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Unraveling the Loan Growth Threshold Effect on Non-Performing Loans During Total Dollarization in Zimbabwe

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Abstract. *The availability of bank loans is a vital component in determining the investment and spending patterns that influence economic growth. This article examines the threshold effect of loan growth on non-performing loans (NPLs) in the Zimbabwean banking industry during dollarization. The study employed panel threshold regression models developed by Seo et al. (2019) and Kremer et al. (2013) on a panel of thirteen banks from 2009 to 2017. The study revealed that locally owned banks held a higher percentage of NPLs (12.7%) than foreign-owned banks (6.1%) during the period under study. The study also documents a loan growth threshold level of 38%. On average, the industry lends excessively, as demonstrated by the 48% loan growth rate. Primarily, local banks dominate this rate by lending above the threshold compared to foreign banks. The study observed that, below and above the threshold, loan growth exerts a negative and significant effect on NPLs. Based on the results, it can be recommended that banks should devise strategies to maintain a steady loan growth rate, enhance profitability, and effectively monitor liquidity risk exposure. The findings provide insights into reviewing bank credit policies and prudential guidelines.*

Keywords: *non-performing loans, excessive lending, moral hazard, panel threshold regression, Zimbabwe*

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1. Introduction

The banking sector is one of the crucial sectors that facilitates the economic growth of a nation. However, non-performing loans (NPLs) can adversely affect banking industry stability (Katuka et al., 2023). The dominance of non-performing loans erodes banks' asset quality and adversely affects credit availability to other economic agents, thus negatively affecting aggregate consumption, investment, and economic growth (Bernanke, 2007).

Research has shown that loan growth influences non-performing loans in several economies (Bhowmik & Sarker, 2021; Sobarsyah et al., 2020). Loan growth indicates the banking industry's ability to provide credit to the economy and hence is an essential indicator of its health (Foos et al., 2010). However, banks and regulatory bodies should identify a loan growth threshold peculiar to their industry for them to provide an optimal level of credit in the economy. Providing loans above this optimal level, or excessive lending, may result in instability within both the economy and the banking industry. The moral hazard hypothesis explains the link between excessive lending and NPLs. Keeton and Morris (1987) supported the view that one of the forms of risk-taking activities (moral hazard) is excessive lending and that a high desire to take on more risk yields a burgeon in NPLs in the long run. This means that excessive lending can proxy moral hazard where banks are incentivized to issue risky loans to generate more profits. Literally, banks assume greater risk than they can manage and become overexposed to non-performing loans, leading to a systemic-wide risk that rapidly spreads and becomes challenging to manage.

Zimbabwe is no exception to experiencing high NPLs, and the issue has attracted significant attention from policymakers and researchers in recent years. In Zimbabwe, non-performing loans followed through three phases during total dollarization. The non-performing loan rate skyrocketed from 1.8% to 15.9% between 2009 and 2013, characterizing the initial phase. The accumulation of NPLs has been a consequence of various factors, including the implementation of credit policies designed for the Zimbabwean dollar era that were not compatible with the new multi-currency system (Chikoko et al., 2012). Non-performing loans remained constant at 15.9% between 2013 and 2014, forming the second phase of the three stages.

Finally, the last phase of the non-performing loans trend evidenced a meltdown in the NPLs rate from 15.9% to 7.8% between 2014 and 2017. The decline in non-performing loans (NPLs) during the last phase can be attributed to the creation of the Zimbabwe Asset Management Company (ZAMCO). This institution was primarily tasked to acquire NPLs from banks, thereby contributing to their reduction. Irrespective of the decline in the NPLs trend, the ratio remained above the 5% benchmark stipulated by the Bank of International Settlement (BIS). This is a cause for concern, considering that sustained growth and continuous recurrence of high NPLs can pose unending economic problems such as bank failures that potentially instigate and magnify cyclical

recession and trigger a financial crisis, as evidenced in Japan in the 1990s (Committee on Banking Supervision, 2004).

Regarding credit growth in Zimbabwe, there was a significant increase of 448% in gross loans, rising from US$693 million in 2009 to US$3.8 billion by the end of 2017 (Reserve Bank of Zimbabwe, 2009, 2018). However, this kind of growth could signal excessive lending and moral hazard, resulting from poor lending standards by banks. Thus, further research is required to examine if banks are lending within limits. Therefore, the study tested the hypothesis that evolution in NPLs emanates from excessive lending strategies.

The article aims to examine the threshold effects of loan growth on NPLs accumulation. The threshold effect of loan growth explains the presence of a discontinuity in the form of a kink in the regression function (Seo et al., 2019). Identifying the threshold effect of loan growth is essential in examining whether loan growth influences non-performing loans in a similar fashion below and above the threshold level. Therefore, the study seeks to achieve the following objectives. The first objective of this study is to determine the loan growth threshold level in the Zimbabwean banking industry. Secondly, the study seeks to determine whether banks are excessively lending, that is, lending beyond the threshold. The last objective of this study is to determine the threshold effect of loan growth on NPLs. The uniqueness of the present study is that it shifted focus from analyzing the threshold effect of NPLs on bank lending decisions to analyzing the threshold effect of bank lending on NPLs, which is an under-researched area of study. More so, the distinctiveness of this study lies in the definition of excessive lending, which is a scenario where the average industry loan growth rate exceeds the identified loan growth threshold. Most studies defined excessive lending as moral hazard, yet there is a possibility of differentiating the two. This means there might be evidence for excessive lending but not moral hazard. Previous studies in Zimbabwe mainly focused on identifying the overall effect of loan growth on NPLs, which does not establish a loan growth threshold that guides bank-lending decisions (Muvingi et al., 2017). Focusing on how loan growth influences non-performing loans sets a threshold or ceiling that better informs banks and regulatory authorities on the maximum expected loan growth rate that puts downward pressure on the NPLs trend.

The structure of the rest of the article is as follows. The next section reviews existing literature on the subject area. Then, Sections 3 and 4 discuss the methodology and empirical results, respectively. Finally, Section 5 concludes the paper.

2. Literature Review and Hypotheses Development

2.1 Theoretical Review

The determinants of NPLs are primarily explained by various hypotheses, including bad luck, skimping, bad management, moral hazard, and pro-cyclical lending. Berger

and DeYoung (1997) centered their discussion on three theories: bad management, skimping, and bad luck. They proposed the bad management hypothesis, which states that a decrease in cost efficiency causes an increase in NPLs. In the same vein, the skimping theory suggests that the pursuit of high profits often results in compromised loan portfolio quality in the long run. Last, the bad luck theory posits that external factors like regional recessions can increase non-performing loans and associated loan recovery costs such as workout arrangements, monitoring defaulted borrowers, and seizing, maintaining, and disposing of assets (Ahmad & Bashir, 2013).

In the same vein, the procyclical credit policy explains the response of NPLs to adjustments in bank lending behavior defined in their credit policies. Essentially, this hypothesis postulates that successful loan performance increases future NPLs, as banks tend to partially liberalize their credit policy during an economic boom (Manz, 2019).

The theoretical framework on the role of loan growth on non-performing loans formation is a critical area and it encompasses key components including the moral hazard concept. At its core, this theory explains the relationship between loan issuance by banks and the likelihood of default by borrowers. Zhang et al. (2016) defined moral hazard as the tendency of banks to issue risky loans knowing that they eventually shift the risk to other parties, such as depositors. This concept suggests that lenders may engage in riskier behavior than otherwise. In other words, if lenders believe that they will not be held accountable for the failure of their loans, they may be more likely to offer loans to riskier borrowers or loosen their lending criteria to increase loan volume. The ultimate result of this increased risk-taking behavior and potential moral hazard is a higher likelihood of non-performing loans.

2.2 Empirical Review

The global debate on the impact of loan growth on non-performing loans, specifically in a dollarized environment, remains unresolved. Grigoli et al.(2018) investigated the linkages and heterogeneous aspects between NPLs, macroeconomic factors, and financial variables such as GDP, credit growth, and deposit growth in a dollarized economy, with a specific focus on Ecuador. This investigation used a quarterly dataset from 2002 to 2016. The study employed several methodologies, including VAR, ARDL, Pooled OLS, Fixed OLS, GMM, Mean Group (MG), and Augmented Mean Group (AMG) models. The findings suggested an insignificant effect of real credit growth on NPLs, implying that NPLs in Ecuador were insensitive to credit growth. However, these results diverge from those reported by Raci and Havolli (2022) in their study on Kosovo, where they found that loan portfolio growth led to an increase in NPLs. However, most studies from dollarized economies fell short on identifying the threshold effect of loan growth on NPLs.

Concomitantly, Bardhan et al. (2019) explored the role of bank-specific factors on non-performing assets (NPA) using a panel of 82 commercial banks in India from 1995

to 2011. The study classified non-performing assets into four categories: net NPA to net advances ratio, net NPA to total assets, gross NPA to total assets and gross NPA to gross advances. Some variables included in the analysis are capital adequacy ratio, deposit growth, operating expenses, profit, and credit growth. Their study utilized the threshold regression technique propounded by Hansen (1999). Their study also recognized the impact of ownership in the banking industry by classifying banks into three groups: public sector banks, private banks, and foreign banks. The study concluded that credit growth was higher in foreign banks than in other group categories. In other words, the study nullified the assumption that foreign banks have stricter credit policies than local banks hence lower credit growth. Adding to the above observations, Bardhan et al. (2019) found the threshold effect of credit growth on non-performing assets. According to their study, the identified threshold estimate is approximately 15%. Their study specifically deliberated that, above the threshold estimate, credit growth exerts a negative and significant effect on non-performing assets. However, they found that below the threshold value, credit growth exerts an insignificant impact on NPAs.

In addition to the empirical studies on the effect of loan growth on NPLs, Vithessonthi (2016) examined the linkage between bank credit and non-performing loans in Japan. The study utilized generalized methods of moments (GMM) and panel ordinary least square (OLS) techniques on a panel of 82 commercial banks. The study variables used were non-performing loans, bank size, liquidity, capitalization, revenue diversification, profitability, and operating risk. The study period spanned from 1993 to 2013, and findings evidenced a time-varying relationship between bank credit growth and non-performing loans. In particular, the study revealed that an increase in the supply of bank loans results in high NPLs. Supplementary research by Vithessonthi (2023) evidenced that the loan growth rate has a negative effect on non-performing loans in the short run. Although the study documents relevant results, examining the credit growth effect on NPLs without factoring in potential non-linearity complexities can be misleading in drafting credit policies and macro-prudential guidelines. Therefore, this study proposes using panel threshold models that guide banks in determining the optimal credit advancement thresholds.

In another study, Bhowmik and Sarker (2021) examined the effect of loan growth on non-performing loans in South Asian countries. The sample consisted of 118 commercial banks with a study period spanning from 2011 to 2019. The study utilized a combination of GMM and OLS regression techniques. GMM and static model findings evidenced a positive and significant influence of credit growth on non-performing loans. More so, their study assumed the absence of a discontinuity in the regression function where loan growth influences NPLs in one direction without breaks.

The above literature discussion points out that loan growth significantly influences non-performing loan formation. However, many studies adopted the Hansen (1999) panel threshold framework and the GMM methodology. The fixed effect estimator proposed by Hansen (1999) set the condition that covariates must be strongly exogenous

for the estimator to be consistent. Such a condition for strong exogeneity can be restrictive in many real applications. In a bid to cover the existing methodological gap, this study proposed applying much more flexible Kremer (2013) and Seo et al. (2019) models that allow the use of endogenous threshold variable and covariates that might produce better and consistent estimates. In addition, the two models are flexible in capturing non-linearity complexities in panel data.

2.3 Hypotheses Development

To the researchers' knowledge, studies have yet to examine the threshold effect of loan growth on NPLs in emerging market contexts and under dollarization. Therefore, the study tested the following hypotheses:

Hypothesis 1: *There is a negative correlation between below-the-threshold loan growth rate and NPLs. Conversely, there is a positive association between above-the-threshold loan growth rate and NPLs. An increase in credit availability benefits the banking system and the overall economy when loans are issued optimally. This means that if the loan growth threshold is not violated, an increase in total loans issued will not cause NPLs to rise; thus, we hypothesize an inverse relationship between NPLs and below-the-threshold loan growth rate. Most studies indicated that lending beyond the loan growth threshold might be disastrous, thus, the study hypothesizes direct relationship between above-the-threshold loan growth rate and NPLs. Several studies analyzed loan growth (Almaskati, 2022; Bardhan et al., 2019).*

Hypothesis 2*: Loan-to-deposit ratio positively correlates with NPLs. The ratio of loans to deposits measures a bank's exposure to liquidity risk, and bank liquidity plays a crucial role in determining lending activity. A higher loan-to-deposit ratio translates to lower liquidity, while lower ratios imply otherwise. According to the illiquidity spiral theory, bank illiquidity results in a vicious cycle that ultimately causes banks to charge high interest rates on loans. High interest rates weaken borrowers' repayment capacity and trigger growth in NPLs. We, therefore, hypothesize a positive relationship between the loan-to-deposit ratio and NPLs. Studies that examined the role of loan-to-deposit ratio on NPLs include Alnabulsi et al. (2022), Anastasiou et al. (2016), Katuka et al. (2018) and Ribichini (2018).*

Hypothesis 3*: Return on assets ratio negatively correlates with NPLs. Literature documents that less profitable banks are tempted to issue high-risk loans, while profitable banks are less likely to have a higher NPL rate. This study, therefore, hypothesizes a negative relationship between ROA and NPLs. Khan et al.(2020) and Obeid (2022) suggested a negative relationship between ROA and NPLs.*

Hypothesis 4*: Inflation negatively correlates with NPLs. Inflation is the change in the general price levels of goods and services in an economy. A high inflation rate erodes the real value of loans, making it easy for borrowers to repay their loans and reduce NPLs. Based on this perspective, we expect that inflation has a negative effect on NPLs. A strand of studies also examined the role of inflation on NPLs formation (Akhter, 2023; Naili & Lahrichi, 2022; Nkusu, 2011).*

Hypothesis 5: *Economic growth negatively influences NPLs. Improvement in economic growth translates to better incomes per capita for the general populace and strengthens borrowers' repayment capacity, which improves loan portfolio performance and reduces NPLs. Several studies included this variable in the literature (Alihodžić, 2022; Ghosh, 2015; Koju et al., 2018).*

3. Methodology and Data

3.1 Data

The bank-level data for the analysis were sourced from audited annual reports and Bank Supervision Division (BSD) reports. The BSD provides detailed financial data on Zimbabwean banks. Additionally, we have extracted year-end financial data from 2009 to 2017, which corresponds to the full dollarization period. We focused on this era because the banks were operating in a stable environment with respect to indicative macroeconomic aggregates. Macro-level data is obtained from the World Bank, specifically World Development Indicators database. Our final sample contains 13 of 19 banks. The sample covers over 75% of the market share in assets, loans, and deposits.

3.2 Study Variables

Table 1 summarizes the variables used in this study. Non-performing loans ratio is the dependent variable in the analysis. In the same vein, loan growth (LGR) is the percentage change in gross loans between two successive periods and is our threshold variable in this study. In addition, two bank-specific control variables included in the analysis are return on assets (ROA) and loan-to-deposit ratio (LTD). We included ROA to reflect bank profitability patterns and LTD to capture the role of bank liquidity risk on NPLs' status. Finally, the analysis incorporates two macroeconomic indicators: GDP growth and inflation. GDP and inflation variables were included to reflect the influence of changes in economic activity and general price levels in the regression model, respectively.

Table 1
Study Variables

Variable	Description	Explanation	Source
Non-performing loans (NPL)	Non-performing loans/Total loans	A measure of bank loan portfolio quality. A higher ratio implies lower asset quality.	Bank financial statements/BSD Reports
Loan growth rate (LGR)	[(Current gross loans/previous period gross loans)-1)]	A measure of bank lending activity in an economy. A higher growth rate means more loans are being issued.	Bank financial statements/BSD Reports
Loan-to-deposit ratio (LTD)	Total loans/total deposit	The ratio measures bank liquidity and its exposure to liquidity risk. A higher ratio indicates poor liquidity and high liquidity risk.	Bank financial statements/BSD Reports

Variable	Description	Explanation	Source
Return on assets (ROA)	Net income/total assets	Measures a bank's ability to generate income from invested assets. High ratios imply better profitability.	Bank financial statements/BSD Reports
Real GDP growth (GDP)	Changes in real GDP	Measures the level of economic activity and performance.	The World Bank (World Development Indicators)
Inflation (INF)	Annual year-on-year percentage change of CPI	A macroeconomic indicator that shows the changes in general price levels in an economy.	The World Bank (World Development Indicators)

3.3 Model Specification

The study addressed the article's objectives by adopting the panel threshold regression model developed by Seo et al. (2019). The motivation for using the model is that it allows more accurate predictions and a better understanding of the relationship between variables in non-linear situations. Seo et al. (2019) highlighted that a threshold model can be applied in instances where a discontinuity is present in a regression function in the form of a kink instead of a jump. The structural static panel threshold model with kink restrictions is estimated as follows:

$$y_{it} = x'_{it}\beta + k(q_{it} - \gamma)I\{q_{it} > \gamma\} + \alpha_i + \varepsilon_{it} \quad (1)$$

where:

y_{it} = dependent variable, namely non-performing loans ratio for bank i in period t,
x'_{it} = a vector of explanatory variables: return on assets, loan-to-deposit ratio, GDP growth rate and inflation,
γ = the unknown threshold value,
i = a cross-sectional index,
t = time,
ε_{it} = an independent and identically distributed (iid) error term, and
q_{it} = the threshold variable, namely loan growth rate. The threshold parameter (γ) will be endogenously determined (estimated) by the model. Deriving from equation (1), the parsimonious static panel threshold regression model with kink restrictions is estimated as follows:

$$NPL_{it} = \alpha_0 + LGR_{it}\beta_1 + \delta(LGR_{it} - \gamma)I\{LGR_{it} \geq \gamma\} + \alpha_i + \varepsilon_{it} \quad (2)$$

$$NPL_{it} = \alpha_0 + \beta_1 ROA_{it} + \beta_2 LTD_{it} + \beta_3 LGR_{it} + \delta(LGR_{it} - \gamma)I\{LGR_{it} \geq \gamma\} + \alpha_i + \varepsilon_{it} \quad (3)$$

Equation (2) analyses the role of loan growth on NPLs without the influence of other control variables included in the elaborate model in equation (3). It is worth noting that estimating equations (2) and (3) produces coefficients in the low regime. Ad-

ditionally, the regression outputs do not include the lagged dependent variable, as the models are static in nature. We estimated equation (4), developed by Kremer (2013), to generate coefficients for both below-the-threshold and above-the-threshold effects of loan growth on NPLs. This model provides a rich way of modelling the impact of loan growth on non-performing loans and accounts for contingency effects. As a result, the paper estimated the following dynamic panel threshold regression model:

$$NPL_{it} = \mu_I + \beta_1 NPL_{it-1} + \beta_2 LGR_{it} I(LGR_{it} \le \gamma) + \delta_I I(LGR_{it} \le \gamma)$$
$$+ \beta_3 LGR_{it} I(LGR_{it} > \gamma) + \rho X_{it} + \theta_t + \varepsilon_{it} \quad (4)$$

where:

μ_I = bank-specific fixed effect,
θ_t = time effect,
NPL_{it-1} = lagged NPL_{it},
LGR_{it} = threshold variable used to split the sample into regimes,
γ is the unknown threshold parameter,
$I(.)$ is the indicator function, which takes the value 1 if the argument in parenthesis is valid and 0 otherwise,
X_{it} = vector of explanatory regressors: return on assets (ROA), loan-to-deposit ratio (LTD), economic growth (GDP) and inflation (INF).

This type of econometric analysis in equation (4) allows loan growth influence to differ depending on whether LGR is below or above some unknown level γ. The impact of loan growth will be $\beta_2(\beta_3)$ for banks in a low (high) loan growth regime. The model allows for differences in the regime intercepts (δ_I). We apply the threshold regression model when $\beta_2 \neq \beta_3$; and otherwise employ linear regression if the two are equal (Law & Singh, 2014). We tested for the threshold effect in equation (4) using Davies's (1977) Sup test, which reports the SupWStar statistic (Andrews, 1993; Davies, 1977; King, 1987). The null hypothesis is that there is no threshold effect in equation (4). The condition for excessive lending in the sample is when the average loan growth rate is above the loan growth threshold. More so, moral hazard is present when the above-the-threshold loan growth positively influences non-performing loans. Several tests including multicollinearity, unit root, and endogeneity tests were performed to ensure robust, consistent, and efficient results.

4. Results and Discussion

4.1 Descriptive Statistics

To gain insight into loan growth and non-performing loans, we split the descriptive statistics into three groups: all banks, local banks, and foreign banks to identify the group of banks that are excessively lending and also marred with non-performing loans in Zimbabwe. Such categorization plays a crucial role in policy formulations by revealing

the appropriate group of banks that requires close monitoring. Table 2 presents summary statistics for all variables used in this study. Empirical findings observed that the aggregate sample has high non-performing loans mean value of 9.14%, above the set BIS threshold of 5%. Higher average non-performing loans expose the banking industry to systemic failure and deteriorating financial intermediation as banks strategically curtail loan advancement to economic agents.

Table 2

Descriptive Statistics

	Obs	Mean	Std. Dev.	Min	Max
All Banks					
NPL	117	0.0914	0.1160	0.0000	0.7670
LGR	117	0.4829	0.9107	-0.4839	5.4976
ROA	117	0.0110	0.0378	-0.2107	0.0808
LTD	117	0.7109	0.3114	0.1670	1.8492
GDP	117	0.0824	0.0698	0.0076	0.1968
INF	117	0.0031	0.0368	-0.077	0.0490
Local Banks					
NPL	54	0.1271	0.1459	0.0041	0.7670
LGR	54	0.5427	1.0034	-0.4839	4.4487
ROA	54	0.0028	0.0443	-0.2107	0.0550
LTD	54	0.8063	0.3453	0.2244	1.8492
Foreign Banks					
NPL	63	0.0609	0.0701	0.0000	0.3081
LGR	63	0.4316	0.8279	-0.2529	5.4976
ROA	63	0.0180	0.0298	-0.1250	0.0808
LTD	63	0.6291	0.2546	0.1670	1.2722

Note. NPL=Non-performing loans ratio; LGR=Loans growth rate; ROA=Return on assets; LTD=Loan-to-deposit ratio; GDP=Gross Domestic Product; INF=Inflation. Sample: N=117; T=2009-2017.

Undoubtedly, higher NPLs mean value for the entire sample was mainly attributed to local banks. Although the level of volatility in non-performing loans for the aggregate sample is relatively low (11.6%), local banks registered a high standard deviation (14.6%), meaning that much attention must be directed towards monitoring their loan portfolio quality. The study observed that non-performing loans presented greater disparity among banks, with local and foreign banks registering a wider range.

In addition, the study finds that the average loan growth during dollarization is 48.29%. Such a significant change may signal excessive lending in the form of an excess supply of loans in the market. Loan growth in local banks is above that of foreign banks. Specifically, the mean loan growth for local and foreign banks is 54.3% and 43.2%, respectively. The result suggests that local banks present more risk than foreign banks and require close monitoring from the monetary authorities regarding credit advancement

and loan portfolio quality. Similar findings that high loan growth rates characterize banks with high non-performing loans were reported by Cincinelli and Piatti (2017).

The research discovered that local banks largely contributed to the higher loan-to-deposit ratio, a measure of banking industry liquidity risk, which dominated the Zimbabwean banking industry. Local banks had a loan-to-deposit ratio of 80.63%, while foreign banks' ratio was 62.91%. Thus, the study observed high liquidity risk in local banks. Concerning profitability, the average return on assets for the aggregate sample and both splits is worrisome. The mean return on assets for the aggregate sample, local and foreign banks is 1%, 0.2% and 1.8%, respectively. Low return on assets ratios implies that banks generate little income per dollar of invested assets. Overly, summary statistics revealed that local banks dominate the industry regarding non-performing loans ratio, loan growth, liquidity risk and poor profitability.

Regarding macroeconomic indicators, the study noted that the overall economy registered lower average inflation rates and high economic growth rates. The lower inflation rates resulted from using stable currencies such as USD and ZAR as legal tenders. Similarly, using stable currencies improved industry capacity utilization and production, ultimately spurring economic growth in Zimbabwe (Chinjova & Scott, 2021).

4.2 Panel Unit Root and Multicollinearity Test Results

The study tested for multicollinearity problems among study variables using the Pearson correlation matrix approach. Conducting a multicollinearity test before the regression analysis is imperative because it results in inaccurate variances and unstable coefficients and probability values (pvalue) that cause minor changes in the data to result in substantial changes in the coefficients (Midi et al., 2010; Vatcheva & Lee, 2016). The study also applied Pesaran's CIPS panel unit root testing criteria to test whether variables are stationary. Unit root testing is essential in regression analysis as it reduces the likelihood of spurious and inconsistent results. Thus, this approach prevents the model specification problem in panel data analysis. The results for the unit root and multicollinearity test appear in Table 3.

Table 3

Unit Root and Multicollinearity Test Results

	Multicollinearity test results					
	NPL	LGR	ROA	LTD	GDP	INF
NPL	1					
LGR	-0.1702	1				
ROA	-0.267	-0.0792	1			
LTD	0.2988	0.0142	-0.2285	1		
GDP	-0.1979	0.5692	-0.0615	0.0184	1	
INF	-0.0146	0.2077	0.1214	0.1373	0.3261	1

Unit root test results				
Variable	**CIPS Statistic**	**10%**	**5%**	**Order of integration**
NPL	-2.746	-2.200	-2.350	I (0)
LGR	-3.180	-2.200	-2.350	I (0)
ROA	-2.436	-2.220	-2.400	I (0)
LTD	-2.589	-2.220	-2.400	I (0)
GDP	2.610	-2.200	-2.350	I (0)
INF	2.610	-2.200	-2.350	I (0)

Note. NPL=Non-performing loans ratio; LGR=Loans growth rate; ROA=Return on assets; LTD = Loan-to-deposit ratio; GDP= Gross Domestic Product; INF=Inflation.

Table 3 reveals that the correlation coefficients for NPL, LGR, ROA, LTD, GDP and INF are all less than 0.8; thus, the variables are free from the multicollinearity problem (Shrestha, 2020). Furthermore, results in Table 3 indicate that the CIPS statistics for non-performing loans, return on assets, loan growth rate, loan-to-deposit ratio, GDP, and inflation are greater than the 5% critical values; thus, the variables are stationary. Since none of the variables was first differenced, all the variables are stationary at level.

4.3 Panel Threshold Regression Results

The paper employed the static panel threshold regression model with kink restrictions, as proposed by Seo et al. (2019). Table 4 reports the results generated by estimating equations (2) and (3) using loan growth rate as the threshold variable.

The parsimonious model (a) directly investigates the association between loan growth and non-performing loans without the interference of control variables, while model (b) factors in the influence of regime-independent covariates. The study finds the threshold effect of loan growth on non-performing loans in both panel threshold regression models. Bootstrap linearity testing for a threshold effect is significant at 1%, implying that the identified loan growth threshold estimate significantly affects non-performing loans. The intrinsic loan growth thresholds for models (a) and (b) are 43.68% and 42.91%, respectively. The identified thresholds are significant at 1% and 5% for models (a) and (b), respectively. According to these results, the optimal loan growth rate for the Zimbabwean industry is approximately 43%. The threshold level of 43% is marginally lower than the average loan growth rate of 48%, implying that the industry was lending more than it should. Further analysis revealed that local banks largely contributed to the overall sample's loan growth rate of 43%. This notion is evidenced by the high mean loan growth rate of 54% for local and 43% for foreign banks. From these results, the average loan growth rate for foreign banks is close to the identified loan growth threshold relative to local banks. Based on previous studies, the estimated threshold is significantly above the 15% estimate reported by Bardhan et al. (2019).

Table 4

Estimation Results of Static Panel Threshold Kink Model

	Dependent Variable: NPL					
	Model (a)			**Model (b)**		
	Coefficient	Standard Error	Z-Statistic	Coefficient	Standard Error	Z-Statistic
Threshold level (γ)	0.4368***	0.1212	3.6000	0.4291**	0.2092	2.0500
Kink slope	0.0579***	0.00954	6.0600	0.0927*	0.0498	1.8600
Impact of covariates in the low regime (below-the-threshold)						
LGR	-0.0684***	0.0093	-7.3200	-0.1132**	0.0512	-2.2100
ROA				-1.4252	0.9828	-1.4500
LTD				0.0625**	0.0256	2.4300
GDP				0.1194**	0.0601	1.9900
INF				0.0158	0.2206	0.0700
Number of moment conditions	60			92		
Observations	117			117		
Linearity test (p-value)	*0.0000*			*0.0000*		

Note. Asterisks (***), (**), (*) denote statistical significance at 1%, 5% and 10%, respectively.

The panel threshold regression model results suggest that, below the threshold value, loan growth exerts a negative and significant effect on NPLs in both models. This means that loan growth below the threshold level reduces non-performing loans. The results are in line with the hypothesized relationship. Our findings conform with the results reported by Vithessonthi (2016). The negative threshold effect of loan growth on non-performing loans below the estimated threshold value can be due to thorough borrower assessment or adopting stricter lending standards, thus not advancing credit to borrowers with lower credit ratings.

In addition, model (b) suggests that loan-to-deposit ratio and GDP positively associate with NPLs, and both variables are significant at 5%. These results imply that NPLs rise as bank liquidity deteriorates (increase in liquidity risk). The findings align with the illiquidity spiral theory, which states that bank illiquidity results in a vicious cycle that ultimately causes growth in NPLs. Anastasiou et al. (2016) obtained similar findings in Euro-area countries. However, the study documents that improvement in economic growth is associated with a rise in NPLs, which is different from the results reported in most studies. Alnabulsi et al. (2022) reported similar findings in the Middle East and North Africa region.

The study used the dynamic panel threshold model, developed by Kremer (2013), to estimate the impact of loan growth on NPLs below and above the threshold. The

probability value for the SupWStar test is 0.003, thus we conclude that there is a threshold effect in the regression model. Furthermore, we failed to reject the null hypothesis that variables are exogenous as the probability value for the Wu-Hausman test is greater than 5%. Table 5 presents the dynamic threshold regression results estimated using equation (4).

Table 5

Estimation Results of Dynamic Panel Threshold Model

Dependent Variable: NPL			
	Model (c)		
	Coefficient	Standard Error	Z-Statistic
Threshold level (γ)	0.3764		
Impact of loan growth rate			
β_H	-0.0557***	0.0199	-2.8000
β_L	-0.2778***	0.1039	-2.6700
Impact of covariates			
Lagged NPL	-0.5700***	0.1386	-4.1100
ROA	-1.9133**	0.8482	-2.2600
LTD	0.1499*	0.0880	1.7000
GDP	0.7006**	0.3209	2.1800
INF	-1.5199*	0.8263	-1.8400
Observations	117		
Number of banks	13		
Threshold effect test (SupWStar) p-value	*0.0030*		
Endogeneity test (Wu-Hausman p-value)	*0.3745*		

Note. Asterisks (***), (**), (*) denote statistical significance at 1%, 5% and 10%, respectively.

The findings in model (c) suggest a loan growth threshold of 37.64%, which is slightly lower than those indicated in models (a) and (b). The established threshold in model (c) is lower compared to those in models (a) and (b) because of the shift from static to dynamic modelling, which allows the dependent variable to have memory or be influenced by previous period NPLs. This, therefore, implies that the study concludes a threshold level of 37.64%. The study outcome concerning the influence of loan growth on non-performing loans below the threshold is consistent with the results suggested in models (a) and (b). We also noted that loan growth negatively influences NPLs above the threshold level. The finding aligns with the results concluded by Bardhan et al. (2019). Their study specifically deliberated that, above the threshold estimate, credit growth exerts a negative and significant effect on non-performing assets. First, banks probably adopted a culture of early recognizing losses related to bad loans. Sec-

ond, banks are probably engaging in workout arrangements to renew non-performing loans into new performing loans, thus suppressing non-performing loans as the loan portfolio grows.

The study found evidence of excessive lending, but the results did not find the presence of moral hazard problem in the Zimbabwean banking industry. Excessive lending is evidenced by the view that all the threshold values in models (a), (b) and (c) are lower than the mean value (48%) reported in descriptive statistics. In addition, the condition for the presence of moral hazard in the sample is when above-the-threshold loan growth exerts a positive influence on non-performing loans, which is the opposite of what the results from this study suggest. Therefore, according to these findings, the banking industry can lend excessively without engaging in moral hazard.

Model (c) results suggest that lagged non-performing loans negatively associate with current period non-performing loans. Such an association means that banks always learn from previous loan portfolio performance and periodically improve their lending procedures and monitoring. The results in model (c) also suggest a negative affiliation between return on assets and non-performing loans, and the variable is significant at 5%. According to the findings, a 1% increase in ROA can cause NPLs to decrease by 1.336%. The interpretation of this finding is that less profitable banks are tempted to issue high-risk loans. More so, the study asserts that profitable banks are less likely to have a higher NPL rate. The negative relationship between ROA and NPLs conforms to the work of Semia and Rachid (2019), Son et al. (2020), Khan et al. (2020) and Obeid (2022). Khan et al. (2020) suggested that profitability has a negative relationship with NPLs in Pakistan, which is also among developing countries in the world. Like model (b) results, model (c) suggests that loan-to-deposit ratio positively associates with NPLs and both variables are significant at 10%. These results emphasize that deterioration in bank liquidity induces an increase in NPLs.

Regarding macroeconomic indicators, the results in model (c) document that improvement in GDP causes NPLs to rise, and the results are consistent with those presented in model (b). The variable is significant at 5% in model (c), and the results deviate from most of the findings in literature as increased GDP is known to improve borrowers' earning capacity, resulting in reduced NPLs. However, the probable logic behind the positive affiliation between economic growth and NPLs in Zimbabwe is that when the economy dollarized, there was massive resuscitation of various industries that were heavily affected by hyperinflation that had a high appetite for bank loans. So, as they contributed towards economic growth, the economy rapidly grew. However, these companies also required more cash inflows. They may have not been able to afford to make cash outflows for loan payments as they had much of the funds invested in capital expenditures and recurring working capital needs. As a result, the improvement in economic growth induced rising NPLs. This explains why NPLs were rising between 2009 and 2014 and later decreased between 2015 and 2017 when borrowers began to settle their overdue loans, thus

the uniqueness of the effect of dollarization in an economy. Studies that reported a positive association between GDP and NPLs include Shingjergji (2013) in Albania and Alnabulsi et al. (2022) in the Middle East and North Africa region.

Regarding the effect of inflation in Zimbabwe, the results in model (c) suggest that inflation negatively influences NPLs. The variable is significant at 10%. The results imply that NPLs tend to fall when inflation rises because most economic agents will be able to settle their loans due to the erosion of the real value of their outstanding loans. However, the bank loses in real terms as rising inflation erodes its balance sheet. Syed and Tripathi (2020) and Rehman et al. (2020) concluded that an increase in the inflation rate causes NPLs to fall in Brazil, Russia, India, China and South Africa (BRICS countries) and Pakistan, respectively.

5. Conclusions and Practical Implications

Using panel threshold regression models on a dataset for thirteen banks from 2009 to 2017, the study documented that loan growth rate is a vital driver of bank non-performing loan stocks. The study documents that local banks contributed to the industry's average loan growth and NPLs more than foreign banks. In addition, the study established that the applicable loan growth threshold for the Zimbabwean banking industry is approximately 38%. More so, the findings suggest that loan growth negatively influences NPLs below and above the loan growth threshold. The study also found evidence of excessive lending in Zimbabwe and the absence of moral hazard, as the study's findings suggested that loan growth above the threshold negatively impacts non-performing loans. Furthermore, we noted that bank liquidity, profitability, economic growth, and inflation significantly influence NPLs.

The novelty of the present paper is embedded in the pioneering of the application of blended panel threshold models developed by Seo et al. (2019) and Kremer et al. (2013) in examining the threshold effect of credit growth on non-performing loans and its extension to the Zimbabwean context. The two models better capture the presence of complex non-linearity relationships. The practical implications of this study are significant, as local banks are grappling with non-performing loans. The study recommends several strategies to address the growth in NPLs. Firstly, it suggests that local banks implement measures to enhance profitability, as an increase in ROA leads to a decrease in NPLs. Additionally, the study recommends that banks monitor liquidity risk exposures, as an increase in LTD induces a rise in NPLs. Regarding LGR, the study recommends banks to maintain a steady loan growth rate, as it has a significant negative effect on NPLs both below and above the threshold. This implies that as the loan growth rate increases, the number of NPLs decreases. Therefore, banks should implement strategies that promote loan growth, such as offering competitive interest rates, improving customer service, and developing innovative loan products. While this article applied the panel threshold models of Seo et al. (2019) and Kremer et al. (2013) to

investigate the threshold effect of loan growth on non-performing loans, future research could focus on a quasi-experiment on the same topic, comparing the dollarization to the de-dollarization period. Furthermore, future researchers may broaden the scope of the present study by employing methodologies that test for the possibility of the presence of multiple thresholds and examine the nature of the relationships thereof.

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