

Banking Sector Concentration, Profitability and Non-Performing Loans: Evidence from 93 Countries

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ABSTRACT

This paper examines the determinants of bank non-performing loans (NPLs) using an unbalanced panel of 93 countries over the period 2000–2020. Combining annual banking sector indicators from the World Bank's Global Financial Development database with macroeconomic variables, the analysis focuses on the roles of bank profitability, balance sheet structure, market concentration and the macroeconomic environment in shaping banks' credit quality. The empirical strategy relies on pooled ordinary least squares regressions, country and year fixed-effects panel models, and pooled interaction specifications that distinguish between advanced and other economies.

In pooled regressions, there is a robust negative association between banking sector profitability and NPL ratios, which remains statistically and economically significant after controlling for an extensive set of bank-level and macroeconomic variables. Additional bank characteristics - such as the credit-to-deposit ratio, net interest margins, overheads and the Z-score - are also systematically related to NPLs in the pooled cross-country analysis. In the fixed-effects framework, however, the coefficient on profitability is no longer statistically significant, and real GDP growth emerges as the key driver of within-country NPL dynamics, indicating that the profitability-NPL relationship is largely cross-sectional. Advanced economies exhibit systematically lower NPL ratios than other economies, but the marginal effects of profitability, bank structure and macroeconomic conditions on NPLs are broadly similar across the two groups. These findings highlight the joint importance of bank-specific factors and macroeconomic conditions for understanding cross-country differences and time variation in bank asset quality, while emphasizing the dominant role of the business cycle in explaining NPL dynamics within countries over time.

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The quality of banks' loan portfolios is central to financial stability and to the transmission of monetary and macroprudential policies. Episodes of sharply rising non-performing loans have featured prominently in many banking crises, often triggering credit contractions and large fiscal costs. Understanding how bank-specific characteristics and the macroeconomic environment shape the incidence of NPLs is therefore important for both prudential supervision and macroeconomic policy design. While a substantial literature has examined the determinants of NPLs in individual countries or specific regions, cross-country evidence that jointly considers bank profitability, market structure, balance sheet indicators and macroeconomic conditions over a long horizon remains relatively limited.

This paper contributes to this debate by studying the determinants of NPLs in a broad panel of 93 countries over the period 2000–2020. The empirical approach is designed to separate different

sources of variation in NPLs. Pooled ordinary least squares (OLS) regressions are used to characterize cross-sectional relationships between NPL ratios, profitability, concentration and other bank-level and macroeconomic variables. Country and year fixed-effects specifications then exploit within-country variation over time to isolate the role of macroeconomic conditions and changes in bank characteristics, controlling for time-invariant country heterogeneity and common shocks. Finally, pooled interaction models with an advanced-economy dummy allow for differences in both the average level of NPLs and the sensitivity of NPLs to bank-specific and macroeconomic factors across country groups.

By combining these elements in a single framework, the paper provides a coherent account of how bank profitability, market structure, balance sheet features and macroeconomic conditions are related to loan performance across a diverse set of banking systems. The results speak to ongoing discussions on the conditions under which higher profitability and particular balance sheet configurations are associated with improved asset quality, and on the extent to which findings from advanced economies generalize to other parts of the world.

2. LITERATURE REVIEW

This section reviews the main strands of research on non-performing loans, with a focus on macroeconomic and bank-specific determinants, the relationship between asset quality and profitability, the role of banking sector market structure, and differences between advanced and emerging economies. It then outlines how the present paper contributes to this literature.

2.1. Macroeconomic and bank-specific determinants of NPLs

A large empirical literature treats NPLs as a key indicator of banking sector fragility and macro-financial vulnerability. Cross-country and regional studies consistently find that NPLs are driven primarily by macroeconomic conditions, with bank-specific characteristics playing an important but secondary role.

For advanced economies, Nkusu (2011) documents that weaker real GDP growth, higher unemployment, increases in real interest rates and falls in asset prices are all associated with higher NPL ratios, and that adverse NPL dynamics can in turn amplify downturns. Klein (2013), focusing on Central, Eastern and South-Eastern Europe, reaches similar conclusions: macroeconomic conditions, especially growth, unemployment and exchange rates, are the main determinants of NPLs, while bank-level variables such as capital and profitability also matter but explain a smaller share of the variation.

Using a global sample, Jakubík and Piloiu (2013) show that real GDP growth is the single most important driver of NPLs, but that lending rates, equity prices and exchange rates also play a statistically and economically significant role. Beck et al. (2015) extend this analysis and confirm, for a broad set of countries, that NPLs rise when growth slows and interest rates increase, while stronger credit growth and higher asset prices are associated with lower NPL ratios. More recent work by Salas et al. (2024), combining bank-level and macroeconomic data for a large cross-country panel, reinforces the central role of cyclical conditions and financial variables while emphasizing that bank-specific factors - capitalization, cost efficiency and profitability - also significantly affect credit risk, especially in emerging markets.

At the bank level, micro-evidence typically combines macro variables with indicators of capital, liquidity, efficiency and management quality. Louzis et al. (2012), using Greek bank data, find that both macroeconomic conditions and bank-specific characteristics (capital, management efficiency, loan growth) are important determinants of NPLs across different loan categories. Messai and

Jouini (2013) reach similar conclusions for a panel of banks from Italy, Greece and Spain: weaker GDP growth and higher unemployment increase NPLs, while better capitalization and profitability are associated with lower NPL ratios. Taken together, this literature suggests that any empirical model of NPLs should control for both cyclical macroeconomic conditions and key bank-specific indicators.

2.2. Profitability and the NPL-performance nexus

A second strand of research examines the two-way relationship between asset quality and bank profitability. Theoretically, high NPLs reduce interest income, increase provisioning needs and erode capital, thereby weakening profitability; at the same time, chronically low profitability can incentivize banks to relax credit standards or shift towards riskier portfolios, raising future NPLs.

Empirically, many studies document a strong negative association between NPLs and profitability. Psaila et al. (2019) demonstrate that for listed Euro-Mediterranean commercial banks, higher NPL ratios are significantly associated with lower returns on assets and equity, even after controlling for solvency and liquidity ratios. Country-specific studies for a range of emerging economies also report that increases in NPLs tend to depress profitability indicators, while better-performing banks exhibit lower NPL ratios, consistent with both direct earnings effects and better risk management.

More recently, Ameer (2024) examines Tunisian banks and models NPLs as a function of both macroeconomic and bank-specific variables, including profitability. The results indicate that lower profitability is associated with higher NPL ratios, and that NPLs themselves feedback negatively into future profitability, pointing to a recursive link between loan quality and bank performance. Ozili (2019), in a global study of financial development and NPLs, similarly finds that low bank profitability is one of several financial sector characteristics associated with higher NPLs.

These findings motivate the inclusion of profitability as a central explanatory variable in NPL regressions. In particular, they suggest that system-wide measures such as aggregate return on assets can serve as useful summary indicators of the health and risk-return profile of banking systems.

2.3. Banking sector concentration, competition and credit risk

The role of banking sector market structure in shaping risk-taking and asset quality has been debated extensively in the banking and industrial organization literature. The “competition-fragility” view, associated with Keeley (1990), posits that more intense competition erodes banks’ charter values and encourages greater risk-taking, especially in the presence of mispriced deposit insurance. By contrast, the “competition-stability” view, formalized by Boyd and De Nicolò (2005), argues that greater market power can lead banks to charge higher lending rates, inducing borrowers to take on riskier projects and raising default probabilities.

Empirical work on competition, concentration and bank risk generally finds mixed or context-dependent effects. Studies using bank-level risk measures, such as Z-scores or distance-to-default, often identify non-linearities in the competition-risk relationship and emphasize the importance of institutional and regulatory backgrounds. More recently, Yagli (2021) brings this debate closer to credit risk by examining NPLs and bank competition in a panel of 52 countries. Using both structural (Boone indicator, Lerner index) and non-structural (concentration ratios) measures, the paper finds that higher market power, as captured by pricing-based indicators, is associated with lower NPLs, whereas simple concentration ratios have limited explanatory power for NPLs once other factors are controlled for. Yagli also shows that the impact of competition and concentration on credit risk differs across country groups, suggesting that institutional context matters.

A key implication of this literature is that concentration and competition are conceptually distinct: concentration ratios describe the distribution of market shares, while competition relates

more directly to conduct and pricing. As a result, many empirical studies treat concentration as a control variable and focus on competition indices derived from prices or revenues. This leaves comparatively less systematic evidence on how simple, system-level measures of concentration, such as the asset share of the three largest banks, relate to aggregate NPL ratios in a broad cross-country setting.

2.4. Advanced versus emerging economies and cross-country heterogeneity

A further set of studies explicitly compares NPL determinants across advanced and emerging economies, or across country groups. Nkusu (2011), focusing on advanced economies, highlights the importance of macro-financial linkages and feedback effects from NPLs to the macroeconomy. Klein (2013) shows that in Central, Eastern and South-Eastern Europe, macroeconomic vulnerabilities and bank-specific weaknesses jointly explain high NPL ratios, with significant implications for growth.

Chaibi and Ftiti (2015) compare the determinants of credit risk in bank-based and market-based financial systems (Germany and France) and find that macroeconomic factors and bank-specific variables both play important roles, but that their relative importance differs across systems. Kuzucu and Kuzucu (2019) analyze the impact of emerging and advanced economies on non-performing loans (NPLs) before and after the global financial crisis, concluding that real GDP growth remains the primary driver of NPLs in both groups, while factors such as exchange rate movements and capital flows are relatively more significant in emerging markets.

Survey work by Ozili (2019, 2025) reviews this cross-country literature and notes that, while substantial progress has been made in identifying macro and bank-specific determinants of NPLs, less attention has been paid to the systematic role of structural banking characteristics, such as financial development, ownership structures or market concentration, and to how these characteristics interact with NPLs across different income and institutional groups. These reviews explicitly call for more cross-country studies that integrate structural banking variables with macro-financial determinants and that compare advanced and developing banking systems within a unified empirical framework.

The paper adds to existing research by providing a simple, transparent cross-country characterization of how banking sector concentration and profitability relate to NPLs, and how these relationships vary between advanced and other economies. This complements more granular bank-level studies and offers a system-wide perspective that is directly relevant for debates on consolidation, competition and financial stability.

3. METHODOLOGY

3.1. Data and variables

The empirical analysis is based on an unbalanced panel of annual observations for 93 countries over the period 2000-2020. The panel is defined at the country-year level and combines banking sector indicators from the World Bank Global Financial Development database (2025) and with macroeconomic variables from World Bank World Development Indicators (2025). All series are expressed at an annual frequency. The panel is unbalanced because data availability differs across countries and indicators; all regressions use all available observations with non-missing values for the variables included in the respective specification.

The main dependent variable is the ratio of bank non-performing loans to gross loans (NPL), expressed in percent. This indicator measures the share of loans that are past due or otherwise impaired and is widely used as a summary measure of banking sector credit quality.

The first explanatory variable of interest is banking sector concentration (CONC), measured as the percentage of total banking sector assets held by the three largest banks in each country. This variable proxies the degree of market concentration and the potential for market power in the banking system. The second key explanatory variable is the banking sector return on assets (ROA), defined as after-tax profits divided by total assets, expressed in percent. ROA is used as a bank-specific measure of profitability and, indirectly, of the underlying risk–return profile of the system.

To account for additional aspects of banks’ balance sheet structure and risk, a set of bank-level control variables is included. These controls comprise the ratio of bank capital to total assets (CAP_TA), the cost-to-income ratio (COST_INC), the ratio of bank credit to bank deposits (CRED_DEP), the net interest margin (NIM), bank overhead costs to total assets (OVER_TA), the ratio of regulatory capital to risk-weighted assets (REG_CAP) and the bank Z-score (ZSCORE), which is an inverse measure of insolvency risk. All bank variables are constructed as sector-wide aggregates at the country level.

The macroeconomic environment is captured by real GDP growth (GDP_GROWTH), the interest rate spread between lending and deposit rates (INT_SPREAD), the real interest rate (REAL_INT) and the unemployment rate (UNEMP). These variables are introduced as additional controls to capture the influence of the business cycle and financial conditions on credit quality.

For the cross-country comparison between advanced and other economies, a categorical variable is constructed based on standard classifications of high-income and advanced economies. Countries commonly classified as high-income or advanced (Western European economies, North America, Japan, and a small number of Asian and European financial centres) are assigned to an “advanced” group, while all remaining countries are classified as “other” economies. A dummy variable ADVc is set equal to one for advanced economies and zero otherwise. This dummy is used both in the descriptive statistics and to allow for differential intercepts and slopes in the regression analysis.

3.2. Baseline pooled regressions

The econometric analysis proceeds in two main steps. The first step estimates a sequence of pooled ordinary least squares (OLS) models that relate the NPL ratio to measures of banking sector concentration and profitability, progressively adding bank-level and macroeconomic controls. In the pooled specifications, the panel is treated as a simple collection of cross-sectional country-year observations. Standard errors are computed using the conventional OLS formula.

The baseline pooled specification relates NPLs to banking sector concentration and profitability according to the following model:

$$NPL_{c,t} = \alpha + \beta_1 CONC_{c,t} + \beta_2 ROA_{c,t} + \varepsilon_{c,t} \quad (1)$$

where $NPL_{c,t}$ denotes the non-performing loan ratio in country c and year t , $CONC_{c,t}$ is the banking sector concentration, $ROA_{c,t}$ is the return on assets, and $\varepsilon_{c,t}$ is an error term capturing all other influences. As a benchmark, a version of this model including only $CONC_{c,t}$ as regressor is also estimated in order to assess the unconditional relationship between market concentration and loan quality.

To account for additional bank-level characteristics and the macroeconomic environment, the baseline specification is extended by including the vectors of bank controls $B_{c,t}$ and macro controls $M_{c,t}$:

$$NPL_{c,t} = \alpha + \beta_1 CONC_{c,t} + \beta_2 ROA_{c,t} + \gamma B_{c,t} + \delta M_{c,t} + \varepsilon_{c,t} \quad (2)$$

In equation (2), $B_{c,t}$ collects the bank-level controls (CAP_TA, COST_INC, CRED_DEP, NIM, OVER_TA, REG_CAP, ZSCORE), and $M_{c,t}$ collects the macroeconomic variables (GDP_GROWTH, INT_SPREAD, REAL_INT, UNEMP). The coefficients γ and δ capture the marginal effects of bank structure and macroeconomic conditions on NPLs, conditional on concentration and profitability. All pooled regressions are estimated on the largest available sample, using all observations with non-missing values for the variables appearing in the specification.

3.3. Fixed-effects panel regressions

The pooled OLS models do not control for unobserved country-specific characteristics or for common shocks affecting many banking systems simultaneously. To address these issues, a fixed-effects panel specification with country dummies and year dummies is estimated. This model exploits only within-country variation over time in concentration, profitability and the control variables to explain changes in NPLs.

The fixed-effects specification takes the form

$$NPL_{c,t} = \alpha_c + \lambda_t + \beta_1 CONC_{c,t} + \beta_2 ROA_{c,t} + \gamma B_{c,t} + \delta M_{c,t} + u_{c,t} \quad (3)$$

where α_c denotes a full set of country-specific intercepts capturing time-invariant characteristics of each banking system (such as institutional quality, legal origin or long-run regulatory regimes), λ_t denotes a full set of year dummies capturing global or widespread shocks, and $u_{c,t}$ is an idiosyncratic error term. The coefficients β_1 and β_2 now measure the average within-country effect of changes in concentration and profitability on changes in NPLs, conditional on the controls and fixed effects. Equation (3) is estimated by OLS with country and year dummy variables explicitly included. Standard errors are adjusted for clustering at the country level to allow for arbitrary serial correlation and heteroskedasticity within countries over time.

3.4. Heterogeneity between advanced and other economies

To investigate whether the determinants of NPLs differ systematically between advanced and other economies, the pooled specification is augmented with the ADV dummy and interaction terms between ADV and the main explanatory variables. This allows both the intercept and the slopes of the NPL equation to vary across the two country groups.

The interaction model is specified as follows:

$$NPL_{c,t} = \alpha + \beta_1 CONC_{c,t} + \beta_2 ROA_{c,t} + \gamma B_{c,t} + \delta M_{c,t} + \theta ADV_c + ADV_c \times (\beta_3 CONC_{c,t} + \beta_2 ROA_{c,t} + \gamma_{ADV} B_{c,t} + \delta_{ADV} M_{c,t}) + \varepsilon_{c,t} \quad (4)$$

In equation (4), ADV_c equals one for advanced economies and zero otherwise. The coefficient θ captures the difference in the conditional average level of NPLs between advanced and other economies, holding the explanatory variables constant. The interaction terms between ADV_c and the regressors allow the marginal effects of concentration, profitability, bank structure and macroeconomic conditions on NPLs to differ across country groups. For example, the marginal effect of ROA on NPLs is β_2 for other economies ($ADV_c = 0$) and $\beta_2 + \beta_4$ for advanced economies ($ADV_c = 1$). The interaction model is estimated by pooled OLS on the full sample of country-year observations with non-missing values for all variables in the specification, using conventional standard errors.

3.5. Treatment of missing data, outliers and robustness

Throughout the empirical work, the panel is treated as unbalanced. For each specification, all available country-year observations with non-missing values for the variables appearing in that specification are retained. No additional transformations or winsorisation of the NPL series are applied, so the estimates reflect the full dispersion of NPL ratios, including episodes of severe banking distress. This choice preserves information on crisis dynamics at the cost of greater sensitivity to extreme observations. Robustness checks based on trimming or winsorising the most extreme NPL observations, as well as alternative sets of controls and lag structures, can be implemented as extensions to the baseline results without altering the structure of the empirical model.

4. ANALYSIS AND FINDINGS

4.1. Descriptive statistics

The empirical analysis is based on an unbalanced panel of 93 countries observed over the period 2000–2020. The panel is defined at the country-year level and combines annual banking sector indicators from the World Bank’s Global Financial Development database with a set of macroeconomic variables and a country classification into advanced versus other economies.

The dependent variable is the ratio of bank non-performing loans to gross loans (NPL), expressed in percent. Bank-level explanatory variables include the after-tax return on assets (ROA), the ratio of bank capital to total assets (CAP_TA), the cost-to-income ratio (COST_INC), the ratio of bank credit to bank deposits (CRED_DEP), the net interest margin (NIM), bank overhead costs to total assets (OVER_TA), the ratio of regulatory capital to risk-weighted assets (REG_CAP) and the bank Z-score (ZSCORE). Macroeconomic controls comprise real GDP growth (GDP_GROWTH), the interest rate spread between lending and deposit rates (INT_SPREAD), the real interest rate (REAL_INT) and the unemployment rate (UNEMP).

Across all available observations, the mean NPL ratio is approximately 6.4%, with a median of 3.7% and a wide dispersion (interquartile range 2.0–8.3%, maximum around 74%). This confirms that the dataset covers both tranquil periods and episodes of severe banking distress. Average ROA is around 1.2%, with a pronounced left tail reflecting years of substantial losses in some banking systems. The average capital-to-assets ratio is close to 9.6%, and the average Z-score is about 16.3, pointing to substantial cross-country heterogeneity in bank solvency and stability.

The cross-country comparison reveals systematic differences between the two groups. The mean NPL ratio is about 3.8% in advanced economies and 8.0% in other economies, while the median NPL is just above 2% in advanced economies compared with around 5% in other economies. Thus, both the level and dispersion of NPLs are lower in the advanced group. Average ROA is lower in advanced economies (around 0.65%) than in other economies (around 1.46%), and net interest margins are narrower (roughly 1.9% versus 5.5%), consistent with more competitive and efficient banking systems. At the same time, credit-to-deposit ratios tend to be higher in advanced economies (around 122% compared with 96% in other economies), suggesting more extensive financial intermediation. Average capital-to-assets ratios are somewhat lower in advanced systems (about 7.3% versus 11.1%), which may reflect more diversified portfolios and lower underlying risk.

Table 1 presents descriptive statistics for the variables used in the empirical analysis. The table is divided into two panels.

Panel A of **Table 1** reports statistics for the full sample of country-year observations. For each variable, the panel shows the number of observations, mean, standard deviation, minimum, first

quartile, median, third quartile and maximum. The sample includes up to 1,950 country–year observations for 93 countries over the period 2000–2020, with the exact number of observations differing by variable due to missing data.

Table 1: Descriptive statistics

Panel A. Full sample

Variable	N	Mean	Std. Dev.	Min	P25	Median	P75	Max
NPL	1809	6.41	7.13	0.10	1.95	3.70	8.30	74.10
ROA	1883	1.18	1.94	-23.89	0.59	1.10	1.73	38.30
CAP_TA	1738	9.64	3.65	1.49	6.97	9.28	11.80	30.60
COST_INC	1875	57.39	14.02	5.03	49.33	57.08	64.37	237.05
CRED_DEP	1871	105.06	50.72	10.67	73.78	96.29	123.96	598.15
NIM	1866	4.24	2.88	0.15	2.15	3.45	5.87	21.36
OVER_TA	1882	3.41	3.36	0.05	1.54	2.49	4.58	84.34
REG_CAP	1823	16.48	4.66	1.75	13.30	15.91	18.40	48.60
ZSCORE	1898	16.32	9.71	-0.33	9.36	14.81	20.24	66.27
GDP_GROWTH	1905	3.24	3.94	-21.40	1.57	3.28	5.39	26.52
INT_SPREAD	1151	7.01	6.56	-3.60	3.23	5.34	8.43	55.80
REAL_INT	1265	6.20	8.79	-53.64	2.12	4.83	9.26	93.92
UNEMP	1908	8.03	5.95	0.25	3.97	6.21	10.03	37.32

Notes: Panel A reports descriptive statistics for the full sample of country–year observations

Panel B. Means by country group

Variable	N_ADV	Mean_ADV	Std_ADV	N_OTHER	Mean_OTHER	Std_OTHER
NPL	665	3.75	5.37	1144	7.96	7.56
ROA	660	0.65	1.96	1223	1.46	1.86
CAP_TA	652	7.29	2.57	1086	11.05	3.46
COST_INC	658	58.55	14.93	1217	56.76	13.46
CRED_DEP	640	121.97	59.01	1231	96.27	43.32
NIM	653	1.91	1.06	1213	5.50	2.76
OVER_TA	661	1.67	1.03	1221	4.35	3.78
REG_CAP	682	15.31	4.06	1141	17.19	4.85
ZSCORE	668	15.71	9.56	1230	16.65	9.78
GDP_GROWTH	672	2.20	3.55	1233	3.81	4.03
INT_SPREAD	188	2.95	1.52	963	7.80	6.86
REAL_INT	266	3.29	2.73	999	6.98	9.65
UNEMP	672	7.38	4.09	1236	8.37	6.73

Notes: Panel B reports means and standard deviations separately for advanced and other economies

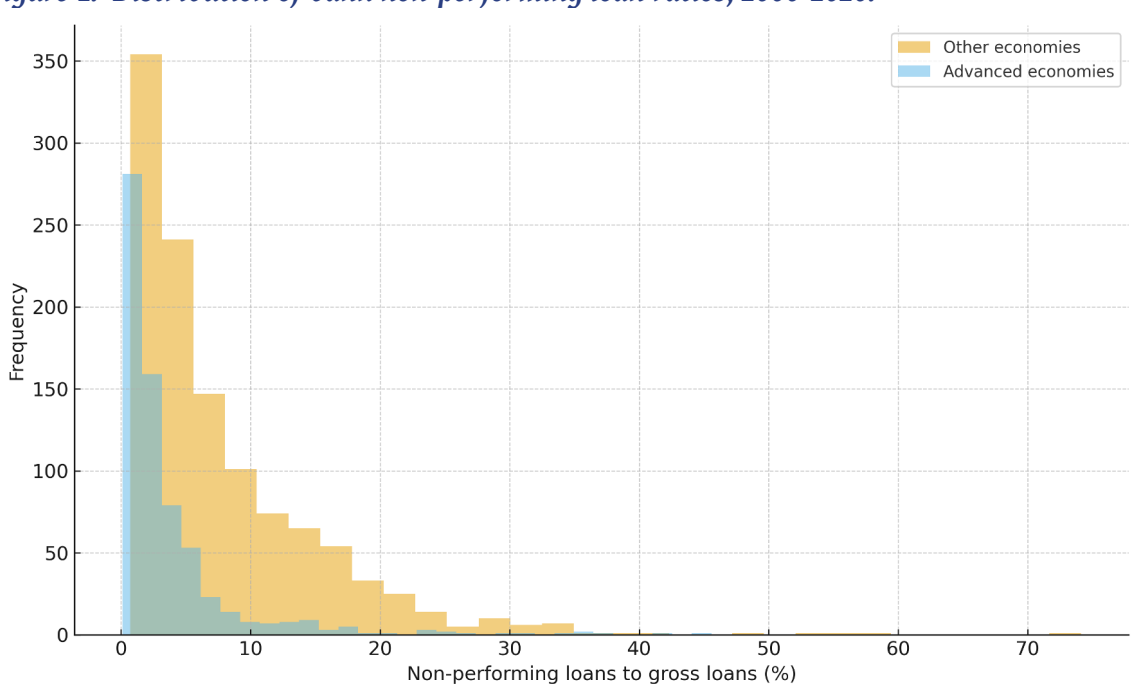
Source: Author's calculation

For the non-performing loan (NPL) ratio, the mean in Panel A is about 6.4%, with a median of 3.7% and a wide range extending from close to zero to more than 70%. Bank profitability (ROA) averages around 1.2%, with a left-skewed distribution reflecting episodes of large losses. Capitalization (CAP_TA) has an average of about 9.6%, while the credit-to-deposit ratio (CRED_DEP) averages around 105%, indicating that, on average, credit slightly exceeds the deposit base. Net interest margins (NIM) average roughly 4.2%, with substantial dispersion. Overheads-to-assets (OVER_TA) and regulatory capital-to-RWA (REG_CAP) also display wide variation across banking systems. The Z-score, used as an inverse measure of insolvency risk, has a mean of about 16.3. On the macro side, real GDP growth averages about 3.2%, real interest rates around 6.2% and unemployment about 8.0%, all with sizeable variability.

Panel B of [Table 1](#) compares mean values and standard deviations for advanced and other economies. For each variable, the panel reports separate sample sizes, means and standard deviations for the advanced group (ADV = 1) and the group of other economies (ADV = 0).

Panel B shows that NPL ratios are lower in advanced economies: the mean NPL is around 3.8% in advanced economies and 8.0% in other economies. Advanced economies also exhibit narrower net interest margins (around 1.9% versus 5.5% in other economies) and lower overheads-to-assets ratios (about 1.7% versus 4.4%). At the same time, banks in other economies have higher capital-to-assets and regulatory capital ratios, whereas banks in advanced economies tend to have higher credit-to-deposit ratios, consistent with more extensive financial intermediation. On the macro side, advanced economies are characterized by lower average real GDP growth but slightly lower unemployment. The differences in means reported in Panel B suggest that banking structures and macroeconomic environments differ systematically between the two groups, which motivates the use of the ADV dummy and interaction terms in the regression analysis.

Figure 1: Distribution of bank non-performing loan ratios, 2000-2020.



Source: Author's calculation

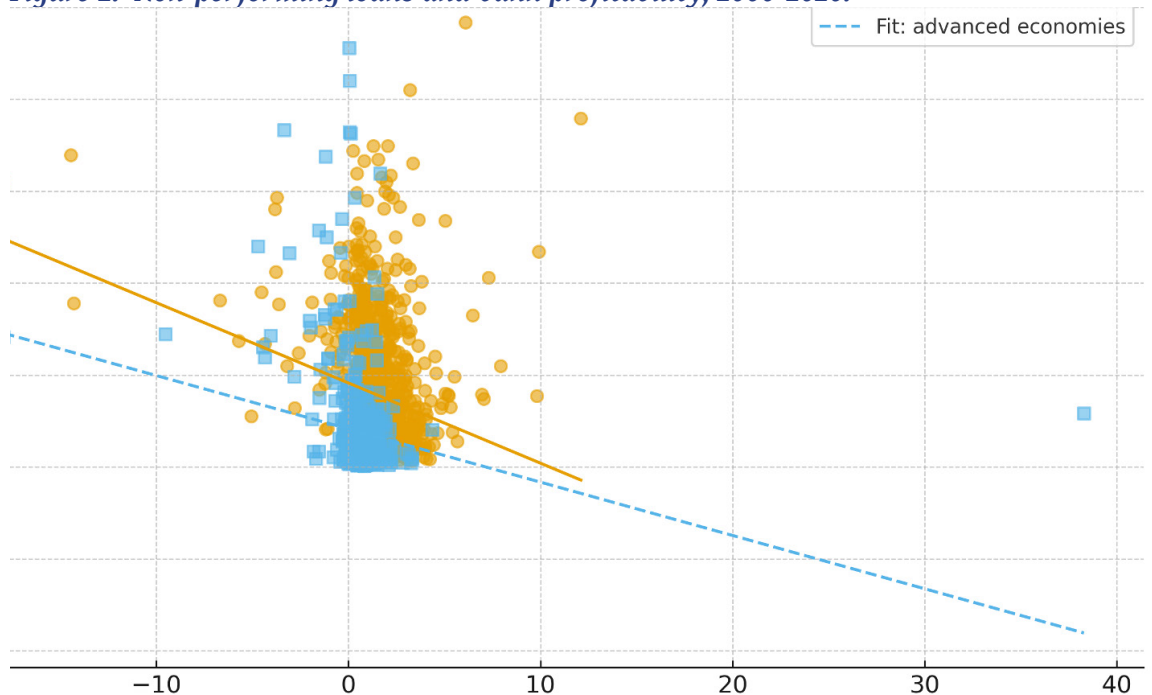
[Figure 1](#) shows the distribution of bank non-performing loan (NPL) ratios over the period 2000-2020, separately for advanced and other economies. The histograms indicate that, in both groups, the distribution of NPLs is right-skewed, with most observations clustered at relatively low levels and a tail of higher values associated with episodes of banking stress.

The figure highlights clear differences between the two country groups. In advanced economies, the bulk of the distribution is concentrated at low NPL ratios, with most observations lying below 5% and relatively few cases above 10%. By contrast, in other economies the distribution is more dispersed and shifted to the right, with a larger share of observations in the 5-15% range and a sizeable tail extending to much higher NPL ratios. This visual evidence is consistent with the summary statistics in [Table 1](#), where mean and median NPL ratios are lower in advanced economies and the upper tail of the distribution is longer in the group of other economies.

[Figure 2](#) plots the ratio of non-performing loans to gross loans against the banking sector return on assets for all country-year observations in the sample, distinguishing between advanced and

other economies. Each point represents a country-year pair, and separate fitted linear regression lines are shown for the two country groups.

Figure 2: Non-performing loans and bank profitability, 2000-2020.



Source: Author's calculation

The scatter suggests a clear negative association between profitability and NPLs in both groups. Observations with higher ROA tend to be associated with lower NPL ratios, while higher NPL ratios are more frequently observed when profitability is weak or negative. The fitted lines for advanced and other economies are both downward sloping and relatively similar in steepness, indicating that the marginal relationship between ROA and NPLs does not differ markedly across the two groups.

At the same time, the cloud of points for advanced economies is concentrated in a region with lower NPL ratios and somewhat lower ROA, whereas the cloud for other economies is more dispersed and extends to both higher NPLs and higher profitability. This pattern is consistent with the descriptive statistics from Table 1: advanced economies have, on average, cleaner loan portfolios but somewhat lower average profitability, while other economies exhibit a wider range of outcomes on both dimensions.

4.2. Baseline pooled regressions

The analysis starts from pooled ordinary least squares (OLS) models that relate NPLs to banking sector profitability and, progressively, to an expanded set of bank-specific and macroeconomic variables. The pooled regressions treat the panel as a simple cross-section of country-year observations and report conventional OLS standard errors. In each specification, the sample is restricted to observations with non-missing values for the variables included in that specification.

Table 2 reports pooled ordinary least squares estimates of the relationship between the ratio of non-performing loans to gross loans (NPL) and a set of banking sector and macroeconomic variables. The dependent variable in all columns is NPL. The table contains three specifications that progressively expand the set of regressors and illustrate how the inclusion of bank-level and macro controls affects the estimated relationship between profitability and credit quality.

Table 2: Pooled OLS regressions (dependent variable: NPL)

	(1)	(2)	(3)
ROA	-0.528*** (0.084)	-0.721*** (0.106)	-1.015*** (0.179)
Capital to assets		0.088 (0.070)	-0.022 (0.096)
Cost-to-income		-0.027* (0.014)	-0.055*** (0.018)
Credit-to-deposits		-0.025*** (0.004)	-0.040*** (0.006)
Net interest margin		0.420*** (0.084)	0.502*** (0.111)
Overheads to assets		0.106* (0.061)	0.130** (0.065)
Reg. capital to RWA		-0.002 (0.046)	0.081 (0.066)
Z-score		-0.123*** (0.017)	-0.128*** (0.024)
GDP growth			0.002 (0.059)
Interest rate spread			-0.036 (0.051)
Real interest rate			0.022 (0.036)
Unemployment			0.100*** (0.034)
Observations	1748	1547	936
R-squared	0.022	0.123	0.151

Note(s): The table reports pooled ordinary least squares estimates of the relationship between the ratio of non-performing loans to gross loans (NPL) and banking sector characteristics and macroeconomic variables. Standard errors are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Source: Author's calculation

In column (1), NPL is regressed only on the banking sector return on assets (ROA). The estimated coefficient on ROA is negative and statistically significant at the 1% level. In magnitude, the estimate implies that a one percentage point increase in ROA is associated with a reduction in the NPL ratio of roughly half a percentage point. The R-squared is relatively low, indicating that profitability alone explains only a small fraction of the cross-sectional and time-series variation in NPLs. Nevertheless, the sign and statistical significance of the coefficient provide initial evidence of an inverse association between profitability and the incidence of non-performing loans.

In column (2), the specification is extended to include the full set of bank-level controls (capital to assets, cost-to-income ratio, credit-to-deposits ratio, net interest margin, overheads-to-assets ratio, regulatory capital-to-RWA and the Z-score). Once these controls are added, the coefficient on ROA becomes more negative and remains statistically significant at conventional levels. This suggests that the negative association between profitability and NPLs is not driven by omitted variation in other observable bank characteristics. Several of the bank controls themselves display significant coefficients. The credit-to-deposits ratio enters with a negative coefficient, indicating that banking systems with higher credit relative to deposits tend to record lower NPL ratios, conditional on other factors. The net interest margin is positively associated with NPLs, consistent with higher margins being correlated with higher credit risk or lower competition. The Z-score is negatively related to NPLs, indicating that more stable banking systems, as measured by this summary indicator, tend to exhibit lower non-performing loan ratios. Overheads-to-assets enter with a positive coefficient,

suggesting that higher operating costs relative to assets are associated with worse loan performance. The inclusion of these bank-level regressors increases the explanatory power of the model, as reflected in a higher R-squared.

In column (3), the set of regressors is further augmented with macroeconomic variables: real GDP growth, the interest rate spread, the real interest rate and the unemployment rate. The sample size in this specification is smaller because macro variables, in particular interest rate indicators, are not available for all country-year observations. In this enlarged model, the coefficient on ROA remains negative and statistically significant and tends to be somewhat larger in absolute value than in column (2), indicating that, conditional on both bank structure and macroeconomic conditions, higher profitability is associated with lower NPL ratios. The signs and significance of the main bank-level controls are broadly preserved. Among the macro variables, the unemployment rate is the most robust predictor of NPLs, with a positive and statistically significant coefficient: higher unemployment is associated with higher ratios of non-performing loans, conditional on bank characteristics. The coefficients on real GDP growth, the interest rate spread and the real interest rate are typically not statistically significant once bank-level indicators are included. Compared with column (2), the R-squared rises only modestly, suggesting that bank-specific factors account for a larger share of the variation in NPLs than the macro controls included here.

Taken together, the results in [Table 2](#) indicate that the negative association between banking sector profitability and NPLs is a robust feature of the data and is not driven by simple compositional differences in bank structure or macroeconomic conditions. The additional bank-level variables make a non-negligible contribution to explaining cross-country differences in NPLs, while the macroeconomic environment, in particular labor market conditions, plays a secondary but still visible role in the pooled regressions.

4.3. Panel fixed-effects regressions

The pooled specifications do not control for unobserved country-specific characteristics or for common shocks that affect many banking systems simultaneously. To address these issues, a panel-data model with country fixed effects and year dummies is estimated. The fixed-effects specification is given by:

$$NPL_{c,t} = \alpha_c + \lambda_t + \beta_{ROA} ROA_{c,t} + \gamma B_{c,t} + \delta M_{c,t} + u_{c,t} \quad (5)$$

where α_c denotes a full set of country-specific intercepts, λ_t is a full set of year dummies, and $u_{c,t}$ is an idiosyncratic error term. The slope coefficients are estimated by OLS with country and year dummy variables explicitly included, and standard errors are clustered at the country level to allow for arbitrary forms of serial correlation and heteroskedasticity within countries over time. The set of regressors $B_{c,t}$ and $M_{c,t}$ is the same as in the third pooled specification, and the estimation sample consists of 936 observations for the subset of countries and years with complete data.

[Table 3](#) presents estimates from a fixed-effects panel regression of the ratio of non-performing loans to gross loans (NPL) on banking sector characteristics and macroeconomic variables. The specification includes country fixed effects and year fixed effects, so the coefficients are identified from within-country variation over time, after controlling for time-invariant country-specific factors and common shocks in each year. Standard errors are clustered at the country level to allow for arbitrary correlation of the residuals within countries over time.

The set of regressors in [Table 3](#) mirrors that of the most comprehensive pooled specification: banking sector profitability (ROA), the bank-level control variables (capital-to-assets, cost-to-income ratio, credit-to-deposits ratio, net interest margin, overheads-to-assets ratio, regulatory

capital-to-RWA and the Z-score) and the macroeconomic controls (real GDP growth, interest rate spread, real interest rate and unemployment).

Table 3: Fixed-effects panel regressions (dependent variable: NPL)

	(1)
ROA	-0.219 (0.245)
Capital to assets	-0.109 (0.200)
Cost-to-income	0.004 (0.028)
Credit-to-deposits	-0.059* (0.030)
Net interest margin	-0.143 (0.210)
Overheads to assets	0.072 (0.051)
Reg. capital to RWA	-0.188 (0.128)
Z-score	-0.078 (0.081)
GDP growth	0.341*** (0.094)
Interest rate spread	-0.036
Real interest rate	0.009
Unemployment	0.168
Observations	936
Number of countries	60
R-squared	0.641
Country fixed effects	Yes
Year fixed effects	Yes

Note(s): The table reports estimates from a country and year fixed-effects regression of the ratio of non-performing loans to gross loans (NPL) on banking sector characteristics and macroeconomic variables. The specification includes country dummies and year dummies (not reported). Standard errors clustered at the country level are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Source: Author's calculation

A first result is that, once country and year fixed effects are included, the coefficient on ROA is no longer statistically significant. Its sign remains negative, but the magnitude is smaller than in the pooled regressions and the standard error is large relative to the point estimate. This suggests that the strong negative association between profitability and NPLs found in the pooled OLS models is mainly driven by persistent cross-country differences in average profitability and credit quality, rather than by systematic co-movement within countries over time.

Among the bank-level controls, only the credit-to-deposits ratio retains some explanatory power in the fixed-effects framework. Its coefficient is negative and weakly significant, indicating that, within a given country, increases in credit relative to deposits are associated with modest declines in NPLs, conditional on the other controls and fixed effects. The remaining bank variables (capital-to-assets, cost-to-income, net interest margin, overheads-to-assets, regulatory capital-to-RWA and the Z-score) typically have signs consistent with the pooled results but are not statistically significant at conventional levels in this specification. This pattern suggests that much of the variation in these bank characteristics is cross-sectional and is already absorbed by the country fixed effects.

By contrast, the macroeconomic environment emerges as a key driver of within-country NPL dynamics. The coefficient on real GDP growth is strongly negative and statistically significant, implying that higher output growth is associated with lower NPL ratios within countries over time. The magnitude of the estimated effect indicates that a one percentage point increase in real GDP growth is associated with a reduction in NPLs of roughly one-third of a percentage point, holding other factors constant. This result is consistent with the view that NPLs are strongly countercyclical and respond to the state of the business cycle. The coefficients on the unemployment rate, the interest rate spread and the real interest rate are not statistically significant once GDP growth, bank variables and fixed effects are included, suggesting that their incremental contribution over and above the growth rate is limited in this specification.

The overall R-squared in Table 3 is relatively high, reflecting the combined explanatory power of the fixed effects and the included regressors. The country and year dummies capture a large portion of the variation in NPLs, and the remaining variation is explained primarily by movements in real GDP growth and, to a lesser extent, by changes in the credit-to-deposits ratio. Taken together, the fixed-effects results indicate that business cycle conditions are the dominant determinant of NPL dynamics within countries, whereas the role of profitability and other bank structural indicators is mainly to explain cross-country differences in average NPL levels rather than short-run fluctuations.

4.4. Advanced versus other economies: interaction model

To examine whether the determinants of NPLs differ systematically between advanced and other economies, the pooled regression with bank and macro controls is augmented with a dummy variable for advanced economies (ADV) and interaction terms between this dummy and the explanatory variables. The resulting specification is:

$$NPL_{c,t} = \alpha + \beta_{ROA} ROA_{c,t} + \gamma B_{c,t} + \delta M_{c,t} + \theta ADV_c + ADV_c \times (\theta_{ROA} ROA_{c,t} + \gamma_{ADV} B_{c,t} + \delta_{ADV} M_{c,t}) + \epsilon_{c,t} \quad (6)$$

where ADV_c equals one for advanced economies and zero otherwise. This specification allows both the intercept and the slopes with respect to the bank and macro variables to differ across country groups. Estimation is carried out by pooled OLS on the same sample of 936 observations used in the third specification of [Table 2](#), and conventional standard errors are reported.

[Table 4](#) reports estimates from a pooled ordinary least squares regression of the ratio of non-performing loans to gross loans (NPL) on banking sector characteristics and macroeconomic variables, allowing the relationship to differ between advanced and other economies. The specification is based on the most comprehensive pooled model and adds an indicator for advanced economies (ADV) and interaction terms between ADV and all explanatory variables. ADV is defined as a dummy equal to one for countries classified as advanced and zero for all other countries.

The ADV dummy captures differences in the average level of NPLs between advanced and other economies, conditional on the explanatory variables. Its coefficient in [Table 4](#) is negative and statistically significant, indicating that, for given values of banking sector and macroeconomic variables, advanced economies tend to have lower NPL ratios than other economies. The magnitude of the point estimate implies that conditional NPL levels in advanced economies are lower by several percentage points on average, which is consistent with the descriptive evidence from [Table 1](#).

The main coefficient on ROA in [Table 4](#) measures the effect of profitability on NPLs for the group of other economies ($ADV = 0$). This coefficient is negative and statistically significant, implying that higher bank profitability is associated with lower NPL ratios in that group. The interaction

term between ADV and ROA captures the difference in the ROA-NPL relationship between advanced and other economies. In the estimates, this interaction term is not statistically significant, and its magnitude is small relative to the main effect. This indicates that the slope of the NPL equation with respect to ROA is broadly similar in advanced and other economies: in both groups, higher profitability is associated with lower NPL ratios, and the size of this effect does not differ in a statistically meaningful way.

Table 4: Pooled interaction regressions (dependent variable: NPL)

	(1)
ADV dummy	-12.166** (5.783)
ROA	-0.958*** (0.179)
Capital to assets	-0.154 (0.102)
Cost-to-income	-0.047* (0.025)
Credit-to-deposits	-0.041*** (0.006)
Net interest margin	0.280** (0.116)
Overheads to assets	0.111* (0.067)
Reg. capital to RWA	0.138** (0.069)
Z-score	-0.129*** (0.025)
GDP growth	-0.032 (0.060)
Interest rate spread	-0.057 (0.051)
Real interest rate	0.019 (0.035)
Unemployment	0.065* (0.034)
ADV × ROA	-0.117 (1.558)
ADV × Capital to assets	0.255 (0.466)
ADV × Cost-to-income	0.024 (0.048)
ADV × Credit-to-deposits	0.034* (0.017)
ADV × Net interest margin	-0.249 (0.909)
ADV × Overheads to assets	-0.290 (1.113)
ADV × Reg. capital to RWA	-0.157 (0.345)

ADV × Z-score	0.167* (0.087)
ADV × GDP growth	0.101 (0.240)
ADV × Interest rate spread	-0.352 (0.587)
ADV × Real interest rate	0.231 (0.267)
ADV × Unemployment	0.208 (0.431)
Observations	936
R-squared	0.203

Note(s): The table reports pooled ordinary least squares estimates of the relationship between the ratio of non-performing loans to gross loans (NPL) and banking sector characteristics and macroeconomic variables, allowing for differences between advanced and other economies. ADV is a dummy equal to one for advanced economies and zero otherwise. Interaction terms are defined as the product of ADV and the respective explanatory variable. Standard errors are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Source: Author's calculation

A similar pattern emerges for the bank-level control variables. For other economies, the credit-to-deposits ratio enters with a negative and statistically significant coefficient, indicating that higher credit relative to deposits is associated with lower NPLs, conditional on the remaining controls. The net interest margin typically has a positive and significant coefficient, suggesting that higher margins are associated with higher NPL ratios, while the Z-score is negatively related to NPLs, indicating that more stable banking systems tend to exhibit lower NPL ratios. Interaction terms between ADV and these bank variables show how the corresponding slopes differ in advanced economies. In most cases, the interaction terms are not statistically significant at conventional levels, or are only weakly significant. The implied slopes for advanced economies, obtained by adding the interaction coefficients to the main effects, are often closer to zero but remain qualitatively similar. Overall, the results suggest that the direction of the marginal effects of key bank structure and risk indicators is the same in both groups, and that any differences in the strength of these effects are limited.

The macroeconomic controls behave in line with the pooled specification without interactions. For other economies, the unemployment rate tends to be positively associated with NPLs, indicating that weaker labor market conditions are correlated with higher NPL ratios, while the coefficients on real GDP growth, the interest rate spread and the real interest rate are generally less robust. The interaction terms between ADV and the macro variables are not statistically significant, implying that there is no strong evidence that the sensitivity of NPLs to macroeconomic conditions differs systematically between advanced and other economies in this pooled framework.

The summary statistics at the bottom of [Table 4](#) confirm that the interaction model uses the same sample as the fully controlled pooled regression and achieves a similar overall explanatory power, as measured by the R-squared. Taken together, the estimates in [Table 4](#) indicate that the main distinction between advanced and other economies lies in the average level of NPL ratios, rather than in the marginal effects of profitability, bank structure or macroeconomic conditions. Advanced economies tend to operate with systematically lower NPLs, but the underlying relationships between the regressors and NPLs appear broadly similar across the two groups.

5. CONCLUSION

This study has examined the determinants of banking sector non-performing loans (NPLs) using an unbalanced panel of 93 countries over the period 2000-2020. The analysis combined banking

sector indicators from the World Bank's Global Financial Development database with standard macroeconomic variables and distinguished between advanced and other economies. The empirical strategy relied on pooled OLS regressions, fixed-effects panel models with clustered standard errors, and a pooled interaction specification that allowed for differences in levels and slopes between country groups.

The pooled regressions indicate a robust negative association between banking sector profitability and NPL ratios. In all pooled specifications, higher ROA is associated with significantly lower NPLs, and this relationship remains statistically and economically significant after controlling for a wide set of bank-level and macroeconomic variables. Additional bank characteristics, such as the credit-to-deposits ratio, the net interest margin, overheads and the Z-score, also contribute to explaining cross-country differences in NPLs. In particular, higher credit-to-deposits ratios and higher Z-scores are associated with lower NPLs, while higher net interest margins and overheads are associated with higher NPLs. Macroeconomic variables, most notably the unemployment rate, add some explanatory power in the pooled setting, consistent with the view that weaker labor market conditions are associated with higher credit risk.

Once unobserved country-specific characteristics and common time shocks are controlled for using a fixed-effects specification with country and year dummies, the emphasis shifts towards the macroeconomic environment. In the fixed-effects regressions, real GDP growth emerges as the main systematic driver of within-country NPL dynamics: higher growth is associated with lower NPL ratios, underscoring the countercyclical nature of credit risk. By contrast, the coefficient on ROA ceases to be statistically significant, and most bank-level controls lose explanatory power within countries over time. This suggests that the strong profitability-NPL relationship observed in the pooled models primarily reflects persistent cross-country differences in average profitability and credit quality, rather than short-run co-movements within individual banking systems.

The interaction analysis between advanced and other economies shows that the principal difference across country groups lies in the level of NPL ratios rather than in the marginal effects of the explanatory variables. Conditional on bank and macro controls, advanced economies exhibit systematically lower NPL ratios, as reflected in a negative and significant coefficient on the advanced-economy dummy. However, the slopes of the NPL equation with respect to profitability, bank structure and macroeconomic conditions are broadly similar across the two groups, and interaction terms are rarely statistically significant. The evidence therefore points to a common set of underlying relationships between profitability, bank characteristics, macroeconomic conditions and credit quality in advanced and other banking systems, with advanced economies operating at a more favorable overall level of loan performance.

From a policy perspective, the results highlight the importance of both micro and macro dimensions. At the micro level, maintaining adequate profitability, a sound funding structure and strong solvency buffers is associated with lower NPL ratios across banking systems. At the macro level, the state of the business cycle, as captured by real GDP growth, plays a central role in shaping NPL dynamics within countries, implying that macroeconomic stabilization and growth-supporting policies can indirectly contribute to healthier bank balance sheets. The analysis also suggests that efforts to improve credit quality in other economies need to address not only bank-specific weaknesses but also broader macroeconomic vulnerabilities.

The study has several limitations that point to avenues for further research. First, the analysis is based on aggregate banking sector data and does not capture heterogeneity across individual banks within countries. Second, the regressions are largely reduced-form and do not address possible endogeneity between NPLs, profitability and macroeconomic conditions. Third, the focus is on contemporaneous relationships; the dynamic adjustment of NPLs with respect to past shocks is not

explored in detail. Future work could extend the analysis with bank-level data, dynamic panel methods, and explicit identification strategies to better disentangle causality and to examine the role of institutional and regulatory factors in shaping the link between bank behavior, macroeconomic conditions and credit quality.

Declarations

The author has no relevant financial or non-financial interests to disclose. The data are available upon a reasonable request from the author.

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