -0.02630 | -0.02039 | -0.00835 | -0.01015 | -0.00899 |
| | (0.020) | (0.024) | (0.021) | (0.007) | (0.009) | (0.009) |
| L1.NNI | 0.00306 | 0.02479 | -0.00705 | -0.01041 | -0.02206 | -0.01032 |
| | (0.059) | (0.064) | (0.070) | (0.031) | (0.033) | (0.029) |
| L1.SIZE | 0.00084 | 0.00027 | 0.00048 | 0.00058 | 0.00018 | 0.00038 |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Observations | 858 | 775 | 823 | 858 | 775 | 823 |
| Number of banks | 71 | 71 | 71 | 71 | 71 | 71 |
| AR(2) test: *p*-value | 0.539 | 0.302 | 0.357 | 0.846 | 0.759 | 0.978 |
| Hansen-J test: *p*-value | 0.0827 | 0.0722 | 0.0919 | 0.141 | 0.133 | 0.226 |

**Source and notes:** Authors' calculation. All independent variables are lagged by one year. The two-step system GMM estimation is used. We take into account orthogonal deviation transformations of instruments, Windmeijer's (2005) finite sample correction, and Roodman's (2009) technique to collapse instruments. Robust standard errors are in parentheses. Time-specific dummy variables and constant are included, but not recorded. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.