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Bank Non-Performing Loan Determinants: A Comparison of European and African Countries

Abstract: The study investigates the determinants of bank non-performing loans (NPL) in European and African countries, focusing on 32 European and African countries from 2010 to 2021. The results based on the two-stage least squares regression methodology show that the number of commercial bank branch, bank liquid reserves to bank assets ratio, inflation rate, exchange rate, real interest rate and the lending rate are significant determinants of bank NPL in the full sample. Size of domestic private credit, bank capital to asset ratio, bank liquid reserve to bank asset ratio, unemployment rate, inflation rate, exchange rate, real interest rate and lending rate are significant determinants of bank NPL in European countries. Bank capital to asset ratio, bank liquid reserve to bank asset ratio and inflation rate in Africa are significant determinants of bank NPL in African countries. The implication of the results is that the determinants of bank NPL in European countries are not necessarily the drivers of bank NPL in African countries.

Keywords: bank, non-performing loans, Africa, Europe.

JEL Classification: G21, G28.

1. Introduction

The purpose of this study is to investigate the determinants of non-performing loans in European and African countries. A non-performing loan (NPL) is a loan that is not paid when due. The NPL ratio is a key indicator of a bank's asset quality and credit risk. A high NPL ratio indicates that a significant portion of a bank's loan portfolio is at risk of default or is already in default which could bring the bank closer to a bank failure. Bank failure is often linked to high NPL (Campbell, 2007), except for cases where banking crises are caused by bank runs, bad business models or poor investment decisions, as was the case with the 2023 regional banking crisis in the United States.

Non-performing loans are an important issue in the banking sector, for three major reasons. One, banks are the main providers of credit to the real economy in many countries and their ability to provide credit for real economic activities will be impaired by high NPL, because high NPL will discourage banks from giving new loans for production and investment purposes, which can lead to contraction in economic output and a decline in gross domestic product (Park and Shin, 2021). Two, rising NPL can lead to the failure of banks and such failure can trigger a system-wide banking crisis through contagion (Lardy, 2018; Ozili, 2018). Three, rising NPL can signal poor credit risk management in banks and imply a failure of banking regulation and supervision on the part of bank supervisors and financial regulators (Zhang, Cai, Dickinson & Kutan, 2016).

Despite the importance of NPL in the banking sector, there is little knowledge about the regional determinants of NPL in the African and European regions. Previous studies have shown that high NPL in banks may be caused by different factors such as poor lending practices, economic recession, rising interest rates, inflation, etc., but knowledge about the regional determinants of NPL is scant in the literature. Previous studies also focused on specific countries or regions without providing a comparative assessment of NPL determinants in different regions (see, for example, Chowdhury, Uddin, Ullah, Ahmmed & Shadek, 2023; Umaternate & Mongid, 2023). In Europe, for example, the literature shows that European banks have sophisticated credit risk management tools and high levels of financial sector development which diminishes the likelihood of having an outrageously high NPL (Ozili, 2019). However, this is not the case in African countries where the banking systems are fragmented, less financially-developed and less sophisticated in credit risk management compared to European countries. These regional differences may give rise to dissimilar NPL determinants in Africa and Europe. Yet, the literature has not compared the NPL determinants in these two regions despite the differences in the credit risk management and the

level of financial development in the two regions. Therefore, we fill this gap in the literature by investigating the determinants of NPL and focusing on Africa and Europe.

This study contributes to the literature that examines the determinants of NPL. The study adds to the literature by exploiting the regional differences in African and European banking systems, to determine whether there are similar or dissimilar determinants of NPL in the two regions. We find evidence of dissimilar determinants, implying that the significant determinants of bank NPL in European countries are not necessarily the drivers of bank NPL in African countries.

The remainder of the study is organized in the following way. Section 2 presents the theory and literature review. Section 3 presents the research methodology while section 4 presents the results. The conclusion is given in section 5.

2. Theory and Literature Review

2.1. Theory of adverse selection

Many theoretical studies use the theory of adverse selection to explain the cause of NPL (Wilson, 1989; Cressy & Toivanen, 2001). The theory of adverse selection states that NPL could arise when some borrowers refuse to disclose potentially damaging information to lenders about their inability to repay a loan, and deceiving lenders to issue loans to them even when they do not have the intention of repaying the loan or the capacity to repay the loan (Berndt & Gupta, 2009). Adverse selection is common in bank lending business. It is a situation when borrowers have information that lenders do not have, and borrowers proceed to take loans from lenders without disclosing information that could signal the borrowers' inability, or lack of full capacity, to repay the loan (Wilson, 1989), thereby increasing the risk of loan default on the part of borrowers and increasing the risk of incurring NPL on the part of the lender. The implication of the theory is that adverse selection is a cause of NPL in banks.

2.2. Literature Review

The literature categorizes NPL determinants as the external determinants of NPL (i.e., factors related to the country or region where the entity operates) and the bank-specific determinants of NPL (i.e. factors related to each individual entity, also known as the internal NPL determinants). Regarding the macroeconomic determinants, the NPL literature identifies economic growth, interest rate, inflation, unemployment and exchange rate as significant macroeconomic determinants of NPL. For instance, Mitrakos and Simigiannis (2009) find that unemployment and income level are highly correlated with the probability of debt default. Espinoza and Prasad (2010) examine the macroeconomic determinants of NPL among 80 Gulf Cooperating Council entities (i.e., Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates) from 1995 to 2008. They use a dynamic panel regression model and find that NPL has a significant negative effect on economic growth and a significant positive effect on interest rate. Ali and Daly (2010) analyse the macroeconomic determinants of NPL in the United States and Australia from 1995 to 2009. They find that GDP, interest rate, industrial production and total indebtedness are significant macroeconomic determinants of NPL. However, they warned that there are differences in the effect of the same variables on both economies, pointing out that the US economy is much more sensitive to macroeconomic shocks than the Australian economy. Furthermore, Louzis, Vouldis, & Metaxas (2012) show that changes in unemployment, inflation or changes in interest rates can affect the NPL of banks. In a related cross-country study, Castro (2013) shows that GDP growth, the housing price index, unemployment rate, interest rate, the exchange rate and credit growth are significant macroeconomic determinants of NPL. Staehr and Uusküla (2017) examine the case of banks in the European Union from 1997 and 2017 and find that the key macroeconomic factors affecting the NPL ratio are GDP growth, inflation and the level of indebtedness. However, some factors, such as the current account balance and house price levels, are determinants for some regions within the European Union, especially in Central and Eastern Europe. Ozili (2019) analyzes the effect of financial development on NPL using a sample of 134 countries from 2003 to 2014, and find that financial development, measured by the presence of foreign financial institutions and the quality of financial intermediation, is related to NPL because low levels of supervision by regulators lead to low-quality loan screening and monitoring which leads to high NPL. Syed and Aidyngul (2022) examine the case of banks in developed and developing countries from 1995 to 2019 and find that the main macroeconomic factors affecting NPL are economic growth, inflation and interest rate.

Regarding the bank-specific determinants, several studies in the NPL literature identify profitability, efficiency, solvency, size, and diversification of banking business as significant bank-specific determinants of NPL. For example, Messai & Jouini (2013) investigate the NPL determinants among 85 banks in Italy, Greece, and Spain from 2004 to 2008, and find that NPL has a significant negative effect on bank profitability. Ciptawan and Melly (2023) also find an inverse relationship between profitability and NPL for financial institutions in Indonesia. Similarly, Ghosh (2015) and Kjosevski and Petkovski (2021) find an inverse relationship between NPL and bank profitability in the United States and in Baltic countries, respectively. In contrast, Kumar and Kishore (2019) did not find a significant relationship between NPL and bank profitability. Espinoza and Prasad (2010) show that bank efficiency is a significant determinant of NPL. They argue that efficient banks have low NPL ratios. Existing studies show evidence to support this argument such as Louzis, Vouldis and Metaxas (2012), Koju, Koju, and Wang (2018), Ozili (2019) and Khan, Siddique, and Sarwar (2020). There is also evidence that bank solvency is a significant bank-specific determinant of NPL, as documented in Kjosevski, Petkovski, and Naumovska (2019), Makri, Tsagkanos, and Bellas (2014), Mpofu & Nikolaidou (2019) and Msomi (2022). In contrast, other studies did not find a significant relationship between solvency and NPL ratio such as Louzis, Vouldis and Metaxas (2012) and Cheng, Lee, Pham, and Chen (2016). Other studies show that the size of an entity is a potential bank-specific determinant of NPL such as Ahmed, Majeed, Thalassinos, and Thalassinos (2021), Koju, Koju and Wang (2018), and Ghosh (2015). The diversification of the banking business has also been found to affect the NPL ratio because banks that have a well-diversified business activity will have a well-diversified loan portfolio and will be less exposed to loan default during financial crises (Ercegovac, Pecaric & Klinac, 2020). Empirical studies such as Khan, Siddique and Sarwar (2020) find an inverse relationship between diversification and NPL ratio for banks in Pakistan. Lee, Yahya, Habibullah, and Ashhari (2019) show that banks that have greater diversification are less susceptible to credit risk and, therefore, have better control of their NPL ratio. In contrast, Ismail, Azlan, Husin, Ishak, and Hashim (2017) and Ahmed, Majeed, Thalassinos, and Thalassinos (2021) find a positive relationship between diversification and NPL, while Rachman, Kadarusman, Anggriono, and Setiadi (2018) show that the relationship between diversification and NPL ratio may not be significant. Other bank-specific factors affecting NPL include corporate governance and banking regulation. Several studies point out that strong corporate governance helps to reduce NPL (Balgova, Plekhanov, and Skrzypinska, 2017). Gonzalez-Garcia and Grigoli (2013) show that in countries where the public sector has direct stakes in the equity of financial institutions, the financial industry is more likely to give more credit to the public sector, which would generate higher NPL ratios due to conflict of interest. Similarly, Lee, Chen,

Chang, and Chen (2022) show that financial institutions that have poor corporate governance have higher NPL ratios.

Other country-specific studies examine the determinants of NPL. Chaibi and Ftiti (2015) analyze the determinants of the NPL ratio of commercial banks in France and Germany in 2005- 2011 using a dynamic data panel method. They examine which factors are common in a market-based economy (France) and a bank-based economy (Germany). The authors find that inflation, GDP growth, interest rate, unemployment and exchange rate are significant determinants of NPL of both economies. In a different study, Cucinelli (2015) investigates the effect of NPL on credit growth in a sample of 488 Italian banks from 2007 to 2013. The study finds that the lending behaviour of banks is adversely affected by NPL and loan loss provision. Chowdhury, Uddin, Ullah, Ahmmed, and Shadek (2023) analyze the specific and macroeconomic factors affecting NPL in Bangladesh from 2007 to 2018. They find that credit growth, leverage, and interest margin are the bank-specific determinants of NPL, while inflation and gross domestic product (GDP) growth are the macroeconomic determinants of NPL. Rachman Kadarusman, Anggriono, and Setiadi (2018) analyze the determinants of NPL in the case of 36 listed commercial banks in Indonesia from 2008 to 2015. They find that profitability and credit growth have an inverse effect on NPL. Khan, Siddique and Sarwar (2020) analyze the determinants of NPL among listed commercial banks in Pakistan from 2005 to 2017. They find that profitability, efficiency, solvency, and income diversification are significant determinants of NPL in Pakistan. Partovi and Matousek (2019) focus on banks in Turkey and find that NPL has a negative impact on technical efficiency, and that efficiency levels vary depending on the ownership structure of the entities. Berger and DeYoung (1997) also find a negative correlation between efficiency and NPL ratio. Other country-specific studies have been conducted on the determinants of NPL such as in China (Zeng, 2012), Nepal (Koju, Koju and Wang, 2018), Macedonia (Kjosevski, Petkovski, and Naumovska, 2019), the European Union (Staehr and Uusküla, 2020), Poland (Petkovski, Kjosevski, and Jovanovski, 2021), Sri Lanka (Rathnayake and Dissanayake, 2021), Bosnia Herzegovina (Žunić, Kozarić, and Dželihodžić, 2021), Ethiopia (Lemma-Lalisho, 2022) and Indonesia (Umaternate and Mongid, 2023).

Existing regional studies examine NPL determinants in African countries. For example, Msomi (2022) examines the macro-economic and bank-specific factors affecting non-performing loans in commercial banks from six African countries (Nigeria, Benin, Burkina Faso, Gambia, Guinea and Liberia) from 2008 to 2019. They find that liquidity ratio, capital adequacy ratio and inflation rate have a significant effect on NPL. Mpofu & Nikolaidou (2019) investigate the determinants

of non-performing loans in eight (8) sub-Saharan African economies from 2000 to 2017. The authors find that NPL decrease when real GDP growth rate, return on equity, return on assets, and total liabilities to total assets ratio increase, and rise when unemployment rate, public debt, inflation rate, broad money, lending interest rate and domestic credit to private sector by banks increase. Olarewaju (2020) examines the determinants of NPL among 110 commercial banks from nine African lower middle-income countries from the 2010 to 2017. They use the dynamic panel regression method and find that lagged NPL, lending rate, capital adequacy, credit growth, cost income ratio and real interest rate are significant factors affecting NPL in the banking sector of lower middle-income countries. Despite the extensive studies on NPL, the literature has not provided a detailed comparison of the determinants of NPL in African countries and European countries. In the next section, we investigate the NPL determinants in selected European and African countries.

3. Research methodology

3.1. The sample

Data were collected from the world bank database. The sample period is from 2010 to 2021. The sample period begins from 2010 to ensure that our data is not contaminated by the global financial crisis event of 2007 to 2009. Data were collected for 56 countries. The countries were selected based on availability of data. Of the 56 countries, 24 countries did not have any reported data for the NPL ratio during the sample period. These countries were excluded from the analysis. This leaves us with a final sample of 32 countries. See table 1 for variable description.

Regarding the distribution of the data, the descriptive statistic in table 2 shows that most European countries in our sample have a relatively low NPL ratio than African countries. Algeria and Angola have a high NPL ratio than European countries such as Norway and Switzerland, except for San Marino which has the highest NPL ratio of 44 percent. The CBB variable is higher in European countries than in African countries. This implies that European countries, such as Switzerland, Montenegro, Bulgaria, Italy and San Marino, have a higher number of commercial bank branches than African countries such as Madagascar, Tanzania and Uganda. In terms of inflation, European countries have a relatively low inflation rate compared to African countries. In terms of the lending rate, European countries also have a relatively low lending rate compared to African countries. The EX variable is higher in African countries than in European countries.

This implies that African countries, such as Madagascar, Uganda, Tanzania, Malawi and Nigeria, have a higher exchange rate relative to the US dollar than European countries such as Netherlands, Switzerland and the United Kingdom. The DBP variable is higher in European countries than in African countries. This implies that European countries, such as the United Kingdom, Switzerland, Norway, the Netherlands and Iceland, have a higher share of private credit by banks than African countries such as Malawi and the Gambia.

Table 1: Description of variables

Variable	Indicator Name	Source
DBP	Domestic credit to private sector by banks (% of GDP)	Global financial development indicators (GFDI), World Bank
CBB	Commercial bank branches (per 100,000 adults)	GFDI World Bank
BCAP	Bank capital to assets ratio (%)	GFDI, World Bank
BLL	Bank liquid reserves to bank assets ratio (%)	GFDI World Bank
NPL	Bank non-performing loans to total gross loans (%)	GFDI World Bank
UNEMP	Unemployment, total (% of total labor force) (modeled ILO estimate)	GFDI World Bank
INF	Inflation, consumer prices (annual %)	GFDI World Bank
LR	Lending interest rate (%)	GFDI World Bank
RIR	Real interest rate (%)	GFDI World Bank
EX	Official exchange rate (LCU per US$, period average)	GFDI World Bank

Source: World Bank

3.2. Empirical model

The model adopted to estimate the determinants of bank NPL is a modified form of the models used in Ozili (2019) and Lee, Chen, Chang and Chen, 2022).

$$NPLi,t = \beta 0 + \beta 1DBPi,t + \beta 2CBBi,t + \beta 3BCAPi,t + \beta 4BLLi,t + \beta 5UNEMPi,t + \beta 6INFi,t + \beta 7EXi,t + \beta 8RIRi,t + \beta 9LRi,t + ei,t \ldots..Eq\ 1$$

Where i, t represents country and year. NPL = bank non-performing loans to total gross loans ratio (%). DBP = domestic credit to private sector by banks (% of GDP). CBB = size of commercial bank branches per 100,000 adults. BCAP = bank capital to assets ratio (%). BLL = bank liquid reserves to bank assets ratio (%). UNEMP = total unemployment rate (% of total labor force). INF = inflation rate (%). LR = lending interest rate. RIR = real interest rate (%). EX = official exchange rate. εit is the error term of the model.

3.3. Estimation procedure

We use three regression estimation methods. We use the ordinary least squares regression estimation following the approach of Amuakwa-Mensah, Marbuah, and Ani-Asamoah Marbuah (2017). We also use the fixed effect regression and the two-stage least squares regression estimations for robustness purposes following the approach of Ozili (2019). The two-stage least squares regression estimation controls for potential endogeneity problems in the data when the explanatory variables are correlated with the error term of the regression model (Maydeu-Olivares, Shi, and Rosseel, 2019). We also use the panel fixed effect regression estimation to control for time invariant unobserved heterogeneity in the data (De Chaisemartin and d'Haultfoeuille, 2020).

Table 2: Descriptive statistics: the average of the variables

Country	Region	NPL	DBP	CBB	BCAP	BLL	UNEMP	INF	LR	RIR	EX
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Algeria	Africa	13.1	21.1	5.2	9.04	42.2	10.6	4.6	8	3.4	100.3
Angola	Africa	12.4	17.3	9.3	10.2	36.3	9.3	17.4	18.1	1.04	229.4
Botswana	Africa	4.2	33.6	8.9	8.6	24.7	19.3	4.7	8.2	3.6	9.4
Bulgaria	Europe	12.3	56.7	60.6	11.1	19.3	8.4	1.7	7.2	3.6	1.6
Eswatini	Africa	7.9	20.7	6.9	11.8	14.1	24.1	5.7	9.2	4.6	11.9
Gambia	Africa	9.6	8.3	7.8	14.5	31.4	6.7	6.2	27.2	20.9	41.7
Hungary	Europe	8.9	41.6	17.3	9.4	20.7	6.8	2.7	4.1	0.5	258.1
Iceland	Europe	3.3	104.5	38.6	17.3	7.6	4.8	3.2	7.5	3.6	121.2
Italy	Europe	11.9	84.8	47.6	5.9	-	10.5	1.1	3.6	2.5	0.8
Kenya	Africa	8.5	30.9	5.04	12.2	8.8	3.6	6.8	14.9	7.9	95.7
Lesotho	Africa	3.6	18.5	3.6	8.1	7.1	17.1	5.0	10.4	3.8	11.9
Madagascar	Africa	9.5	12.6	2.1	7.6	25.02	1.9	6.8	54.3	44.1	2894.3
Malawi	Africa	6.5	10.5	2.6	9.5	37.4	5.1	15.7	33.6	13.4	501.8
Malta	Europe	5.8	90.8	33.5	6.7		5.04	1.3	4.6	2.4	0.8
Mauritius	Africa	5.3	91.5	19.5	8.3	8.3	7.2	3.02	8.3	6.1	33.8
Moldova	Europe	11.7	25.3	41.4	12.1	29.5	4.6	5.7	11.5	3.5	15.7
Montenegro	Europe	12.6	53.4	40.3	9.1	21.4	17.7	1.5	8.00	5.6	0.8
Mozambique	Africa	7.8	25.01	3.9	10.4	30.9	3.4	7.1	18.6	12.8	48.1
Namibia	Africa	2.8	53.1	12.2	9.02	5.9	20.3	4.8	9.0	3.5	11.9
Netherlands	Europe	2.4	109.9	13.9	25.5		5.2	1.6	1.7	0.7	0.8
Nigeria	Africa	8.1	12.0	5.1	8.8	37.8	4.5	12.3	16.02	6.6	227.3
North Macedonia	Europe	7.4	48.9	24.5	10.3	24.4	24.8	1.5	7.3	4.6	50.8
Norway	Europe	1.1	118.2	8.5		1.1	3.8	2.1	3.2	1.1	7.4
Romania	Europe	10.5	30.3	28.5	8.7	20.7	5.9	2.9	8.3	4.1	3.7
Rwanda	Africa	6.1	18.9	5.5	14.4	15.1	12.1	4.3	16.8	12.5	763.1
San Marino	Europe	44.1	-	176.5	6.4	-	-	1.6	4.6	3.5	0.8
Switzerland	Europe	0.7	162.6	43.6	7.1	-	4.7	0.02	2.6	2.8	0.9
Tanzania	Africa	8.1	12.8	2.1	11.3	20.6	2.5	6.5	16.1	9.23	1943.1
Uganda	Africa	4.7	12.2	2.6	12.9	22.02	3.4	5.7	22.2	16.3	3116.6
Ukraine	Europe	33.3	40.7	0.8	8.8	11.9	8.6	11.4	17.3	1.6	18.7
United Kingdom	Europe	2.03	145.4	23.9	5.2	-	5.7	2.0	0.5	-1.1	0.6
Zambia	Africa	9.4	11.6	4.1	11.0	26.5	7.9	10.4	13.1	3.1	9.7
Statistics:											
Mean		9.43	47.94	22.58	10.30	20.88	8.93	5.27	12.96	6.93	328.99
Median		6.74	31.15	9.24	9.48	19.89	6.72	3.872	9.71	5.26	17.62
Maximum		61.11	183.92	233.81	89.48	86.04	33.13	48.69	60.00	52.43	3829.98
Minimum		0.52	5.44	0.38	1.49	0.33	0.60	-1.54	0.50	-13.91	0.61
Std. Dev.		10.13	41.19	33.92	7.82	14.24	6.544	5.52	10.92	9.547	801.83
Observations		359	364	365	346	301	372	377	351	350	382

Source: Authors' calculations

3.4. Justifying the inclusion of the variables in the model

We use four bank-specific independent variables, namely the BCAP, CBB, DBP and BLL variables. The BCAP variable represents bank capital adequacy ratio and is measured as bank equity capital to asset ratio. We expect a negative relationship between the BCAP variable and the NPL variable because a high capital adequacy ratio will place a constraint on banks' ability to lend and would discourage banks from taking excessive risk in their lending activities (Malimi, 2017). This will reduce credit risk and decrease the size of bank NPL. The CBB variable captures the size of banking activity, proxy by the number of commercial bank branch per 100,000 adults. We expect a positive relationship between the CBB variable and the NPL variable because banks that have large banking activity usually have a large bank branch network and they issue more loans to many customers (Bruhn and Love, 2014). Higher loans will increase credit risk and could lead to a rise in bank NPL. The DBP variable captures the extent of banks' lending to the economy. We do not have a definite prediction for the effect of the DBP variable on the NPL variable because greater lending to the economy could give rise to fewer NPL if bank loans are well-diversified across various sectors of the economy (Carletti, Cerasi and Daltung, 2007; Erdas and Ezanoglu, 2022; Ozili, 2022). However, if bank lending is not well-diversified, banks could face high credit risk which may materialize into rising NPL (Demsetz and Strahan, 1997). The BLL variable captures the liquidity of the banking sector (see table 1 for variable description). We expect a positive relationship between the BLL variable and the NPL variable because banks that have high liquid reserves will have sufficient liquid assets which they can use to withstand short-term losses caused by rising NPL (Tran and Tran, 2025; Alaoui Mdaghri, 2022; Ozili, 2019).

Regarding the external NPL determinants, we use five macroeconomic variables. The UNEMP variable represents the rate of total unemployment in a country. We expect a positive relationship between the UNEMP variable and the NPL variable because as more borrowers lose their jobs and become unemployed, they will not be able to generate income that would be used to repay the debt owed to financial institutions or banks, thereby leading to a rise in loan defaults and a rise in bank NPL (Lee and Rosenkranz, 2020). The LR variable represents the market interest rate in a country. We expect a positive relationship between the LR variable and the NPL variable because a high lending rate indicates the tightening of financing conditions which will make borrowing more expensive and increase the likelihood that existing borrowers will default if they cannot access cheaper financing to repay their existing debt obligations (Olarewaju, 2020). Therefore, a high lending rate could lead to a rise in bank NPL. The INF variable represents the rate of inflation in a country. We expect a positive relationship between the INF variable

and the NPL variable because, during periods of high inflation, banks will reprice their financial products and services to reflect the high inflation rate (Gallas, Bouzgarrou, and Zayati, 2025; Umar and Sun, 2018). Such repricing would lead to a general rise in the cost of banking services as well as increase in interest rate which would increase the risk of loan default among borrowers, thereby increasing bank NPL. The EX variable represents the official exchange rate of a country. We expect a positive relationship between the EX variable and the NPL variable because, during periods of high exchange rate, banks that have large sums of foreign currency denominated debt may experience difficulty in repaying their debt (Anita, Tasnova and Nawar, 2022). They may incur additional costs to obtain the foreign exchange that would be used to repay their foreign currency denominated debt, and banks will subsequently transfer the extra cost to borrowers through higher interest rate on local currency denominated debt which will make domestic borrowing more expensive and increase the likelihood that existing borrowers will default on loan repayment. Therefore, a high exchange rate could lead to a rise in bank NPL. The RIR variable represents the real interest rate. We expect a positive relationship between the RIR variable and the NPL variable because a high real interest rate indicates the tightening of financing conditions which will make borrowing more expensive and increase the likelihood that existing borrowers will default on their loan repayment (Kuzucu and Kuzucu, 2019). Therefore, a high real interest rate could lead to a rise in bank NPL.

3.5. Correlation

The Pearson correlation analysis for the variables is reported in table 3. The NPL variable is significant and positively related to the BLL, LR and INF variables. This implies that an increase in the inflation rate, lending rate, and banking sector liquidity is associated with higher NPL. The NPL variable is also significant and negatively related to the BCAP and EX variables. This implies that higher capital adequacy ratio and exchange rates are associated with higher NPL.

Table 3: Pearson correlation for the variables (full sample)

Variable	NPL	DBP	CBB	BCAP	BLL	UNEMP	INF	EX	RIR	LR
NPL	1.000									

DBP	-0.078	1.000								
	(0.21)	-----								
CBB	0.004	0.514***	1.000							
	(0.95)	(0.00)	-----							
BCAP	-0.181***	0.012	0.145**	1.000						
	(0.00)	(0.85)	(0.01)	-----						
BLL	0.105*	-0.435***	-0.078	-0.041	1.000					
	(0.09)	(0.00)	(0.20)	(0.51)	-----					
UNEMP	-0.071	0.170**	0.067	-0.141**	-0.222***	1.000				
	(0.25)	(0.01)	(0.28)	(0.02)	(0.00)	-----				
INF	0.260***	-0.358***	-0.365***	-0.088	0.204***	-0.205***	1.000			
	(0.00)	(0.00)	(0.00)	(0.15)	(0.00)	(0.00)	-----			
EX	-0.101*	-0.328***	-0.293***	-0.029	0.079	-0.368***	0.093	1.000		
	(0.10)	(0.00)	(0.00)	(0.64)	(0.20)	(0.00)	(0.13)	-----		
RIR	-0.079	-0.267***	-0.237***	-0.015	0.058	-0.291***	-0.084	0.661***	1.000	
	(0.20)	(0.00)	(0.00)	(0.80)	(0.35)	(0.00)	(0.17)	(0.00)	-----	
LR	0.102*	-0.449***	-0.388***	-0.069	0.200***	-0.396***	0.336***	0.694***	0.812***	1.000
	(0.10)	(0.00)	(0.00)	(0.26)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	-----

P-value is in parenthesis. ***, **, * represent 1%, 5% and 10% levels

Source: Authors' calculations

4. Discussion of Results

This section presents the results for the determinants of NPL. The results are reported in tables 4, 5 and 6. In the discussion of results, we consider a result to be robust if the variable is statistically significant and the variable reports the same coefficient sign in the three estimations.

4.1. Determinants of NPL: full sample analysis

The full sample results are reported in table 4. The CBB variable is statistically significant and positively related to the NPL variable in the three estimations in columns 1, 2 and 3 of table 4. The result is robust. The significant and positive CBB coefficient implies that high banking activity significantly increases the size of bank NPL. A possible reason for this result could be because banks that have large activity tend to issue more loans to many customers and the increased loans could increase credit risk and lead to a rise in bank NPL (Bruhn and Love, 2014). The LR variable is also statistically significant and positively related to the NPL variable in the three estimations in columns 1, 2 and 3 of table 4. The result is robust. The significant and positive LR coefficient implies that a high lending rate in the banking sector triggers a rise in bank NPL. A possible reason for this result could be because a high lending rate tightens financing conditions, make borrowing more expensive and increase the likelihood that existing borrowers will default which would increase bank NPL (Olarewaju, 2020). The EX variable is also statistically significant but is negatively related to the NPL variable in the three estimations in columns 1, 2 and 3 of table 4. The result is robust. The EX variable is negatively significant, which is contrary to our prediction of a positive relationship between the EX and NPL variables. The significant and negative EX coefficient implies that a high exchange rate in the economy leads to fewer bank NPL. A possible reason for this result could be that banks reduce lending in foreign currency when exchange rate is high, which subsequently reduces the risk of NPL. Meanwhile, the DBP, RIR, INF, UNEMP, BLL and BCAP variables are not consistently robust as they report mixed significance in the result reported in columns 1, 2, and 3.

Table 4: Determinants of NPL: full sample regression estimation

		(1)	(2)	(3)
	Predicted sign	OLS regression estimation	Panel fixed effect estimation	2SLS estimation
		Coefficient (T-statistic)	Coefficient (T-statistic)	Coefficient (T-statistic)
c		12.132*** (3.92)	6.654** (2.08)	
DBP	+/-	-0.017 (-0.63)	-0.238*** (-4.48)	0.036 (1.49)
CBB	+	0.068* (1.88)	0.175** (2.27)	0.070* (1.88)
BCAP	-	-0.537*** (-3.00)	-0.859*** (-4.79)	-0.034 (-0.26)
BLL	+	-0.004 (-0.11)	-0.016 (-0.53)	0.062* (1.77)
UNEMP	+	-0.075 (-1.01)	1.257*** (8.28)	0.080 (1.25)
INF	+	0.144 (1.24)	0.039 (0.49)	0.235** (2.01)
EX	+	-0.002*** (-2.96)	-0.003** (-2.04)	-0.002** (-2.56)
RIR	+	-0.211** (-2.14)	-0.038 (-0.59)	-0.222** (-2.19)
LR	+	0.325*** (3.10)	0.399*** (3.09)	0.416*** (3.95)
Adjusted R^2		13.51	73.27	8.49
F-statistic		5.44	16.95	
Instrument rank				10

The fixed effect panel regression includes both year effect and country effect. The 2SLS instrumental variables are the one-year lagged explanatory variables. Lagging the explanatory variables allows us to mitigate endogeneity issues. T-statistic is reported in parenthesis. ***, **, * represent statistical significance at the 1%, 5% and 10% levels.

Source: Authors' calculations

4.2. Determinants of NPL in European countries

This section examines the determinants of NPL in the sampled European countries. The results are reported in table 5. The BCAP variable is statistically significant and negatively related to the NPL variable in the three estimations in columns 1, 2 and 3 of table 5. The result is robust. The significant and negative BCAP coefficient implies that a high capital adequacy ratio reduces the size of bank NPL in European banks. A possible reason for this result could be because a high capital adequacy ratio will place a constraint on European banks' ability to lend and would discourage European banks from taking excessive risk (Malimi, 2017). This will reduce credit risk and decrease the size of bank NPL. The LR variable is statistically significant and positively related to the NPL variable in the three estimations in columns 1, 2 and 3 of table 5. The result is robust. The significant LR coefficient implies that a high lending rate in the banking sector triggers a rise in bank NPL in European banks. A possible reason for this result could be because a high lending rate could tighten financing conditions, make borrowing more expensive and increase the likelihood that existing borrowers will default which would increase bank NPL (Olarewaju, 2020). The INF variable is negatively significant in columns 1, 2 and 3 of table 5, which is contrary to our prediction. The result is robust. The significant and negative INF coefficient implies that a high inflation rate in the economy leads to fewer bank NPL. A possible reason for this result could be that, during periods of high inflation, European banks increase the price of bank loans. This will discourage borrowers from borrowing and lead to a fall in loan demand. The resulting reduction in the demand for bank loans will decrease bank lending, reduce credit risk and decrease the size of NPL (Umar and Sun, 2018).

Meanwhile, the BLL, UNEMP, EX and RIR variables are not consistently robust as they report mixed significance in the result reported in columns 1, 2, and 3. The DBP variable is statistically significant and negatively related to the NPL variable in the fixed effect regression estimation in column 2 and is positively significant in columns 1 and 3 of table 5. The CBB variable is not significant in columns 1, 2 and 3 of table 5, implying that the number of commercial bank branches per 100,000 adults does not have a significant effect on NPL.

Table 5: Determinants of NPL: European sample regression estimation

		(1)	(2)	(3)
	Predicted sign	OLS regression estimation	Panel fixed effect estimation	2SLS estimation
		Coefficient (T-statistic)	Coefficient (T-statistic)	Coefficient (T-statistic)
c		11.624** (2.45)	36.453** (3.17)	
DBP	+/-	0.093* (1.76)	-0.354*** (-3.71)	0.133** (2.57)
CBB	+	-0.002 (-0.03)	-0.091 (-0.91)	0.029 (0.67)
BCAP	-	-2.125*** (-7.04)	-2.393*** (-6.16)	-1.941*** (-6.43)
BLL	+	0.146 (1.44)	0.108 (1.24)	0.282*** (3.24)
UNEMP	+	-0.225** (-2.24)	0.018 (0.07)	-0.174* (-1.71)
INF	+	-0.409** (-2.26)	-0.287* (-1.99)	-0.452** (-2.43)
EX	+	0.019* (1.90)	0.007 (0.16)	0.029*** (3.29)
RIR	+	-0.357* (-1.77)	-0.107 (-0.66)	-0.434** (-2.11)
LR	+	2.311*** (8.92)	2.183*** (5.39)	2.665*** (12.01)
Adjusted R^2		74.27	88.33	72.61
F-statisti[c]		28.24	24.84	
Instrument rank				10

***, **, * represent statistical significance at the 1%, 5% and 10% levels.

Source: Authors` calculations

4.3. Determinants of NPL for the African countries

The BCAP, CBB, BLL, UNEMP, INF and LR variables are significant and positively related to NPL. This indicates that the determinants of NPL in African countries are bank capital adequacy ratio, bank activity size, unemployment rate, inflation rate and bank lending rate. In contrast, the DBP, EX and RIR variables are significant and negatively related to NPL. However, when we test the robustness of the results, we observe that the results for the African countries are not robust because the variables are not statistically significant and do not report the same coefficient sign in the three estimations in table 6. For example, the BCAP

and BLL variables are statistically significant and positively related to the NPL variable in columns 1 and 3 and are insignificant in column 2 of table 6. The INF variable is statistically significant in columns 1 and 3 and is insignificant in column 2, indicating that the result is not robust, hence, no meaningful conclusion can be drawn. The DBP, CBB, UNEMP, EX, RIR and LR variables are statistically significant in column 2 and are insignificant in columns 1 and 3, indicating that the results are not robust, hence, no meaningful conclusion can be drawn.

Table 6: Determinants of NPL: African sample regression estimation

		(1)	(2)	(3)
	Predicted sign	OLS regression estimation	Panel fixed effect estimation	2SLS estimation
		Coefficient (T-statistic)	Coefficient (T-statistic)	Coefficient (T-statistic)
c		2.914 (1.06)	-3.051 (-0.61)	
DBP	+/-	-0.037 (-0.90)	-0.184** (-2.06)	-0.012 (-0.36)
CBB	+	0.144 (0.85)	0.837** (2.49)	0.094 (0.57)
BCAP	-	0.262* (1.75)	-0.154 (-0.79)	0.379*** (3.77)
BLL	+	0.064** (2.44)	-0.041 (-1.44)	0.079*** (3.57)
UNEMP	+	-0.077 (-1.16)	1.003*** (3.32)	-0.032 (-0.62)
INF	+	0.216** (2.31)	0.097 (0.98)	0.248*** (-2.83)
EX	+	0.0004 (0.59)	-0.005*** (-3.19)	0.0004 (0.59)
RIR	+	0.035 (0.53)	-0.105* (-1.88)	0.038 (-0.59)
LR	+	-0.038 (-0.52)	0.244** (2.06)	-0.024 (-0.32)
Adjusted R^2		20.22	54.48	20.15
F-statistic		5.22	6.28	
Instrument rank				10

The fixed effect panel regression includes both year effect and country effect. The 2SLS instrumental variables are the one-year lagged explanatory variables. Lagging the explanatory variables allows us to mitigate endogeneity issues. T-statistic is reported in parenthesis. ***, **, * represent statistical significance at the 1%, 5% and 10% levels.

Source: Authors` calculations

5. Conclusion

In this study, we investigated the determinants of NPL in European and African countries. We used data from 32 European and African countries from 2010 to 2021. The two stage least squares regression estimation results show evidence that the number of commercial bank branch, bank liquid reserves to bank assets ratio, inflation rate, exchange rate, real interest rate and the lending rate are significant determinants of NPL in the full sample. We find dissimilar results when we divide the sample into the European and African regions. In the European countries subsample, there is evidence that the Size of domestic private credit, bank capital to asset ratio, bank liquid reserve to bank asset ratio, unemployment rate, inflation rate, exchange rate, real interest rate and lending rate are significant determinants of NPL in European banks. In contrast, bank capital to asset ratio, bank liquid reserve to bank asset ratio and inflation rate in Africa are significant determinants of bank NPL in African countries.

The implication of the findings is that the determinants of bank NPL in European countries are not necessarily the drivers of bank NPL in African countries. The findings also have theoretical and practical implications for various stakeholders, including financial institution managers, regulators, analysts, and academics. From a theoretical standpoint, our results contribute to a better understanding of the dynamics of non-performing loans at a regional level, and shed light on the specific factors, both at a micro and macro level, which determine the size of NPL in the European and African banking sectors. From a practical perspective, our conclusions provide guidance to bank managers. They should exercise control over factors such as branch network size, as it could potentially increase the NPL ratio. Additionally, factors like lending interest rates, exchange rates and a bank's capital-to-assets ratio warrant the attention of policymakers to mitigate NPL risk.

However, our study has some limitations. It focuses on non-performing loans (NPL) over an 11-year period (2010 to 2021) and specifically covering Europe and Africa, which would have certain limitations. Restricting the study to Europe and Africa may limit the generalizability of the findings at a global level. Different regions, such as Asia or the Americas, may have distinct economic, cultural, and regulatory characteristics that could impact NPL dynamics differently. Moreover, focusing on a specific 11-year period may not capture long-term trends or cyclical patterns in NPL. Economic conditions, regulatory policies, and financial practices can vary over longer timeframes, and a limited time period may restrict understanding of the underlying dynamics driving NPL evolution.

Potential areas for further investigation in understanding the determinants of non-performing loans (NPL) could involve incorporating additional variables or investigating additional countries. These variables may include intangible aspects such as the presence of gender diversity in the management of banks. They may also include other factors related to the extent of awareness and adherence to environmental policies and sustainability. In terms of research methodology, future research should explore the determinants of NPL using diverse techniques, such as artificial neural networks or alternative statistical methods like structural equation modelling.

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