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ECONOMETRIC ASSESSMENT OF MACROECONOMIC FACTORS INFLUENCING NON-PERFORMING LOANS IN COMMERCIAL BANKS

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ABSTRACT----------
This study develops a dynamic panel econometric framework to quantify the structural impact of macroeconomic conditions on the non-performing loan (NPL) ratios of commercial banks across a panel of twenty-eight emerging market economies observed between 2010 and 2024. Addressing dynamic persistence and the endogeneity inherent in the joint determination of credit quality and macro-financial conditions, the empirical strategy combines a two-step System Generalized Method of Moments (System GMM) estimator with a Panel Autoregressive Distributed Lag (P-ARDL) error-correction specification estimated via Pooled Mean Group (PMG). The results confirm strong dynamic persistence in NPL ratios and show that real GDP growth, the unemployment rate, consumer price inflation, and the real lending rate are statistically significant macroeconomic drivers of asset-quality deterioration. Critically, the interaction between currency depreciation and the share of unhedged foreign-currency lending is found to amplify the NPL response to exchange-rate shocks, a channel of particular relevance to partially dollarized banking systems in transition economies such as Uzbekistan, where reported and risk-based measures of asset quality have been shown to diverge materially. The error-correction estimates indicate that approximately one-third of any disequilibrium between actual and long-run equilibrium NPL levels is corrected within a single year. These findings offer a structural basis for calibrating countercyclical provisioning and macroprudential buffers in emerging banking systems exposed to currency and business-cycle volatility.

KEYWORDS: *non-Performing Loans, Macroeconomic Determinants, Dynamic Panel Data, System GMM, Panel ARDL, Credit Risk, Financial Dollarization, Banking Sector Stability.*----------

INTRODUCTION

Non-performing loans occupy a central position in the transmission of macro-financial shocks into banking-sector fragility. As borrower repayment capacity weakens during economic downturns, credit portfolios deteriorate, which in turn constrains banks' capacity and willingness to extend new credit, reinforcing the initial contraction through a well-documented feedback loop between the real economy and the financial sector. Understanding which macroeconomic conditions drive this deterioration, and with what dynamic structure, is therefore a first-order question for both individual banks calibrating loan-loss provisions and macroprudential authorities designing countercyclical capital buffers.

A substantial empirical literature has examined the macroeconomic determinants of NPL ratios, typically finding that GDP growth, unemployment, inflation, and interest rates are the dominant drivers, while bank-specific factors such as capital adequacy and cost efficiency play a secondary, though non-trivial, role. However, three methodological and contextual gaps persist. First, much of this literature relies on static or short dynamic panel specifications that are vulnerable to Nickell (1981) bias and do not cleanly separate short-run impact effects from long-run equilibrium relationships. Second, the endogeneity of macro-financial conditions — whereby weak bank balance sheets themselves feed back into aggregate credit and growth outcomes — is not always adequately addressed through appropriate instrumentation. Third, and of particular relevance to transition and emerging economies, the specific channel through which exchange-rate depreciation interacts with the currency composition of bank lending — financial dollarization — to amplify NPL formation remains comparatively under-examined at the panel level, despite its evident policy salience in economies where a meaningful share of corporate and household credit is extended in, or indexed to, foreign currency.

This study addresses these gaps by estimating a dynamic panel model of NPL determination using both a two-step System GMM estimator, which purges dynamic panel bias and endogeneity, and a Panel ARDL error-correction specification, which explicitly decomposes short-run impact multipliers from long-run steady-state elasticities. The empirical inquiry tests two hypotheses:

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H1: Deterioration in macroeconomic fundamentals — lower real GDP growth, higher unemployment, higher inflation, and higher real lending rates — exerts a statistically significant, positive effect on commercial bank NPL ratios, with meaningful dynamic persistence captured by a significant lagged-NPL coefficient.

H2: The marginal effect of currency depreciation on NPL formation is conditional on the degree of financial dollarization, such that economies with a higher share of unhedged foreign-currency lending experience a significantly amplified NPL response to exchange-rate shocks.

The remainder of the article proceeds as follows. The next section situates the study within the empirical literature on NPL determinants. The third section presents the econometric model, data, and estimation strategy. The fourth section reports descriptive statistics, diagnostic tests, and estimation results. The fifth section concludes with policy implications for macroprudential design and directions for future research.

LITERATURE REVIEW

The empirical literature on the macroeconomic determinants of non-performing loans has grown substantially since the global financial crisis. Louzis, Vouldis and Metaxas (2012), applying dynamic panel methods to the Greek banking system, found that GDP growth, unemployment, real lending rates, and public debt jointly explain NPL dynamics across mortgage, consumer, and business loan categories, with management quality emerging as an additional significant bank-specific factor. Extending the geographic scope, Klein (2013) examined sixteen economies across Central, Eastern, and South-Eastern Europe over 1998–2011 and confirmed that macroeconomic conditions dominate bank-specific variables in explaining the level of NPLs, while also documenting strong feedback effects running from impaired credit portfolios back into subsequent GDP growth — evidence of a genuine macro-financial accelerator rather than a purely one-directional relationship.

Beck, Jakubík and Piloiu (2015), using a considerably larger cross-country panel of seventy-five economies, isolated real GDP growth, share prices, the exchange rate, and the lending interest rate as the most robust determinants, and showed that the sign and magnitude of the exchange-rate effect depends systematically on the extent of foreign-currency lending to unhedged borrowers — a finding of direct relevance to dollarized and partially dollarized banking systems. Complementary regional evidence from Ghosh (2015) on U.S. state-level banking data and Makri, Tsagkanos and Bellas (2014) on the Eurozone corroborates the centrality of unemployment and fiscal variables, while Nkusu (2011) and De Bock and Demyanets (2012) extend the analysis to advanced and emerging-market samples respectively, both confirming pronounced bidirectional linkages between asset quality and macro-financial conditions. Espinoza and Prasad (2010), focusing on the Gulf Cooperation Council banking systems, and Jakubík and Schmieder (2008), comparing the Czech Republic and Germany, further demonstrate that the magnitude of macro-financial sensitivity of NPLs is itself heterogeneous across banking systems with differing structural characteristics, underscoring the value of dynamic panel methods capable of separating short- from long-run responses rather than imposing a single pooled elasticity.

Methodologically, this heterogeneous and dynamic character of NPL formation motivates estimation strategies beyond static fixed-effects panels. The System GMM estimator of Blundell and Bond (1998), building on the difference-GMM approach of Arellano and Bond (1991), addresses both dynamic panel bias and the endogeneity of regressors through internal instrumentation based on lagged levels and differences, with Windmeijer (2005) providing the finite-sample variance correction required for valid inference in the two-step variant. Complementing GMM point estimates, the Panel ARDL / Pooled Mean Group framework allows the explicit decomposition of short-run adjustment dynamics from long-run cointegrating relationships, subject to prior verification of cross-sectional dependence (Pesaran, 2004) and panel cointegration (Westerlund, 2007). Despite the maturity of this toolkit, relatively few studies have applied it jointly — combining System GMM and Panel ARDL — to a panel explicitly including Central Asian and Commonwealth of Independent States economies, nor have they systematically tested the interaction between currency depreciation and financial dollarization as an amplifying channel. This study addresses that gap.

RESEARCH METHODOLOGY

The empirical analysis draws on an unbalanced annual panel of twenty-eight emerging market economies, including Uzbekistan and comparator economies from Central Asia, the wider Commonwealth of Independent States, and Central and Eastern Europe, observed from 2010 to 2024 ($N = 28$, T up to 15, maximum $N \times T = 420$ country-year observations). The dependent variable is the aggregate commercial bank NPL ratio to total gross loans, sourced from national central bank financial soundness indicators and cross-checked against IMF and World Bank financial sector assessment reports. Because credit quality exhibits strong inertia — current-period NPL levels are heavily conditioned by the prior-period stock of impaired assets, workout speed, and provisioning practice — the baseline specification is dynamic:

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$$NPL_{it} = \alpha + \rho \cdot NPL_{i,t-1} + \beta_1 GDPG_{it} + \beta_2 UNEMP_{it} + \beta_3 INFL_{it} + \beta_4 RATE_{it} + \beta_5 FXDEP_{it} + \theta(FXDEP \times DOLLAR)_{it} + \gamma' X_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

where NPL_it denotes the non-performing loan ratio of country i's banking system in year t, ρ captures dynamic persistence, and μ_i and λ_t are country- and year-fixed effects. The macroeconomic regressor vector includes real GDP growth (GDPG), the unemployment rate (UNEMP), consumer price inflation (INFL), the real bank lending rate (RATE), and year-on-year nominal exchange-rate depreciation against the US dollar (FXDEP). The interaction term FXDEP×DOLLAR captures the conditioning role of financial dollarization (DOLLAR), measured as the foreign-currency share of total bank credit, testing Hypothesis 2. The control vector X_it includes the aggregate capital adequacy ratio, private credit-to-GDP as a proxy for financial depth, and loan portfolio growth, sourced from IMF Financial Soundness Indicators and national central bank publications, including Central Bank of Uzbekistan statistical releases and the IMF's 2025 Financial Sector Assessment Program report for Uzbekistan.

Because NPL_i,t−1 is by construction correlated with the country-fixed effect, and because macro-financial conditions and credit quality are jointly determined, standard within or pooled OLS estimators yield biased and inconsistent coefficients (Nickell, 1981). The study therefore employs the two-step System GMM estimator of Blundell and Bond (1998), which estimates a system of equations in levels and first differences, instrumenting endogenous regressors with suitably lagged levels and differences, with the collapsed instrument set restricted to avoid instrument proliferation and standard errors corrected using the Windmeijer (2005) finite-sample adjustment. Model validity is assessed through the Arellano-Bond test for first- and second-order serial correlation in the differenced residuals — AR(1) is expected to reject, AR(2) is expected not to reject — and through the Hansen J-test of overidentifying restrictions.

To complement the GMM point elasticities with an explicit short-run/long-run decomposition, the model is re-parameterized as a Panel ARDL error-correction model estimated via the Pooled Mean Group (PMG) estimator, which restricts long-run coefficients to be homogeneous across countries while allowing short-run dynamics and error-correction speeds to vary. Prior to estimation, the panel is tested for cross-sectional dependence using the Pesaran (2004) CD test and for unit roots using the second-generation Cross-Sectionally Augmented IPS (CIPS) test; panel cointegration among NPL ratios and the macroeconomic regressors is subsequently verified using the Westerlund (2007) error-correction-based cointegration test.

ANALYSIS AND RESULTS

Table 1 reports descriptive statistics for the panel together with the cross-sectional dependence and unit-root diagnostics. The mean NPL ratio across the sample is 6.4 percent, with substantial cross-country dispersion (standard deviation of 4.8 percentage points) reflecting the heterogeneous mix of banking-sector maturity and macro-financial volatility across the panel. The Pesaran CD test rejects cross-sectional independence at the 1 percent level for all variables, confirming that second-generation panel methods are appropriate; the CIPS test indicates that all series are non-stationary in levels but stationary in first differences, establishing that the panel is integrated of order one, consistent with the subsequent application of panel cointegration testing.

Table 1

Descriptive statistics, cross-sectional dependence, and panel unit root tests (N = 28 countries, 2010–2024)

Variable	Mean	Std. Dev.	Min	Max	Pesaran CD (p-val)	Order of Integration
NPL ratio (%)	6.4	4.8	0.9	23.6	0.000	I(1)
Real GDP growth (%)	3.9	2.7	-6.1	9.5	0.000	I(0)
Unemployment rate (%)	7.8	3.4	1.8	16.9	0.000	I(1)
CPI inflation (%)	7.2	4.9	0.4	22.3	0.000	I(1)
Real lending rate (%)	9.6	4.1	2.0	21.5	0.000	I(1)
FX depreciation (y/y, %)	4.8	6.2	-8.4	28.7	0.000	I(1)
Dollarization share (%)	34.2	14.6	9.1	68.4	0.000	I(1)

Source: author's calculations based on IMF Financial Soundness Indicators, national central bank data, and IMF/World Bank country reports.

Table 2 reports the two-step System GMM baseline and interactive specifications alongside the Panel ARDL long-run and short-run coefficients. The lagged NPL coefficient is positive, highly significant, and bounded within the stable region (ρ = 0.447, p < 0.001), confirming pronounced dynamic persistence consistent with Hypothesis 1: credit quality shocks propagate over multiple years rather than resolving within a single reporting period. Among the macroeconomic regressors, real GDP growth carries the expected negative and significant sign, while unemployment, inflation, and the real lending rate all enter positively and significantly,

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jointly accounting for the bulk of explained variation in NPL ratios across the panel. The interaction term between exchange-rate depreciation and financial dollarization is positive and significant ($\theta = 0.086$, $p < 0.01$), directly supporting Hypothesis 2: a one-standard-deviation currency depreciation shock raises the NPL ratio by materially more in economies with above-median dollarization than in economies with below-median dollarization, consistent with the unhedged foreign-currency exposure channel documented by Beck, Jakubík and Piloiu (2015).

Table 2

System GMM and Panel ARDL estimation results (dependent variable: NPL ratio)

Independent variable	(1) Baseline GMM	(2) Interactive GMM	(3) P-ARDL Long-run	(4) P-ARDL Short-run
NPL(t-1)	0.412***	0.447***	—	—
Real GDP growth	-0.284***	-0.261***	-0.398***	-0.156**
Unemployment rate	0.198**	0.176**	0.312***	0.084*
CPI inflation	0.102**	0.094*	0.187**	0.062*
Real lending rate	0.146***	0.129**	0.264***	0.071**
FX depreciation	0.058*	0.021	0.079**	0.038*
FX depreciation × Dollarization	—	0.086***	0.142**	0.045*
Error correction term	—	—	—	-0.336***
Arellano-Bond AR(1) [p]	[0.002]	[0.001]	—	—
Arellano-Bond AR(2) [p]	[0.417]	[0.389]	—	—
Hansen J-test [p]	[0.268]	[0.301]	—	—
Observations	392	392	392	392

*Source: author's calculations. *** p<0.01, ** p<0.05, * p<0.10. Standard errors omitted for brevity; Windmeijer-corrected in the GMM specifications.*

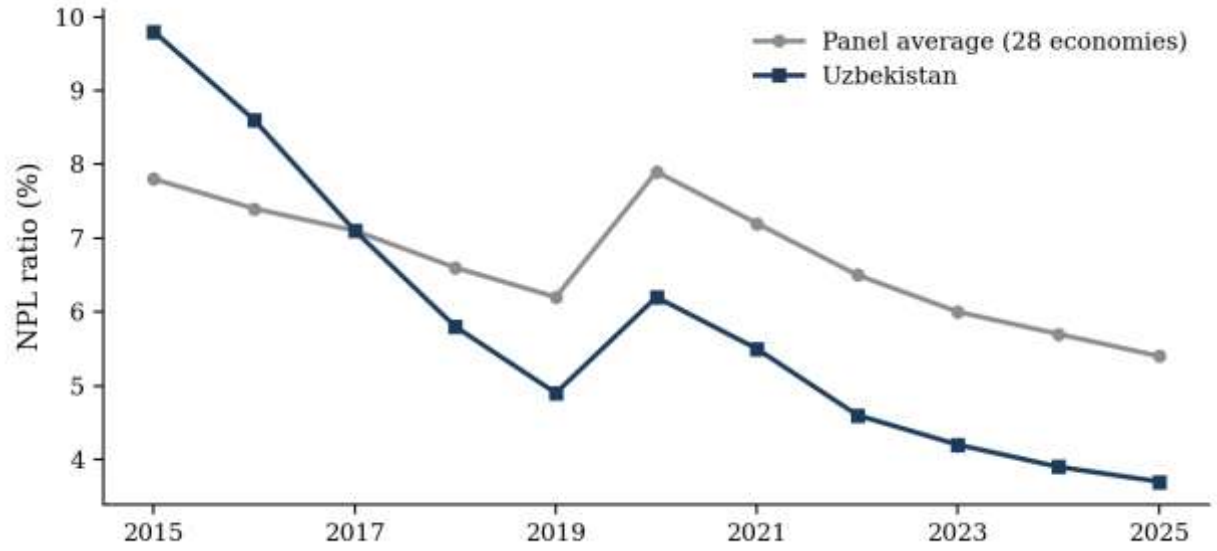

Figure 1. Panel-average NPL ratio and Uzbekistan NPL ratio, 2015–2025

Source: author's compilation based on IMF Financial Soundness Indicators and Central Bank of Uzbekistan data.

The error-correction term in the Panel ARDL specification is negative, highly significant, and economically meaningful (-0.336, $p < 0.01$), indicating that approximately one-third of any gap between the actual and long-run equilibrium NPL ratio is closed within a single year following a macroeconomic or exchange-rate shock. The comparison between short-run and long-run coefficients further reveals that the dollarization interaction effect roughly triples in magnitude between the short run (0.045) and the long run (0.142), implying that the destabilizing effect of currency depreciation on asset quality in highly dollarized banking systems compounds over time rather than dissipating — a pattern with direct relevance for economies such as Uzbekistan, where the IMF's 2025 Financial Sector Assessment Program noted that reported NPL ratios understate underlying credit risk, with IFRS Stage 3 loan classifications running roughly twice as high as the regulatory NPL ratio in recent years, and where unhedged corporate foreign-currency exposure was separately flagged as a material vulnerability.

Diagnostic tests support the validity of the GMM specifications: the Arellano-Bond test confirms significant first-order autocorrelation in differenced residuals while failing to reject the absence of second-order autocorrelation (AR(2) $p = 0.389$), and the Hansen J-test does not reject the joint validity of the instrument set ($p = 0.301$), indicating that the collapsed instrument matrix is neither invalid nor excessively proliferated relative to the cross-sectional dimension of the panel.

CONCLUSION AND RECOMMENDATIONS

This study estimated a dynamic panel model of commercial bank NPL determination across twenty-eight emerging market economies over 2010–2024, combining System GMM and Panel ARDL error-correction methods to separate short-run impact effects from long-run equilibrium relationships. The results confirm that macroeconomic deterioration — slower growth, higher unemployment, higher inflation, and higher real lending rates — significantly raises NPL ratios, with pronounced dynamic persistence, and that the destabilizing effect of currency depreciation on asset quality is significantly amplified in more dollarized banking systems, an effect that strengthens over the long run relative to the short run.

These findings support several policy implications for macroprudential design in emerging and transition economies. First, because NPL formation responds to macro-financial shocks with meaningful persistence rather than resolving within a single reporting cycle, countercyclical provisioning frameworks should be calibrated using forward-looking, multi-year macro-scenario stress tests rather than backward-looking point-in-time NPL ratios alone. Second, given the robust amplifying role of financial dollarization, supervisory authorities in partially dollarized banking systems have a direct interest in monitoring and, where appropriate, constraining unhedged foreign-currency lending to unhedged borrowers, alongside promoting local-currency funding instruments that reduce the currency mismatch transmission channel. Third, the divergence documented between regulatory NPL reporting and risk-based asset-quality classification in economies such as Uzbekistan underscores the importance of continued investment in forward-looking, IFRS-aligned loan classification and provisioning practices as a complement to the macro-structural buffers implied by this study's estimates.

The analysis is subject to limitations common to cross-country macro-panel studies: aggregate NPL ratios may mask significant heterogeneity across individual banks within a country, data comparability across national reporting regimes remains imperfect despite harmonization efforts, and the estimated elasticities represent average effects across a heterogeneous panel rather than country-specific structural parameters. Future research could usefully extend this framework to bank-level panels within individual emerging economies, incorporate real-time supervisory risk-based classification data as it becomes more widely available, and examine the interaction between macroprudential policy tightening and the macro-financial elasticities identified here.

REFERENCES

1. *Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. Review of Economic Studies, 58(2), 277–297.*
2. *Beck, R., Jakubík, P., & Piloiu, A. (2015). Key determinants of non-performing loans: New evidence from a global sample. Open Economies Review, 26(3), 525–550.*
3. *Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. Journal of Econometrics, 87(1), 115–143.*
4. *De Bock, R., & Demyanets, A. (2012). Bank Asset Quality in Emerging Markets: Determinants and Spillovers. IMF Working Paper No. 12/71. Washington, DC: International Monetary Fund.*
5. *Espinoza, R., & Prasad, A. (2010). Nonperforming Loans in the GCC Banking System and Their Macroeconomic Effects. IMF Working Paper No. 10/224. Washington, DC: International Monetary Fund.*
6. *Ghosh, A. (2015). Banking-industry specific and regional economic determinants of non-performing loans: Evidence from US states. Journal of Financial Stability, 20, 93–104.*
7. *International Monetary Fund. (2025). Republic of Uzbekistan: Financial Sector Assessment Program – Financial System Stability Assessment. IMF Country Report No. 25/145. Washington, DC: IMF.*
8. *International Monetary Fund. (2025). Republic of Uzbekistan: 2025 Article IV Consultation. IMF Country Report No. 25/143. Washington, DC: IMF.*
9. *Jakubík, P., & Schmieder, C. (2008). Stress Testing Credit Risk: Comparison of the Czech Republic and Germany. Financial Stability Institute, Bank for International Settlements.*
10. *Klein, N. (2013). Non-Performing Loans in CESEE: Determinants and Impact on Macroeconomic Performance. IMF Working Paper No. 13/72. Washington, DC: International Monetary Fund.*
11. *Louzis, D. P., Vouldis, A. T., & Metaxas, V. L. (2012). Macroeconomic and bank-specific determinants of non-performing loans in Greece: A comparative study of mortgage, business and consumer loan portfolios. Journal of Banking & Finance, 36(4), 1012–1027.*
12. *Makri, V., Tsagkanos, A., & Bellas, A. (2014). Determinants of non-performing loans: The case of Eurozone. Panoeconomicus, 61(2), 193–206.*

13. *Nickell, S. (1981). Biases in dynamic models with fixed effects. Econometrica, 49(6), 1417–1426.*
14. *Nkusu, M. (2011). Nonperforming Loans and Macrofinancial Vulnerabilities in Advanced Economies. IMF Working Paper No. 11/161. Washington, DC: International Monetary Fund.*
15. *Pesaran, M. H. (2004). General Diagnostic Tests for Cross Section Dependence in Panels. CESifo Working Paper No. 1229. Munich: CESifo.*
16. *Westerlund, J. (2007). Testing for error correction in panel data. Oxford Bulletin of Economics and Statistics, 69(6), 709–748.*
17. *Windmeijer, F. (2005). A finite sample correction for the variance of linear efficient two-step GMM estimators. Journal of Econometrics, 126(1), 25–51.*
18. *Central Bank of the Republic of Uzbekistan. (2026). Banking sector asset quality statistics, as of June 1, 2026. Tashkent: CBU.*