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Posted Date: 19 January 2026

doi: 10.20944/preprints202601.1410.v1

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Long-Run Monetary Policy Transmission and Bank Credit Dynamics Under Risk and Balance-Sheet Constraints: Evidence from an Emerging Economy

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Abstract

In emerging economies characterized by a predominance of the banking sector, the transmission of monetary policy to bank credit remains a central and ongoing topic of debate. Although the interest rate channel is the primary tool of central banks, numerous studies reveal persistent inertia in short-term bank credit, casting doubt on the effectiveness of monetary transmission. This study examines the transmission of monetary policy to bank credit for non-financial businesses in Morocco, adopting a dynamic, long-term approach. The empirical analysis is based on monthly data covering 2006–2023 and uses an ARDL–ECM model that distinguishes short-term dynamics from long-term adjustment mechanisms and incorporates structural breaks. The results indicate that variations in the policy rate do not have a significant effect on short-term bank credit, which confirms the weakening of the traditional rate channel. However, this inertia is accompanied by a strong long-term equilibrium relationship between credit, monetary policy, and risk conditions. The results highlight a gradual monetary transmission, strongly influenced by credit risk and bank balance-sheet arbitrage. The apparent inefficiency of the short-term rate channel thus reflects a transmission modulated by prudential and structural constraints, rather than a breakdown of the monetary transmission mechanism.

Keywords: monetary transmission mechanism; bank credit; credit risk; portfolio adjustments; balance-sheet effects; long-run dynamics; emerging markets

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1. Introduction

In emerging economies characterized by a predominance of the banking sector, the transmission of monetary policy to the real economy is a significant challenge for macroeconomic stability and growth. The policy rate is the preferred conventional instrument of central banks to guide monetary conditions. However, the actual effectiveness of this tool in influencing bank credit to non-financial companies remains widely debated in academic literature and institutional analyses.

Monetary transmission is traditionally viewed as a relatively direct mechanism, in which changes in the policy rate quickly affect financing conditions and, consequently, bank credit volumes (Bernanke & Gertler, 1995). However, a growing number of empirical studies challenge this perspective, particularly in emerging economies. Several analyses demonstrate that bank credit adjustments are frequently weak, delayed, or even absent in the short term, even during prolonged periods of accommodative monetary policy (Tenreyro & Thwaites, 2016).

The literature offers divergent interpretations of this observation. Some authors consider it a structural weakening of the credit channel, attributable to strengthened prudential constraints, persistent risk aversion, or deep institutional rigidities. Others believe that this inertia does not

doi:10.20944/preprints202601.1410.v1

constitute a failure of monetary transmission, but rather reflects adjustment delays inherent in risk assessment processes, bank portfolio arbitrations, and balance sheet constraints, particularly present in bank-dominated financial systems (Adrian & Shin, 2010; Gambacorta & Shin, 2018).

However, the relevant time horizon for evaluating the transmission of monetary policy remains insufficiently clearly defined in this debate. The empirical literature mainly focuses on short-term reactions to credit and often concludes that the transmission is weak or nonexistent. However, this focus on the immediacy of adjustments can obscure the existence of long-term equilibrium relationships, whose adjustments are slow, conditional, and heavily dependent on credit risk and the structure of bank balance sheets (Bernanke et al., 1999; Cloyne et al., 2023). Therefore, the lack of an immediate credit response does not necessarily constitute evidence of monetary policy ineffectiveness.

This issue is significant in the Moroccan context. Institutional analyses by Bank Al-Maghrib highlight a persistent dissociation between the relatively rapid adjustment of monetary conditions and the more rigid dynamics of bank credit granted to non-financial enterprises, notably due to the inertia of outstanding amounts, prudential constraints, and risk management mechanisms.

Generally speaking, the institutional literature on emerging economies shows that the transmission of monetary policy to bank credit often remains incomplete, variable, and dependent on the macro-financial context. A recent report from the International Monetary Fund indicates that international financial conditions, the evolution of risk spreads, and the structure and strength of bank balance sheets strongly influence monetary transmission channels. Thus, monetary policy measures most often lead to gradual adjustments in credit conditions and volumes, rather than immediate increases in bank financing to the private sector (IMF, 2024).

This study is set in this context. It aims to analyze how monetary policy is transmitted to bank credit intended for non-financial companies in Morocco, taking into account both short-term and long-term effects, as well as the role of credit risk and banks' portfolio choices. The analysis is based on monthly data from 2006 to 2023, which allows for the inclusion of different monetary regimes, periods of macro-financial stress, and phases of change in the structure of bank balance sheets.

Moreover, the choice to focus on bank credit in the non-financial sector is motivated by its dominant quantitative weight and its central role in macroeconomic transmission. According to the Bank Al-Maghrib Annual Report (2023), total outstanding bank credit reached 1,114.9 billion dirhams, equivalent to approximately 76.2% of GDP. In this total, the majority of the outstanding amount is allocated to the non-financial sector, which thus constitutes the main channel thru which the banking system finances real economic activity. Conversely, although loans to financial companies recorded a strong acceleration in 2023, their relative weight remains limited, and their dynamics are primarily determined by refinancing, liquidity management, and intra-financial arbitrage.

Moreover, recent developments confirm a structural divergence between the two credit segments. After an exceptional expansion in 2022, credit to the non-financial sector decelerated sharply in 2023, before embarking on a gradual recovery trajectory anticipated by Bank Al-Maghrib. This evolution contrasts with that of credit to the financial sector, whose high volatility reflects more balance-sheet adjustments and liquidity constraints than actual demand for financing from the real economy. Therefore, bank credit to the non-financial sector appears not only quantitatively dominant but also more economically relevant for analyzing the effective transmission of monetary policy in Morocco.

On the methodological front, this study uses an ARDL–ECM econometric model, adapted to the analysis of long-term relationships between integrated variables of different orders and likely to be influenced by structural breaks (Pesaran et al., 2001). This model clearly distinguishes short-term dynamics from long-term adjustments without imposing overly strict constraints on its structure.

The main results show that bank credit does not respond significantly to short-term variations in the policy rate, but this does not undermine monetary transmission. This exists with solid long-term equilibrium relationships. The results indicate that monetary transmission occurs mainly through gradual adjustments, influenced by credit risk and bank balance-sheet constraints, rather than through immediate reactions to monetary signals.

doi:10.20944/preprints202601.1410.v1

2. Literature Review

The transmission of monetary policy in emerging economies with strong banking dominance has long been the subject of a theoretical consensus, but remains empirically controversial. If traditional models posit that the policy rate influences the real economy through the bank credit channel, empirical results suggest that this relationship is far from mechanical. In many emerging countries, changes in the policy rate do not translate into immediate adjustments or proportional quantitative responses in bank credit, particularly for financing non-financial companies.

A first reading of this literature highlights a persistent inertia in short-term bank credit, often interpreted as a structural weakening of the credit channel. Several studies document the lack of significant credit expansion following episodes of monetary easing, suggesting that lending decisions would be dominated by non-monetary factors, such as risk, solvency, or institutional constraints (Mishra et al., 2014). However, this interpretation remains incomplete, as it relies on a contemporary reading of credit adjustments.

A second approach, stemming from the foundational works of Bernanke and Gertler (1995) and Bernanke et al. (1999), challenges this view by emphasizing that the lack of immediate credit response should not be equated with the ineffectiveness of monetary policy. According to this perspective, transmission depends closely on the financial situations of banks and borrowers, as well as on the balance sheet constraints to which intermediaries are subject. Bank credit can thus react with a delay, once risk and balance sheet structure adjustments have been made.

This logic is further developed in the literature on the bank balance sheet channel and portfolio arbitrages. The work of Adrian and Shin (2010) shows that banks adjust their leverage and asset composition in response to monetary and financial conditions, which can, in specific contexts, lead to a reallocation toward liquid, low-risk assets, such as government securities. The empirical results of Acharya and Steffen (2015) and Gambacorta and Shin (2018) confirm that these arbitrages can temporarily neutralize the expected effect of the policy rate on bank credit, without breaking the long-term relationship between monetary policy and the financing of the real economy.

At the same time, the credit risk literature emphasizes that asset quality is a central determinant of monetary transmission. The credit rationing framework (Stiglitz & Weiss, 1981) suggests that when perceived risk increases, banks primarily adjust credit quantities rather than prices. The empirical work of Jiménez et al. (2012) shows that the deterioration of non-performing loans limits banks' ability to amplify monetary impulses through credit expansion, particularly in emerging economies where risk-sharing mechanisms are incomplete.

These microeconomic analyses extend into international institutional assessments. Reports from the Bank for International Settlements and the International Monetary Fund highlight that, in many emerging countries, monetary transmission to bank credit is filtered mainly through capital constraints, balance sheet quality, and prudential requirements (BIS, 2019; IMF, 2019). More recently, Checo et al. (2024) show that monetary policy shocks are mainly absorbed through balance sheet adjustments and risk revaluations, while credit volumes respond gradually and heterogeneously, depending on the macro-financial regime.

The case of Morocco fits this issue perfectly. Despite several phases of monetary easing, the evolution of bank credit to non-financial enterprises remains marked by significant inertia and structural breaks related to economic cycles and prudential reforms (Bank Al-Maghrib, 2021). Recent studies by Boutfssi and Zizi (2025) show that access to bank financing depends less on contemporary variations in the key interest rate than on prudential constraints, risk perception, and institutional hedging mechanisms. Similarly, Boutfssi and Quamar (2026) highlight a dissociation between the rapid reaction of financial conditions and the inertia of credit volumes, emphasizing the central role of portfolio arbitrages and progressive correction mechanisms.

On the institutional front, the progressive strengthening of the prudential framework, notably through Bank Al-Maghrib's circular no. 1/W/16 has increased the resilience of the banking system while altering the conditions for the transmission of monetary policy. Recent supervision and financial stability

 doi:10.20944/preprints202601.1410.v1

reports confirm that credit supply is now conditioned mainly by loss-absorption capacity and balance-sheet structure, rather than by a mechanical response to the sole signal of the policy rate.

Despite these advances, the literature remains fragmented. Few studies simultaneously integrate the non-stationarity of macro-financial series, structural breaks, and delayed credit adjustment mechanisms within a unified econometric framework. In particular, the articulation between long-term relationships, short-term dynamics, and changes in prudential regimes remains insufficiently explored in the context of bank-dominated emerging economies.

It is precisely from this perspective that the present study is situated, employing an ARDL–ECM framework that allows for the identification of both long-term equilibrium relationships and conditional adjustment mechanisms governing the transmission of monetary policy to bank credit in the non-financial sector.

3. Conceptual Framework and Research Hypothesis

This study falls within the literature on the transmission of monetary policy within bank-dominated financial systems, with a focus on emerging economies. In this context, bank credit to the non-financial sector serves as a central channel for the transmission of monetary impulses to the real economy. However, the theoretical and empirical literature indicates that this transmission is neither immediate nor uniform over time, and that it can be influenced by financial frictions, balance sheet constraints, and institutional characteristics specific to the banking system.

In this context, the policy rate is a central monetary policy instrument capable of influencing financing conditions. However, its effect on bank credit supply results from the interaction among interest rate signals, credit risk conditions, and banks' portfolio arbitrages. Short-term changes in credit can thus exhibit a certain inertia, attributable to contractual rigidities, internal risk assessment processes, and prudential requirements. Conversely, long-term dynamics can highlight stable relationships between credit and its macro-financial determinants.

The adopted conceptual framework thus distinguishes short-term mechanisms from long-term relationships, while accounting for the possibility that transmission mechanisms may vary over time. Changes in the macro-financial context, the regulatory framework, or the operating conditions of the banking sector are likely to alter the transmission of monetary policy to credit, without necessarily questioning the existence of a long-term equilibrium. The proposed empirical analysis aims to examine the nature of these relationships, their adjustment modalities, and their temporal stability, within a unified econometric framework.

Research hypothesis:

H1: *Short-term monetary transmission*

Changes in the policy rate have a statistically significant effect on the short-term dynamics of bank credit to the non-financial sector.

H2: *Long-term relationship*

Bank credit to the non-financial sector maintains a statistically significant long-term relationship with monetary policy and macro-financial conditions.

H3: *Adjustment mechanism toward equilibrium*

The deviations of bank credit from its long-term equilibrium level are gradually corrected over time, reflecting a dynamic adjustment mechanism.

 doi:10.20944/preprints202601.1410.v1

H4: *Non-invariance of transmission mechanisms*

The mechanisms through which monetary policy and macro-financial conditions influence bank credit to the non-financial sector are not time-invariant and can undergo structural changes as the macro-financial and institutional environment evolves.

4. Methodology

4.1. General Empirical Strategy

This study uses a time series econometric method to analyze how monetary policy is transmitted to bank credit for non-financial companies in an emerging economy dominated by banks. This choice is based on the tradition of dynamic macro-financial analysis, which shows that bank credit adjustments are often slow, depend on risk conditions, and take time due to balance sheet constraints and prudential rules (Bernanke & Gertler, 1995; Bernanke et al., 1999).

Unlike static approaches or models that assume the policy rate immediately, symmetrically, and linearly influences credit volumes, this study assumes that credit dynamics depend on complex interactions among the monetary signal, perceptions of credit risk, and banks' portfolio choices. This idea aligns with the literature on bank balance sheets and risk channels, which explains that credit decisions depend primarily on the financial soundness of banks, asset quality, and applicable regulations, and not solely on the cost of liquidity (Adrian & Shin, 2010; Gambacorta & Shin, 2018).

From an econometric perspective, this approach assumes that monetary policy can have different effects across time horizons. There may be little or no impact in the short term, but gradual adjustments toward a long-term equilibrium. The analysis must therefore use a framework that clearly distinguishes short-term dynamics from long-term relationships, while accounting for the statistical properties of macro-financial series, which are often non-stationary and prone to structural breaks (Lütkepohl, 2005).

The methodology is structured sequentially and cumulatively, in accordance with best practices in time series econometrics applied to macro-financial data (Pesaran et al., 2001; Banerjee et al., 1993). It aims to successively examine:

(i) the statistical properties of the series in order to identify their order of integration and avoid any spurious regression (Phillips & Perron, 1988);

(ii) (the possible presence of structural breaks or changes in the macro-financial regime, apprehended thru structural controls and stability tests (Brown et al., 1975);

(iii) the existence of a long-term equilibrium relationship between bank credit and its determinants, a prerequisite for identifying a sustainable monetary policy transmission mechanism (Pesaran et al., 2001);

(iv) short-term adjustment mechanisms, analyzed within an error correction framework allowing for the measurement of the speed of convergence toward long-term equilibrium after a shock (Banerjee et al., 1993);

(v) the temporal stability of these mechanisms, in order to evaluate the robustness of the estimated relationship in the face of changes in the macro-financial and regulatory context (Brown et al., 1975).

This empirical strategy thus allows for the analysis of monetary transmission within a dynamic and institutionally coherent perspective, adapted to the specificities of emerging economies dominated by the banking sector, without presupposing a priori the speed or intensity of bank credit adjustments.

4.2. Data

The empirical analysis is based on monthly data from January 2006 to September 2023. This period encompasses several monetary policy regimes, significant prudential developments, and various macro-financial shocks, all of which are likely to have influenced banks' credit supply behavior.

 doi:10.20944/preprints202601.1410.v1

The data comes exclusively from official institutional sources. Credit aggregates, risk indicators, and balance sheet variables are sourced from the consolidated statistics of the banking system. In contrast, monetary and macro-financial variables are sourced from the official publications of the competent authorities. The use of these sources ensures the reliability, consistency, and reproducibility of the analysis.

Volume variables are expressed in natural logarithms to stabilize the variance and facilitate the economic interpretation of the coefficients, while rates and ratios are kept at levels.

4.3. Transmission Variables and Channels

The dependent variable is bank credit granted to the non-financial corporate sector, denoted as $NFSC_{t},$,expressed in logarithmic form:

$$LOGNFSC_t = \ln\left(NFSC_t\right) \quad (1)$$

Three main explanatory variables are introduced, each corresponding to a specific transmission channel:

- Monetary channel: the policy rate (PR_t), representing the conventional signal of monetary policy.
- Risk and prudential channel: the non-performing loan ratio ($NPLRATIO_t$), used as a proxy for perceived risk and prudential constraints weighing on credit supply.
- Portfolio and liquidity arbitrage channel: the outstanding amount of public securities held by banks, expressed in logarithm ($LOGBILL_t$), reflecting asset allocation choices and balance sheet management.

This specification allows for a joint analysis of the effects of the monetary signal, risk conditions, and balance-sheet arbitrages on the dynamics of bank credit.

4.4. Properties of Series, Unit Root Tests, and Collinearity

Before undertaking dynamic modeling, the stationarity properties of the series are evaluated using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests. This step aims to identify the order of integration of the variables and to prevent the risks of spurious regressions, common in the analysis of macro-financial series.

Unit root tests are conducted, accounting for the possibility of structural breaks to limit biases arising from unacknowledged regime changes. This approach ensures that the conditions for applying the ARDL–ECM framework are met.

Furthermore, a collinearity test is conducted before estimating the model to ensure that the explanatory variables are not excessively interdependent. Collinearity is assessed using variance inflation factors (VIFs), which help ensure the stability of the estimated coefficients and the robustness of subsequent econometric inferences.

4.5. Control of Structural Breaks

Given the length of the studied period and the likelihood of regime changes that may affect the dynamics of bank credit, the analysis explicitly incorporates a control for structural breaks.

To this end, structural break detection tests are employed to identify statistically significant discontinuities in the analyzed series. Based on these tests, exogenous dummy variables are introduced as structural controls at all empirical stages, including stationarity tests and ARDL and ECM model estimations.

The introduction of these variables aims to neutralize the potential impact of statistically identified regime changes, which could undermine the stability of the estimated relationships over the long term. These dummy variables are not interpreted as economic transmission mechanisms but are used solely as control variables to ensure the robustness of the estimates.

 doi:10.20944/preprints202601.1410.v1

4.6. Choice of the ARDL Model and General Specification

Given the presence of integrated variables of mixed orders I(0) and I(1), the strong inertia of bank credit, and the need to incorporate structural break controls, the study adopts an Autoregressive Distributed Lag (ARDL) model.

The ARDL approach allows for the simultaneous identification of a long-term equilibrium relationship and short-term adjustment mechanisms, while remaining suitable for the analysis of monthly series exhibiting slow dynamics.

The general specification estimated is as follows:

$$\ln(NFSC_t) = \alpha_0 + \sum_{i=1}^{p} \alpha_i \ln(NFSC_{t-i}) + \sum_j \beta_j PR_{t-j} + \sum_k \gamma_k NPLRATIO_{t-k} + \sum_l \delta_l LOGBILL_{t-l} + \phi_1 \ln(NFSC_{t-1}) + \phi_2 PR_{t-1} + \phi_3 NPLRATIO_{t-1} + \phi_4 LOGBILL_{t-1} + \sum_m \psi_m D_{m,t} + \varepsilon_t \quad (2)$$

4.7. Cointegration Test and Long-Term Relationship

The existence of a long-term equilibrium relationship between bank credit and its determinants is tested using the bounds cointegration test associated with the ARDL approach. The rejection of the null hypothesis of no cointegration indicates that the variables share a stable long-term relationship. When cointegration is established, the long-term relationship is estimated in the form:

$$\ln(NFSC_t) = \theta_0 + \theta_1 PR_t + \theta_2 NPLRATIO_t + \theta_3 LOGBILL_t \quad (3)$$

4.8. Short-Term Dynamics

The ARDL model is reparametrized as an error-correction model (ECM) to analyze short-term adjustments while maintaining consistency with the long-term equilibrium. The error correction term measures the speed of adjustment of credit toward its equilibrium level following a shock.

4.9. Tests de Diagnostic et Stabilité Des Paramètres

The statistical validity of the model (Error Correction Model, ECM) is evaluated using standard diagnostic tests. The autocorrelation of residuals is examined using the Breusch–Godfrey LM test, heteroscedasticity by the White test, and parameter stability by the CUSUM and CUSUM of Squares tests.

4.10. Endogenous Rupture and Potential Change in Transmission Mechanisms

To evaluate the potential for a dominant reconfiguration of credit adjustment mechanisms during the studied period, an endogenous Quandt–Andrews-type breakpoint test is applied to the ECM equation. This test allows for the identification of potential structural instability affecting short-term dynamics.

When relevant, the model is enriched by interaction terms between a post-break dummy variable and the main explanatory variables, and a joint Wald test is used to assess whether the transmission mechanisms differ significantly between regimes.

5. Preliminary Tests

5.1. Descriptive Analysis

Table 1 presents the descriptive statistics for the main macro-financial variables studied, based on 213 monthly observations. The volume variables, such as credit to the non-financial sector and the outstanding amount of Treasury bills, are expressed in logarithms to reduce their asymmetry and facilitate the interpretation of relative variations.

The variables LOGNFSC (credit to the non-financial sector) and LOGBILL (outstanding Treasury bills held by banks) exhibit moderate dispersion, with standard deviations of 0.295 and 0.423, respectively. This stability corresponds to the cumulative nature and institutional inertia of these aggregates. The

 doi:10.20944/preprints202601.1410.v1

distribution of LOGNFSC is very leptokurtic (kurtosis = 5.67) and left-skewed, indicating periods of slowdown or credit contraction, often observed during macro-financial tensions.

The non-performing loan ratio (NPLRATIO) varies more than its average, with a standard deviation of about 0,0328, for an average of 0.10. This reflects the cyclical nature of credit risk and its sensitivity to macroeconomic conditions. Its distribution is not normal, as is typical for banking risk indicators, which are often influenced by one-off adjustments and threshold effects.

The policy rate (PR) exhibits low absolute dispersion but a highly asymmetric, leptokurtic distribution. This reflects the discretionary nature of monetary policy, which is adjusted in steps and rarely continuously.

The Jarque–Bera normality tests reject the normality assumption for all variables. This result is expected for long-term monthly macro-financial series and justifies the use of robust methods based on time-series dynamics rather than strict assumptions of normality.

Table 1. Descriptive statistics.

Variable	Mean	Standard Deviation	Skewness	Kurtosis	Jarque–Bera	Observations
LOGBILL	25,5437	0,4228	0,2455	1,8936	0,0015	213
LOGNFSC	26,3764	0,2954	−1,8239	5,6746	0,0000	213
NPLRATIO	0,1003	0,0328	−0,1377	1,8320	0,0017	213
PR	0,0272	0,0059	−0,8730	2,8140	0,0000	213

Note: *LOGNFSC denotes the logarithm of bank credit to the non-financial sector; LOGBILL the logarithm of outstanding Treasury bills held by banks; NPLRATIO the ratio of non-performing loans; PR the policy rate. The Jarque–Bera tests indicate a rejection of normality for all variables, which is common for monthly macro-financial series.* Source: Authors' calculations.

5.2. Correlation Test

The correlation matrix reveals significant co-movement among the main macro-financial variables, highlighting economic regularities consistent with a financial interpretation of monetary transmission.

First, the positive and relatively high correlation between credit to the non-financial sector (LOGNFSC) and outstanding Treasury bills held by banks (LOGBILL), at 0.684, indicates a strong co-evolution of these two aggregates in the sample. On the economic front, this relationship suggests that phases of credit expansion coincide with an increase in public securities portfolios, which corresponds more to a simultaneous expansion of bank balance sheets and favorable liquidity conditions than to a simple mechanism of private credit displacement.

Secondly, the policy rate (PR) shows a negative correlation with bank balance sheet variables. The correlation between PR and LOGNFSC is −0.535, while that between PR and LOGBILL is even more pronounced (−0.801). These coefficients show that higher policy rates are associated with lower levels of bank credit and public securities holdings. This relationship primarily reflects the fluctuations of the monetary cycle and overall financial conditions, without necessarily implying a direct and immediate causal effect of the policy rate on credit volumes.

Thirdly, the correlation between credit risk (NPLRATIO) and credit volume (LOGNFSC) is very weak and slightly negative (−0.050). This coefficient, close to zero, indicates that the impact of risk on credit supply does not manifest immediately, but rather through delayed adjustments, in accordance with prudential mechanisms and bank decision-making timelines. On the other hand, NPLRATIO shows a negative correlation with the policy rate (−0.560), which reflects the cyclical nature of credit risk.

Finally, no bilateral correlation exceeds absolute values close to unity, which excludes severe multicollinearity and confirms the feasibility of multivariate estimation. Overall, these descriptive results justify the use of a dynamic ARDL–ECM approach, which distinguishes short-term co-movements from long-term equilibrium relationships.

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Table 2. Correlation matrix (Pearson).

Variable	LOGBILL	LOGNFSC	NPLRATIO	PR
LOGBILL	1,000	0,684	0,633	−0,801
LOGNFSC	0,684	1,000	−0,050	−0,535
NPLRATIO	0,633	−0,050	1,000	−0,560
PR	−0,801	−0,535	−0,560	1,000

Source: Authors' calculations.

The results indicate that all centered VIFs remain well below the usual threshold of 5, which suggests the absence of problematic multivariate collinearity among the explanatory variables. Therefore, the multivariate estimates can be interpreted without a significant risk of distorting standard deviations or instability in coefficients due to collinearity.

Table 3. Variance Inflation Factors (VIF).

Explanatory Variable	Centered VIF
PR	2,823
NPLRATIO	1,692
LOGBILL	3,236

Source: Authors' calculations.

5.3. Stationarity Tests

The ADF and Phillips-Perron tests give consistent and reliable results. LOGBILL, NPLRATIO, and PR do not reject the null hypothesis of a unit root at the level (p-values between 0.27 and 0.99), indicating non-stationarity due to their cumulative, cyclical, or discretionary nature. On the other hand, LOGNFSC clearly rejects the unit root hypothesis, with ADF statistics = −6.47 and PP statistics = −6.80 (p-values at 0.000), well below the 1% critical threshold, confirming its stationarity at the level (I(0)).

This difference in the orders of integration, with LOGNFSC in I(0) and the other variables in I(1), is logical in a regulated banking system. Institutional and prudential rules limit credit, while monetary instruments, risk, and public securities evolve more sustainably. Moreover, none of the variables is I(2), confirming that the ARDL–Bounds model is suitable for studying both long-term relationships and short-term adjustments.

Table 4. Unit root tests (ADF and Phillips–Perron).

Variable	Test	Statistic	p-Value	Order of Integration
LOGBILL	ADF	0,596	0,989	I(1)
	PP	0,514	0,987	I(1)
LOGNFSC	ADF	−6,470	0,000	I(0)
	PP	−6,796	0,000	I(0)
NPLRATIO	ADF	−2,012	0,282	I(1)
	PP	−2,038	0,271	I(1)
PR	ADF	−1,984	0,294	I(1)
	PP	−1,564	0,499	I(1)

Source: Authors' calculations.

5.4. Structural Ruptures

The Bai–Perron test highlights three statistically significant structural breaks in the relationship between credit to the non-financial sector and its macro-financial determinants. The sequential F statistics exceed the 5% critical values for the 0 vs 1, 1 vs 2, and 2 vs 3 tests, leading to rejection of the null hypothesis of coefficient stability. On the other hand, the 3 vs 4 test is not significant, which indicates that three breaks constitute the optimal specification.

 doi:10.20944/preprints202601.1410.v1

On a methodological level, these results confirm that credit dynamics cannot be correctly analyzed under the assumption of parametric stability over the entire period. They fully justify the introduction of dummy variables or stability tests in the ARDL model, as well as the differentiated analysis of macro-financial regimes. The identified break dates, 2009M01, 2012M09, and 2016M06, correspond to macro-financial regime changes likely to affect credit transmission mechanisms, without presuming a priori the exact nature of the shocks. It is important to emphasize that the Bai–Perron test does not identify temporary shocks, but rather lasting changes in the structural relationships between credit, risk, and bank portfolio arbitrages.

Thus, the 2009 break is consistent with a phase of global macro-financial stress, the 2012 break with a period of prolonged tensions affecting risk quality and the economic environment, while the 2016 break suggests a more profound and more persistent reconfiguration of credit adjustment mechanisms. This last break is significant because it concerns the coefficients themselves, and not just a simple level effect.

Table 5. Test of multiple structural breaks (Bai–Perron).

Sequential Test	F-Statistic	F-Statistic Adjusted	Critical Value	Decision
0 vs 1	182,15	728,59	16,19	Rejet H_0
1 vs 2	28,78	115,14	18,11	Rejet H_0
2 vs 3	19,04	76,18	18,93	Rejet H_0
3 vs 4	1,48	5,90	19,64	Non rejet

Source: Authors' calculations.

6. Estimation of the Dynamic Model

6.1. Estimation of the ARDL Model

The ARDL estimation reveals strong persistence in the dynamics of credit to the non-financial sector. The coefficient for the first credit lag, LOGNFSC(−1), is 0.8095 and highly significant ($p < 0.01$), indicating that approximately 81% of the current credit level is explained by its previous value. This observation confirms the marked inertia of bank credit, consistent with its nature as a stock variable and the presence of contractual and institutional rigidities.

Several higher-order credit lags are also significant, with alternating signs. Lags 6 and 9 show positive effects, while lag 7 (LOGNFCS -7) shows an adverse effect. This configuration suggests a delayed, non-monotonic adjustment dynamic, reflecting progressive mechanisms of balance-sheet reallocation and risk reassessment rather than an immediate adjustment to cyclical shocks. The lack of significance of the intermediate lags supports the hypothesis of a gradual adjustment.

The coefficient of the policy rate (PR) is negative (−0.3571) but not statistically significant ($p = 0.221$). Although the sign is consistent with the theoretical mechanisms of monetary transmission, this result indicates that, in the short term, changes in the policy rate do not lead to a significant quantitative adjustment in bank credit. Monetary policy thus seems to act indirectly, with a delay, and without an immediate effect on credit volumes.

On the other hand, credit risk conditions exert a decisive influence. The coefficient associated with the non-performing loan ratio (NPLRATIO) is negative, high, and highly significant (−0.4825; $p < 0.01$). A one percentage point increase in this ratio, on average, leads to a contraction of about 0.48% in bank credit, highlighting the primacy of prudential considerations and asset quality in lending decisions.

The outstanding Treasury bills (LOGBILL) show a positive and significant coefficient (0.0208; $p < 0.05$). Although this effect is quantitatively limited, it suggests that investments in public securities are accompanied by favorable liquidity conditions and an overall expansion of bank balance sheets, rather than a credit eviction mechanism for the non-financial sector.

Finally, the dummy variables capturing major macro-financial stocks are all statistically significant. The negative coefficients for the years 2009 and 2012 indicate notable contractions in bank

 doi:10.20944/preprints202601.1410.v1

credit during periods of economic stress, while the positive coefficient for the period after 2016 reflects a phase of expansion and gradual normalization of credit. These results confirm the sensitivity of bank credit to macroeconomic cycles and systemic shocks.

Table 6. ARDL estimation of non-financial sector credit.

Variable	Coefficient	Standard Error	t-Statistic	p-Value
LOGNFSC(−1)	0,809544	0,071178	11,37358	0,0000
LOGNFSC(−2)	−0,016436	0,092766	−0,177176	0,8596
LOGNFSC(−3)	0,059836	0,087795	0,681545	0,4964
LOGNFSC(−4)	−0,076336	0,085054	−0,897497	0,3706
LOGNFSC(−5)	−0,020454	0,082826	−0,246951	0,8052
LOGNFSC(−6)	0,297546	0,082833	3,592097	0,0004
LOGNFSC(−7)	−0,330939	0,086041	−3,846299	0,0002
LOGNFSC(−8)	0,055973	0,089072	0,628399	0,5305
LOGNFSC(−9)	0,183084	0,064492	2,838873	0,0050
PR	−0,357138	0,290625	−1,228861	0,2207
NPLRATIO	−0,482457	0,114924	−4,198046	0,0000
LOGBILL	0,020834	0,008611	2,419519	0,0165
D2009	−0,037487	0,008479	−4,421080	0,0000
D2012	−0,012590	0,004762	−2,643724	0,0089
D2016	0,023150	0,004973	4,655275	0,0000
Constante	0,575756	0,246701	2,333825	0,0207

Source: Authors’ calculations.

6.2. Cointegration Test

6.2.1. ARDL Bounds Cointegration Test

The bounds cointegration test associated with the ARDL approach indicates an F statistic of 4.942. This value is higher than the upper critical bound at the 5% level (I(1) = 4.725), but lower than the critical value at the 1% level.

As a result, the null hypothesis of no long-term relationship is rejected at the 5% significance level, confirming the existence of a stable cointegration relationship between credit to the non-financial sector and the model's variables.

The parameter k = 0 indicates that, in the chosen specification, no explanatory variable is explicitly integrated into the long-term equation, apart from the constant. This result means that the identified cointegration must be interpreted as the existence of a long-term equilibrium level of credit, rather than as a structural relationship directly linking credit to its observed determinants.

Table 7. ARDL cointegration test using the bounds method (Bounds Test).

Test	Value
F-statistic	4.942
Number of variables (k)	0

Source: Authors’ calculations.

doi:10.20944/preprints202601.1410.v1

Table 8. Critical values.

Threshold	I(0)	I(1)
10 %	3.87	3.87
5 %	4.725	4.725
1 %	6.695	6.695

Source: Authors' calculations.

6.2.2. Long-Term Relationship (Levels Equation)

The cointegration test indicates that the long-term relationship reduces to a positive, highly significant constant (15.079; p = 0.0007). This coefficient indicates the long-term equilibrium level of the logarithm of credit to the non-financial sector, around which short-term dynamic adjustments take place.

The statistical significance of this constant indicates that there is a stable anchor for long-term bank credit, despite temporal fluctuations. Since there are no explanatory variables in the long-term equation (k = 0), this means that the economic factors of credit do not structurally appear in the long term in this model, but rather mainly through the short-term adjustments captured by the error correction model (ECM).

The long-term relationship thus serves as a reference point for equilibrium and ensures the model's dynamic coherence. The analysis of factors explaining credit focuses mainly on short-term dynamics.

Table 9. Level estimation of the long-term relationship (ARDL).

Variable	Coefficient	Standard Error	t-Statistic	p-Value
Constant	15.07904	4.359831	3.458631	0.0007

Note: *The long-term relationship is represented here solely by a constant (k = 0), indicating the existence of a long-term equilibrium level of credit, without explicit identification of structural determinants.* Source: Authors' calculations.

6.2.3. ARDL–ECM Error Correction Model (Short-Term Dynamics)

The coefficient of the error correction term ECM(−1) is negative and statistically significant (−0.038; p = 0.0019), which confirms the existence of a long-term equilibrium return mechanism. This result shows that approximately 3.8% of the deviation from the equilibrium level of credit is corrected each period, indicating a slow but stable adjustment speed. This slowness is explained by the nature of bank credit, which involves long-term commitments, contractual rigidities, and prudential constraints.

The delayed variations in credit (ΔLOGNFSC) have significant effects at various horizons. The negative and significant coefficients at lags 1, 2, 4, 5, 7, and 8 indicate that credit expansion phases are followed by short-term corrective movements, reflecting gradual adjustment mechanisms related to risk management and balance sheet arbitrations. On the other hand, lags 3 and 6 are not statistically significant, indicating the absence of an autonomous effect at these intermediate horizons. These results reveal a short-term dynamic that is non-linear and irregular, rather than an instantaneous adjustment.

The policy rate (PR) has a negative coefficient (−0.357) but is not statistically significant (p = 0.221). This result suggests that, in the short term, variations in the policy rate do not lead to a significant quantitative adjustment in bank credit, confirming the absence of an immediate rate channel in credit dynamics.

Conversely, risk conditions play a decisive role. The coefficient associated with the non-performing loan ratio (NPLRATIO) is negative, high, and highly significant (−0.482; p < 0.01). An increase of 1 percentage point in the non-performing loan ratio leads, on average, to a contraction of about 0.48% in bank credit, underscoring the primacy of prudential considerations and asset quality in credit-granting decisions.

The outstanding Treasury bills (LOGBILL) have a positive and significant effect (0.021; p < 0.05). Although quantitatively modest, this effect suggests that higher levels of public securities holdings are associated with favorable liquidity conditions and an overall expansion of bank balance sheets, rather than a credit displacement mechanism for the non-financial sector.

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Finally, the dummy variables capturing macro-financial shocks are all statistically significant. The negative coefficients for 2009 and 2012 reflect significant contractions in bank credit during periods of economic stress, while the positive coefficient in 2016 reflects a phase of expansion and gradual normalization of credit. These results confirm the high sensitivity of bank credit to macroeconomic cycles and systemic shocks.

The results of the ARDL–ECM model indicate that, in the short term, the dynamics of bank credit are dominated by risk conditions and balance sheet adjustments. At the same time, the policy rate does not play a significant immediate role. The error-correction mechanism confirms a slow but stable convergence toward long-term equilibrium, highlighting that monetary transmission to credit operates indirectly and gradually, rather than through rapid quantitative adjustments

Table 10. Short-run dynamics.

Variable	Coefficient	Erreur-Type	Stat. t	p-Value
ECM(-1)	-0.038183	0.012145	-3.143863	0.0019
ΔLOGNFSC(-1)	-0.152274	0.070400	-2.162969	0.0318
ΔLOGNFSC(-2)	-0.168709	0.067147	-2.512530	0.0128
ΔLOGNFSC(-3)	-0.108873	0.066489	-1.637471	0.1032
ΔLOGNFSC(-4)	-0.185209	0.062745	-2.951761	0.0036
ΔLOGNFSC(-5)	-0.205663	0.063622	-3.232607	0.0014
ΔLOGNFSC(-6)	0.091882	0.065160	1.410099	0.1602
ΔLOGNFSC(-7)	-0.239057	0.063317	-3.775534	0.0002
ΔLOGNFSC(-8)	-0.183084	0.064492	-2.838873	0.0050
PR	-0.357138	0.290625	-1.228861	0.2207
NPLRATIO	-0.482457	0.114924	-4.198046	0.0000
LOGBILL	0.020834	0.008611	2.419519	0.0165
D2009	-0.037487	0.008479	-4.421080	0.0000
D2012	-0.012590	0.004762	-2.643724	0.0089
D2016	0.023150	0.004973	4.655275	0.0000

Source: Authors’ calculations.

6.3. Model Stability Tests

The stability of the coefficients of the ARDL-ECM model was evaluated using the CUSUM and CUSUM of Squares tests, applied to the error-correction version estimated by least squares. These tests, based on recursive residuals, apply only to the sub-period during which all model parameters are correctly identified, due to the model's complex dynamic structure and the high number of lags. Therefore, the stability graphs do not cover the entire 2006-2023 sample, but only the relevant recursive period.

During this sub-period, the CUSUM and CUSUM of Squares statistics remain within the critical bands at the 5% threshold, indicating the absence of structural instability in the estimated coefficients. This result suggests that, once the model's dynamics are established, the observed relationships, such as the speed of adjustment toward long-term equilibrium and the influence of risk conditions on credit dynamics, remain stable over time. The fact that the critical bands are never crossed, even during recent macroeconomic shocks, confirms the robustness of the parameters estimated over the analyzed period.

It should be noted that this temporal limitation is inherent to the CUSUM test methodology and does not affect the validity of the stability analysis. This constraint indicates that the test evaluates the recursive stability of the coefficients once the model is fully specified. In this context, the results provide robust empirical evidence of the stability of the ARDL–ECM model and enhance the credibility of conclusions regarding monetary transmission and the risk mechanisms influencing credit to the non-financial sector.

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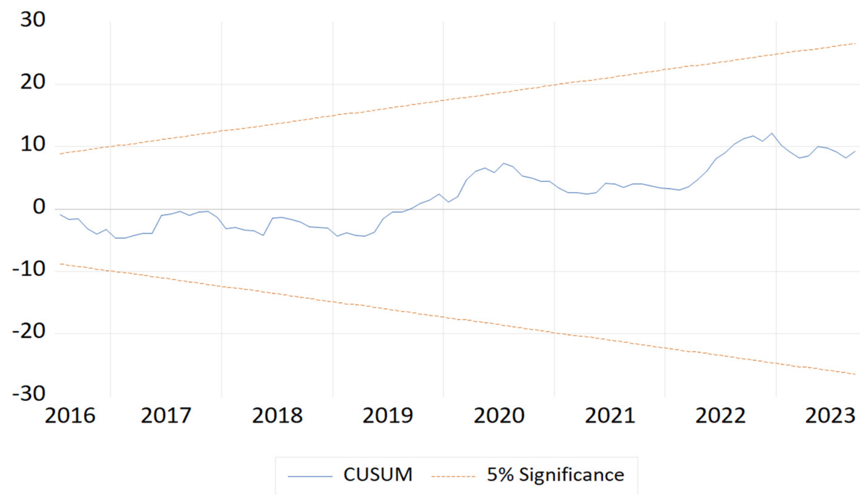

Figure 1. Parameter stability test – CUSUM (ECM equation). ***Note:*** *The CUSUM statistic remains within the 5% confidence bands, indicating the stability of the parameters over the studied period.* Source: Authors' calculations.

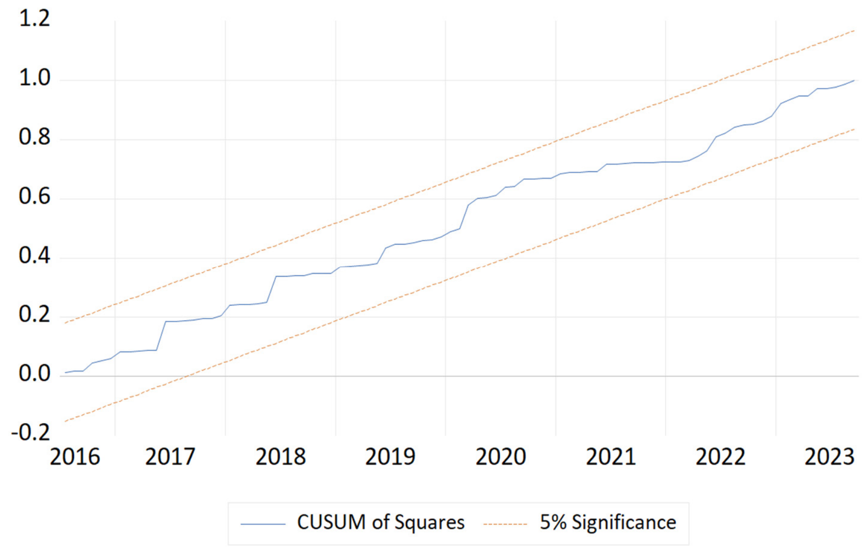

Figure 2. Parameter stability test – CUSUM of Squares (ECM equation). *Note: The CUSUM of Squares statistic remains within the critical bounds at 5%, confirming the absence of progressive structural instability.* Source: Authors' calculations.

6.4. Diagnostic Tests for the ARDL–ECM Model

6.4.1. Diagnosis of Autocorrelation of Residuals

The Breusch–Godfrey test applied to the ECM residuals indicates statistically significant autocorrelation at the monthly horizon. Indeed, the LM statistic based on F is equal to 3.1279 with a p-value of 0.0005, and the Obs*R^2 statistic reaches 35.8584 with a p-value of 0.0003; in both cases, the null hypothesis of no autocorrelation up to 12 lags is rejected at the 5% level. This result is consistent with the strong persistence of credit series and the slow dynamics observed by the ECM. In order to ensure the validity of the inferences, the model results are interpreted using robust standard deviations of the HAC/Newey–West type (with a setting consistent with the monthly frequency, typically 12 lags), which allows for the correction of the impact of autocorrelation on standard errors without modifying the estimated coefficients.

 doi:10.20944/preprints202601.1410.v1

Table 11. Diagnostic of autocorrelation of residuals (Breusch–Godfrey LM).

Test	Statistic	Df	p-Value	Decision (5%)
LM (F-statistic)	3,1279	(12, 176)	0,0005	Rejet de H0
LM (Obs*R-squared)	35,8584	12	0,0003	Rejet de H0

Source: Authors' calculations.

6.4.2. Test for Heteroscedasticity

The White heteroscedasticity test applied to the residuals of the ARDL–ECM model does not reveal non-constant conditional variance at the 5% threshold. Indeed, the F statistic is equal to 1.688 with a p-value of 0.056, while the Obs*R^2 statistic reaches 24.217 with a p-value of 0.062; in both cases, the null hypothesis of homoscedasticity cannot be rejected at the conventional threshold of 5%. These results indicate that the errors' variance remains generally stable over the studied period. Out of caution, and given the model's monthly dynamics and the previously detected residual autocorrelation, statistical inferences are nevertheless based on robust standard deviations of the HAC/Newey–West type, ensuring robust conclusions.

Table 12. Test of heteroscedasticity of residuals (White).

Statistic	Valeur	df	p-Value	Decision
F-statistic	1,6883	(15, 188)	0,0561	H_0 non rejetée (5 %)
Obs*R-squared	24,2169	15	0,0615	H_0 non rejetée (5 %)
Scaled explained SS	20,7709	15	0,1443	H_0 non rejetée

Source: Authors' calculations.

6.5. Structural Break Tests

The Quandt–Andrews test with unknown breakpoint unambiguously rejects the null hypothesis of no structural break in the dynamics of credit to the non-financial sector. All the statistics (Maximum, Exponential, and Average, both LR and Wald) are significant at the 1% threshold, confirming a robust regime change. The break is endogenously located in June 2016, at which point the coefficients associated with the policy rate, credit risk, portfolio arbitrages, and the error-correction term change significantly. This result indicates that, from 2016 onward, the relationship between monetary policy, prudential conditions, and credit adjustment underwent a structural reconfiguration, compatible with a change in the monetary and financial framework. The break thus affects the transmission mechanisms rather than simple cyclical volatility, which reinforces the interpretation in terms of a long-term regime conditioning the short-term dynamics of credit.

Table 13. Quandt–Andrews Structural Break Test.

Statistic	Date of Rupture	Value	p-Value
Maximum LR F-statistic	2016M06	13,103	0,000
Maximum Wald F-statistic	2016M06	52,412	0,000
Exp LR F-statistic	—	4,331	0,000
Exp Wald F-statistic	—	22,915	0,000
Average LR F-statistic	—	5,841	0,000
Average Wald F-statistic	—	23,362	0,000

Note. *probabilities calculated using Hansen's 1997 method.* Source: Authors' calculations.

 doi:10.20944/preprints202601.1410.v1

6.6. Analysis of the Change in Mechanisms (ECM with Interactions)

6.6.1. ECM with Regime Interactions

The results confirm that the structural break identified in 2016 corresponds to a change in transmission mechanisms rather than a level shock. Before 2016, the policy rate had little influence on credit dynamics, and this observation holds after the break, as indicated by the lack of a significant interaction between D2016 and PR. In contrast, the prudential channel is profoundly altered; indeed, the D2016×NPLRATIO interaction is strongly negative and highly significant, showing that after 2016, a deterioration in credit risk leads to a much sharper contraction in credit growth. Moreover, the positive and significant interaction between D2016 and Treasury bill holdings suggests an increased role for liquidity conditions and balance sheet arbitrage in post-2016 credit dynamics. Finally, the error-correction term remains negative and significant, confirming the existence of a long-term equilibrium, with a slight indication of acceleration in adjustment after the break. Overall, the disruption of 2016 reflects a shift towards a credit dynamic more governed by prudential constraints and balance sheet management than by the direct transmission of monetary policy.

Table 14. Test of mechanism changes after 2016.

Variable	Coefficient	t-stat	p-Value
PR	1.0737	0.865	0.388
NPLRATIO	−0.2244	−1.615	0.107
LOGBILL	0.0020	0.105	0.916
ECM (LOGNFSC(-1))	−0.0339	−2.904	0.004
D2016	1.0141	0.712	0.477
D2016 × PR	−0.8375	−0.653	0.514
D2016 × NPLRATIO	−2.3893	−5.061	0.000
D2016 × LOGBILL	0.1121	2.919	0.004
D2016 × ECM	−0.1346	−1.692	0.092

Source: Authors' calculations.

6.6.2. Joint Stability Test of the Mechanisms

The joint Wald test significantly rejects the hypothesis of stability of transmission mechanisms from 2016 onward. The simultaneous significance of the interactions among the post-2016 dummy variable, the policy rate, the non-performing loan ratio, and outstanding Treasury bills indicates a structural reconfiguration of credit dynamics in the non-financial sector from that date onward. This observation confirms that the identified break is not limited to a simple level shift but reflects a change in the economic channels governing credit adjustment. More specifically, the transmission becomes more sensitive to risk conditions and liquidity arbitrages, while the policy rate channel remains secondary.

It is important to note that an additional disruption was also anticipated for the 2020–2021 period, in connection with the pandemic crisis. This period was characterized by a major exogenous macro-financial shock, likely to influence both the supply and demand for credit. However, the absence of a dominant structural break during this phase suggests that the observed mechanisms mainly involve a temporary intensification of existing constraints, rather than a lasting change in transmission channels. As a result, the health crisis constitutes a cyclical shock, addressed by exceptional and transitional measures, without a profound questioning of the structural regime established since 2016.

Thus, the post-2016 period is characterized by a credit dynamic permanently constrained by prudential requirements, risk management, and bank balance-sheet trade-offs. The subsequent crisis episodes, including the pandemic, fit within this already modified structural framework, without fundamentally altering its operational logic.Tableau 14. Test de Wald conjoint – Rupture structurelle postérieure à 2016

 doi:10.20944/preprints202601.1410.v1

Table 15. Joint Wald Test – Stability of Coefficients (Post-Break Period).

Statistique	Valeur	ddl	p-Value
F-statistic	8,597	(3, 184)	0,000
Chi-square	25,791	3	0,000

Note. *The test statistics confirm the rejection of the null hypothesis at the 1% level, indicating that the coefficients associated with the interaction variables are jointly significant. The restrictions are linear in the coefficients.* Source: Authors' calculations.

Table 16. Linear restrictions tested (normalized coefficients).

Coefficient	Estimated Value	Standard Error
C(17)	−0,837461	1,281586
C(18)	−2,389290	0,472089
C(19)	0,112145	0,038414

Source: Authors' calculations.

7. Results, Economic Policy Implications, and Recommendations

The empirical results of this study highlight a transmission of monetary policy to bank credit to the non-financial sector, marked above all by strong short-term inertia. However, this inertia does not indicate a lack of transmission but instead fits within a well-identified long-term equilibrium relationship, accompanied by dynamic adjustment mechanisms strongly conditioned by credit risk and bank balance-sheet trade-offs. By combining an ARDL–ECM approach with stability and structural break tests, the analysis goes beyond a strictly instantaneous reading of monetary transmission. It highlights a process dependent on the macro-financial regime, characteristic of bank-dominated emerging economies.

On the empirical front, the lack of a statistically significant effect of the short-term policy rate first confirms the weakening of the traditional interest rate channel. Nevertheless, this result should not be interpreted as an indication of monetary policy ineffectiveness. It rather reflects the existence of institutional rigidities, long-term contracts, and prudential constraints that limit the immediate adjustment of credit volumes. In this context, the policy rate primarily serves as a macro-financial signal rather than as a direct short-term quantitative lever. On the other hand, the significance of the error-correction term confirms the existence of a gradual adjustment mechanism toward long-term equilibrium, attesting that monetary policy effectively influences the credit trajectory, albeit with a differentiated timeline.

Moreover, the results highlight that risk conditions are the central determinant of short-term credit dynamics. The dominant role of the non-performing loan ratio indicates that prudential and informational considerations, consistent with the theoretical frameworks of credit rationing and the risk channel, primarily guide lending decisions. Thus, banks primarily adjust credit volumes in response to deteriorating perceived risk, which explains the apparent inertia of credit in the face of contemporary monetary impulses, even in the presence of a stable long-term relationship.

Moreover, bank portfolio arbitrages appear as a structuring mechanism of monetary transmission. The positive effect associated with public securities holdings suggests that these assets primarily serve a liquidity management and balance sheet stabilization function, rather than a role in systematically displacing private credit. However, this result highlights an essential intermediate channel: the allocation of balance sheets between sovereign securities and credit to the non-financial sector directly conditions the adequate sensitivity of credit supply to monetary impulses. Thus, monetary transmission is filtered by portfolio arbitrages, particularly in a context where government securities hold a structural place on bank balance sheets.

Moreover, the structural break and joint Wald tests confirm the time-varying nature of transmission mechanisms. This break does not correspond to a simple change in the level of credit, but to a deeper reconfiguration of the adjustment channels, marked by a strengthening of the role of risk and balance sheet constraints. This evolution is consistent with the transformations of the institutional and prudential framework, notably the progressive tightening of requirements for

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equity and risk management in line with international standards. Therefore, if the long-term equilibrium relationship remains intact, the adjustment dynamics toward this equilibrium are profoundly altered, reflecting a change in the macro-financial regime.

On this basis, the empirical results allow explicit testing of the formulated research hypotheses. First, the absence of a statistically significant effect of the short-term policy rate leads to the rejection of hypothesis H1, which posits that monetary transmission occurs immediately through the interest rate channel. Secondly, the existence of a long-term equilibrium relationship between bank credit, as indicated by the cointegration test, validates hypothesis H2. Thirdly, the significance and negative sign of the error correction term confirm the existence of a dynamic adjustment mechanism toward equilibrium, thereby validating hypothesis H3. Finally, the structural break tests and the joint Wald test reject the hypothesis of coefficient stability, confirming the time-varying nature of transmission mechanisms and thus validating hypothesis H4.

Implications of Economic and Prudential Policy

These results have several important implications for monetary authorities, prudential supervisors, and banking institutions.

First, the evaluation of monetary policy transmission to credit cannot be limited to a short-term analysis based solely on the interest rate channel. It must explicitly integrate risk mechanisms and balance sheet adjustments, which condition the effective response of credit supply. In this regard, the analytical frameworks for monetary policy would benefit from closer alignment with prudential supervision tools.

Secondly, although Moroccan banks already have advanced risk management and stress-testing systems, the results highlight the value of more systematically integrating credit risk dynamics into macro-financial analysis of monetary transmission. Thus, stress tests can be mobilized not only as instruments of regulatory compliance but also as analytical tools to anticipate the impact of monetary impulses on credit supply in different macro-financial regimes.

Thirdly, the slow adjustment toward long-term equilibrium argues for evaluating the effectiveness of monetary policy over a medium- to long-term horizon. Indeed, an exclusive focus on the immediate reactions of credit would risk underestimating the cumulative and indirect effects of monetary policy, mediated by risk conditions and prudential constraints.

Fourthly, the results highlight the need for greater monitoring of banks' government securities portfolios. These portfolios should not be viewed solely as liquidity reserves or low-risk assets, but also as key variables conditioning monetary transmission and credit allocation to the non-financial sector. In particular, an excessive accumulation of sovereign bonds can strengthen balance sheets' short-term resilience while altering the sensitivity of credit supply to monetary signals.

Finally, the overall results highlight the importance of close coordination between monetary policy and prudential policy. In a banking system dominated by balance-sheet constraints, the transmission of monetary impulses depends closely on the regulatory framework, portfolio quality, and liquidity trade-offs. Therefore, a coherent articulation between monetary orientation, prudential requirements, and macro-financial supervision appears essential to ensure an effective and stable transmission of monetary policy to the non-financial sector.

8. Conclusions

The findings of this study indicate that the transmission of monetary policy to bank credit for the non-financial sector in Morocco does not occur immediately, nor does it primarily operate through the conventional interest rate channel. Instead, robust empirical results demonstrate that short-term credit inertia coexists with a long-term equilibrium relationship and a statistically significant dynamic adjustment mechanism. Therefore, the effectiveness of monetary policy can only be assessed by considering different time horizons, rather than relying solely on a contemporaneous analysis of credit volumes.

 doi:10.20944/preprints202601.1410.v1

This article makes a scientific contribution by identifying credit risk and bank balance-sheet arbitrage as key elements in the transmission of monetary policy in a bank-dominated emerging economy. The absence of a direct short-term effect on the policy rate does not imply monetary policy neutrality. Instead, transmission occurs indirectly, shaped by prudential constraints, information asymmetry, and risk management practices. Banks primarily adjust credit volumes based on portfolio quality and perceived risks, rather than solely in response to interest rate changes.

Furthermore, the analysis highlights the structuring role of government securities portfolios in the monetary transmission process. Rather than merely serving as a mechanism for crowding out private credit, these portfolios function as tools for balance sheet stabilization and liquidity management, while also influencing the adequate sensitivity of credit supply to monetary impulses. In this context, the interaction between sovereign asset allocation and the financing of the non-financial sector represents an intermediate channel that remains underexplored empirically in emerging economies, constituting an original contribution of this study.

Moreover, structural break tests confirm that monetary transmission mechanisms are not time-invariant. The identified break reflects a shift in the macro-financial regime, characterized by a strengthened role for prudential constraints and balance sheet arbitrage in lending decisions. While the long-term equilibrium relationship remains stable, the adjustment dynamics toward this equilibrium are significantly reconfigured. This finding underscores the importance of explicitly incorporating institutional and regulatory developments into analyses of monetary transmission.

From an economic policy perspective, these results demonstrate that the effectiveness of monetary policy cannot be evaluated solely by the immediate responses in bank credit. It is also necessary to consider risk indicators, the structure of bank balance sheets, and the composition of sovereign securities portfolios. To ensure stable and coherent transmission to the non-financial sector, coordination between monetary and prudential policies is essential.

Overall, this study contributes to the literature by demonstrating that, in bank-dominated emerging economies, monetary transmission is a gradual, indirect process dependent on the macro-financial regime. It is primarily structured by credit risk and balance-sheet arbitrage rather than solely by the interest rate channel. In doing so, the article provides a relevant analytical framework for understanding both the limitations and the conditions for monetary policy effectiveness across comparable institutional contexts.

Author Contributions: Conceptualization, A.B.; methodology, A.B.; software, A.B.; validation, A.B., Y.Z., and T.Q.; formal analysis, A.B.; investigation, A.B.; resources, A.B.; data curation, A.B.; writing original draft preparation, A.B.; writing review and editing, A.B., Y.Z., and T.Q.; visualization, A.B.; supervision, Y.Z. and T.Q.; project administration, A.B.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data: Availability Statement: https://data.gov.ma/data/fr/group/finance; https://www.bkam.ma/Publications-et-recherche/Publications-institutionnelles/Rapport-annuel-presente-a-sm-le-roi; https://www.bkam.ma/Politique-monetaire/Cadre-strategique/Decision-de-la-politique-monetaire/Historique-des-decisions; https://www.bkam.ma/Marches/Principaux-indicateurs/Marche-obligataire/Marche-des-bons-de-tresor/Marche-secondaire/Taux-de-reference-des-bons-du-tresor

Appendix

The empirical results are presented in the form of screenshots because the Student Version of EViews 12 does not permit the direct export or downloading of estimation outputs in editable formats (such as Excel, or Word tables). As a result, it is not technically possible to transfer the original output tables directly from the software into the manuscript.

Accordingly, all reported tables in the paper were carefully reconstructed and formatted based on the original EViews output displayed in the screenshots. Each coefficient, test statistic, and p-value was transcribed faithfully from the software results, ensuring full consistency between the presented tables and the underlying estimations. The screen-shots are provided for transparency and verification purposes, allowing readers and re-viewers to cross-check the reported values against the original software output.

Importantly, this limitation is purely technical and does not affect the estimation procedures, the validity of the econometric methods employed, or the robustness of the results. All estimations were conducted using standard econometric routines in EViews, and the reported findings can be fully replicated using the same dataset and model specifications in any unrestricted version of the software.

Appendix A. Descriptive Analysis and Preliminary Tests

Reproduction at the level of Table 1.

Appendix A.1 Data Description

	LOGBILL	LOGNFSC	NPLRATIO	PR
Mean	25.54369	26.37644	0.100295	0.027183
Median	25.63886	26.46975	0.110256	0.030000
Maximum	26.41126	26.71701	0.177729	0.035000
Minimum	24.90832	25.39344	0.043557	0.015000
Std. Dev.	0.422847	0.295401	0.032828	0.005857
Skewness	0.245533	-1.823923	-0.137725	-0.872955
Kurtosis	1.893632	5.674649	1.832044	2.814017
Jarque-Bera	13.00361	181.5871	12.77996	27.35979
Probability	0.001501	0.000000	0.001678	0.000001
Sum	5440.807	5618.181	21.36276	5.790000
Sum Sq. Dev.	37.90551	18.49949	0.228470	0.007272
Observations	213	213	213	213

Appendix A.2 Collinearity Test

Reproduction at the level of Table 2 and Table 3.

	LOGBILL	LOGNFSC	NPLRATIO	PR
LOGBILL	1	0.68401156...	0.63329252...	-0.8007074...
LOGN...	0.68401156...	1	-0.0499814...	-0.5352534...
NPLRA...	0.63329252...	-0.0499814...	1	-0.5599362...
PR	-0.8007074...	-0.5352534...	-0.5599362...	1

VIF

Variance Inflation Factors
Date: 01/14/26 Time: 13:48
Sample: 2006M01 2023M09
Included observations: 213

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	0.744180	12810.42	NA
PR	4.803593	63.92439	2.823236
NPLRATIO	0.091614	17.55526	1.691600
LOGBILL	0.001056	11867.22	3.235832

Appendix A.3 ADF and PP Tests: Stationary Result

Reproduction at the level of Table 3

Appendix A.3 1. ADF and PP Tests: Stationary Result of LOGBILL

Null Hypothesis: LOGBILL has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.595542	0.9894
Test critical values:	1% level	-3.461327	
	5% level	-2.875062	
	10% level	-2.574054	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOGBILL)
Method: Least Squares
Date: 01/05/26 Time: 18:37
Sample (adjusted): 2006M03 2023M09
Included observations: 211 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGBILL(-1)	0.003167	0.005318	0.595542	0.5521
D(LOGBILL(-1))	-0.190536	0.068389	-2.786057	0.0058
C	-0.073749	0.135804	-0.543055	0.5877

R-squared	0.036460	Mean dependent var	0.006001
Adjusted R-squared	0.027195	S.D. dependent var	0.032666
S.E. of regression	0.032218	Akaike info criterion	-4.018449
Sum squared resid	0.215908	Schwarz criterion	-3.970792
Log likelihood	426.9464	Hannan-Quinn criter.	-3.999185
F-statistic	3.935282	Durbin-Watson stat	1.998460
Prob(F-statistic)	0.021012		

Null Hypothesis: LOGBILL has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		0.513632	0.9869
Test critical values:	1% level	-3.461178	
	5% level	-2.874997	
	10% level	-2.574019	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.001057
HAC corrected variance (Bartlett kernel)	0.000796

Phillips-Perron Test Equation
Dependent Variable: D(LOGBILL)
Method: Least Squares
Date: 01/05/26 Time: 18:37
Sample (adjusted): 2006M02 2023M09
Included observations: 212 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGBILL(-1)	0.001639	0.005348	0.306490	0.7595
C	-0.035827	0.136598	-0.262282	0.7934

R-squared	0.000447	Mean dependent var	0.006033
Adjusted R-squared	-0.004313	S.D. dependent var	0.032591
S.E. of regression	0.032662	Akaike info criterion	-3.995842
Sum squared resid	0.224024	Schwarz criterion	-3.964176
Log likelihood	425.5592	Hannan-Quinn criter.	-3.983043
F-statistic	0.093936	Durbin-Watson stat	2.377264
Prob(F-statistic)	0.759535		

 doi:10.20944/preprints202601.1410.v1

Appendix A.3.2. ADF and PP Tests: Stationary Result of LOGNFSC

Null Hypothesis: LOGNFSC has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.470388	0.0000
Test critical values:	1% level	-3.461178	
	5% level	-2.874997	
	10% level	-2.574019	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOGNFSC)
Method: Least Squares
Date: 01/05/26 Time: 18:40
Sample (adjusted): 2006M02 2023M09
Included observations: 212 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGNFSC(-1)	-0.025596	0.003956	-6.470388	0.0000
C	0.681239	0.104344	6.528792	0.0000

R-squared	0.166223	Mean dependent var	0.006136
Adjusted R-squared	0.162253	S.D. dependent var	0.018539
S.E. of regression	0.016968	Akaike info criterion	-5.305575
Sum squared resid	0.060462	Schwarz criterion	-5.273909
Log likelihood	564.3909	Hannan-Quinn criter.	-5.292776
F-statistic	41.86592	Durbin-Watson stat	2.033265
Prob(F-statistic)	0.000000		

Null Hypothesis: LOGNFSC has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.795868	0.0000
Test critical values:	1% level	-3.461178	
	5% level	-2.874997	
	10% level	-2.574019	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000285
HAC corrected variance (Bartlett kernel)	0.000255

Phillips-Perron Test Equation
Dependent Variable: D(LOGNFSC)
Method: Least Squares
Date: 01/05/26 Time: 18:41
Sample (adjusted): 2006M02 2023M09
Included observations: 212 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGNFSC(-1)	-0.025596	0.003956	-6.470388	0.0000
C	0.681239	0.104344	6.528792	0.0000

R-squared	0.166223	Mean dependent var	0.006136
Adjusted R-squared	0.162253	S.D. dependent var	0.018539
S.E. of regression	0.016968	Akaike info criterion	-5.305575
Sum squared resid	0.060462	Schwarz criterion	-5.273909
Log likelihood	564.3909	Hannan-Quinn criter.	-5.292776
F-statistic	41.86592	Durbin-Watson stat	2.033265
Prob(F-statistic)	0.000000		

doi:10.20944/preprints202601.1410.v1

Appendix A.3.3. ADF and PP Tests: Stationary Result of NPLRATIO

Null Hypothesis: NPLRATIO has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.011863	0.2817
Test critical values:	1% level	-3.461178	
	5% level	-2.874997	
	10% level	-2.574019	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(NPLRATIO)
Method: Least Squares
Date: 01/05/26 Time: 18:41
Sample (adjusted): 2006M02 2023M09
Included observations: 212 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NPLRATIO(-1)	-0.017869	0.008882	-2.011863	0.0455
C	0.001620	0.000935	1.732352	0.0847

R-squared	0.018910	Mean dependent var	-0.000168
Adjusted R-squared	0.014238	S.D. dependent var	0.004259
S.E. of regression	0.004229	Akaike info criterion	-8.084312
Sum squared resid	0.003756	Schwarz criterion	-8.052646
Log likelihood	858.9370	Hannan-Quinn criter.	-8.071513
F-statistic	4.047594	Durbin-Watson stat	1.781109
Prob(F-statistic)	0.045512		

Null Hypothesis: NPLRATIO has a unit root
Exogenous: Constant
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.038048	0.2705
Test critical values:	1% level	-3.461178	
	5% level	-2.874997	
	10% level	-2.574019	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1.77E-05
HAC corrected variance (Bartlett kernel)	2.89E-05

Phillips-Perron Test Equation
Dependent Variable: D(NPLRATIO)
Method: Least Squares
Date: 01/05/26 Time: 18:41
Sample (adjusted): 2006M02 2023M09
Included observations: 212 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NPLRATIO(-1)	-0.017869	0.008882	-2.011863	0.0455
C	0.001620	0.000935	1.732352	0.0847

R-squared	0.018910	Mean dependent var	-0.000168
Adjusted R-squared	0.014238	S.D. dependent var	0.004259
S.E. of regression	0.004229	Akaike info criterion	-8.084312
Sum squared resid	0.003756	Schwarz criterion	-8.052646
Log likelihood	858.9370	Hannan-Quinn criter.	-8.071513
F-statistic	4.047594	Durbin-Watson stat	1.781109
Prob(F-statistic)	0.045512		

 doi:10.20944/preprints202601.1410.v1

Appendix A.3.4. ADF and PP Tests: Stationary Result of PR

Null Hypothesis: PR has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.984489	0.2936
Test critical values:	1% level	-3.461630	
	5% level	-2.875195	
	10% level	-2.574125	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PR)
Method: Least Squares
Date: 01/05/26 Time: 18:42
Sample (adjusted): 2006M05 2023M09
Included observations: 209 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PR(-1)	-0.017450	0.008793	-1.984489	0.0485
D(PR(-1))	0.007477	0.059361	0.125958	0.8999
D(PR(-2))	0.007477	0.059361	0.125958	0.8999
D(PR(-3))	0.527477	0.059361	8.885902	0.0000
C	0.000467	0.000244	1.916627	0.0567

R-squared	0.284124	Mean dependent var	-1.20E-05
Adjusted R-squared	0.270088	S.D. dependent var	0.000867
S.E. of regression	0.000740	Akaike info criterion	-11.55510
Sum squared resid	0.000112	Schwarz criterion	-11.47514
Log likelihood	1212.508	Hannan-Quinn criter.	-11.52278
F-statistic	20.24142	Durbin-Watson stat	2.018726
Prob(F-statistic)	0.000000		

Null Hypothesis: PR has a unit root
Exogenous: Constant
Bandwidth: 9 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.564069	0.4992
Test critical values:	1% level	-3.461178	
	5% level	-2.874997	
	10% level	-2.574019	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	7.32E-07
HAC corrected variance (Bartlett kernel)	1.38E-06

Phillips-Perron Test Equation
Dependent Variable: D(PR)
Method: Least Squares
Date: 01/05/26 Time: 18:42
Sample (adjusted): 2006M02 2023M09
Included observations: 212 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PR(-1)	-0.012159	0.010085	-1.205660	0.2293
C	0.000319	0.000280	1.136543	0.2570

R-squared	0.006874	Mean dependent var	-1.18E-05
Adjusted R-squared	0.002145	S.D. dependent var	0.000860
S.E. of regression	0.000860	Akaike info criterion	-11.27098
Sum squared resid	0.000155	Schwarz criterion	-11.23932
Log likelihood	1196.724	Hannan-Quinn criter.	-11.25818
F-statistic	1.453617	Durbin-Watson stat	1.989883
Prob(F-statistic)	0.229305		

 doi:10.20944/preprints202601.1410.v1

Appendix A.4. Multiple Structural Fracture Test (Bai–Perron)

Reproduction at the level of Table 5.

Multiple breakpoint tests
Bai-Perron tests of L+1 vs. L sequentially determined breaks
Date: 01/05/26 Time: 21:06
Sample: 2006M01 2023M09
Included observations: 213
Breaking variables: C PR NPLRATIO LOGBILL
Break test options: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Sequential F-statistic determined breaks: 3

Break Test	F-statistic	Scaled F-statistic	Critical Value**
0 vs. 1 *	182.1484	728.5938	16.19
1 vs. 2 *	28.78463	115.1385	18.11
2 vs. 3 *	19.04401	76.17605	18.93
3 vs. 4	1.476139	5.904554	19.64

* Significant at the 0.05 level.
** Bai-Perron (Econometric Journal, 2003) critical values.

Break dates:

	Sequential	Repartition
1	2009M01	2009M01
2	2012M09	2011M08
3	2016M06	2016M06

Appendix B Estimation du Modèle ARDL

Reproduction at the level of Table 6

Dependent Variable: LOGNFSC
Method: ARDL
Date: 01/06/26 Time: 18:36
Sample (adjusted): 2006M10 2023M09
Included observations: 204 after adjustments
Maximum dependent lags: 12 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (12 lags, custom fixed):
Fixed regressors: PR NPLRATIO LOGBILL D2009 D2012 D2016 C
Number of models evaluated: 12
Selected Model: ARDL(9)
Note: final equation sample is larger than selection sample

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LOGNFSC(-1)	0.809544	0.071178	11.37358	0.0000
LOGNFSC(-2)	-0.016436	0.092766	-0.177176	0.8596
LOGNFSC(-3)	0.059836	0.087795	0.681545	0.4964
LOGNFSC(-4)	-0.076336	0.085054	-0.897497	0.3706
LOGNFSC(-5)	-0.020454	0.082826	-0.246951	0.8052
LOGNFSC(-6)	0.297546	0.082833	3.592097	0.0004
LOGNFSC(-7)	-0.330939	0.086041	-3.846299	0.0002
LOGNFSC(-8)	0.055973	0.089072	0.628399	0.5305
LOGNFSC(-9)	0.183084	0.064492	2.838873	0.0050
PR	-0.357138	0.290625	-1.228861	0.2207
NPLRATIO	-0.482457	0.114924	-4.198046	0.0000
LOGBILL	0.020834	0.008611	2.419519	0.0165
D2009	-0.037487	0.008479	-4.421080	0.0000
D2012	-0.012590	0.004762	-2.643724	0.0089
D2016	0.023150	0.004973	4.655275	0.0000
C	0.575756	0.246701	2.333825	0.0207

R-squared	0.996557	Mean dependent var	26.41633
Adjusted R-squared	0.996282	S.D. dependent var	0.230491
S.E. of regression	0.014053	Akaike info criterion	-5.616706
Sum squared resid	0.037130	Schwarz criterion	-5.356462
Log likelihood	588.9040	Hannan-Quinn criter.	-5.511433
F-statistic	3627.822	Durbin-Watson stat	1.879780
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

doi:10.20944/preprints202601.1410.v1

Appendix C Cointegration Test and ARDL-ECM Error Correction Model (Short-Term Dynamics)

Reproduction at the level of Tables 7, 8, 9 and 10

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LOGNFSC)
Selected Model: ARDL(9)
Case 2: Restricted Constant and No Trend
Date: 01/06/26 Time: 18:37
Sample: 2006M01 2023M09
Included observations: 204

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.575756	0.246701	2.333825	0.0207
LOGNFSC(-1)*	-0.038183	0.012145	-3.143863	0.0019
D(LOGNFSC(-1))	-0.152274	0.070400	-2.162969	0.0318
D(LOGNFSC(-2))	-0.168709	0.067147	-2.512530	0.0128
D(LOGNFSC(-3))	-0.108873	0.066489	-1.637471	0.1032
D(LOGNFSC(-4))	-0.185209	0.062745	-2.951761	0.0036
D(LOGNFSC(-5))	-0.205663	0.063622	-3.232607	0.0014
D(LOGNFSC(-6))	0.091882	0.065160	1.410099	0.1602
D(LOGNFSC(-7))	-0.239057	0.063317	-3.775534	0.0002
D(LOGNFSC(-8))	-0.183084	0.064492	-2.838873	0.0050
PR	-0.357138	0.290625	-1.228861	0.2207
NPLRATIO	-0.482457	0.114924	-4.198046	0.0000
LOGBILL	0.020834	0.008611	2.419519	0.0165
D2009	-0.037487	0.008479	-4.421080	0.0000
D2012	-0.012590	0.004762	-2.643724	0.0089
D2016	0.023150	0.004973	4.655275	0.0000

* p-value incompatible with t-Bounds distribution.

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15.07904	4.359831	3.458631	0.0007

EC = LOGNFSC - (15.0790)

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	4.942139	10%	3.8	3.8
k	0	5%	4.6	4.6
		2.5%	5.39	5.39
		1%	6.44	6.44
Actual Sample Size	204		Finite Sample: n=80	
		10%	3.87	3.87
		5%	4.725	4.725
		1%	6.695	6.695

Appendix D ARDL–ECM Diagnostic Test

Reproduction at the level of Table 11 (Breusch–Godfrey LM)

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 12 lags

F-statistic	3.127864	Prob. F(12,176)	0.0005
Obs*R-squared	35.85844	Prob. Chi-Square(12)	0.0003

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 01/06/26 Time: 20:50
Sample: 2006M10 2023M09
Included observations: 204
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.305311	0.271922	1.122787	0.2631
D(LOGNFSC(-1))	-0.984409	0.361429	-2.723657	0.0071
D(LOGNFSC(-2))	0.120784	0.260520	0.463629	0.6435
D(LOGNFSC(-3))	-0.339970	0.224178	-1.516517	0.1312
D(LOGNFSC(-4))	0.146269	0.182670	0.800728	0.4244
D(LOGNFSC(-5))	-0.423010	0.174077	-2.430019	0.0161
D(LOGNFSC(-6))	0.215287	0.174653	1.232659	0.2193
D(LOGNFSC(-7))	0.046185	0.160573	0.287624	0.7740
D(LOGNFSC(-8))	-0.060550	0.172128	-0.351772	0.7254
PR	-0.111955	0.290467	-0.385433	0.7004
NPLRATIO	-0.239644	0.153896	-1.557178	0.1212
LOGBILL	0.013224	0.009576	1.380969	0.1690
D2009	-0.019799	0.011523	-1.718244	0.0875
D2012	-0.010346	0.005888	-1.757091	0.0806
D2016	0.013399	0.006839	1.959196	0.0517
LOGNFSC(-1)	-0.022395	0.014687	-1.524836	0.1291
RESID(-1)	1.077998	0.378509	2.848014	0.0049
RESID(-2)	-0.280623	0.310416	-0.904021	0.3672
RESID(-3)	0.156332	0.263217	0.593929	0.5533
RESID(-4)	-0.220001	0.215606	-1.020385	0.3089
RESID(-5)	0.303030	0.193596	1.565273	0.1193
RESID(-6)	-0.557296	0.180291	-3.091089	0.0023
RESID(-7)	0.137787	0.158270	0.870584	0.3852
RESID(-8)	-0.209548	0.149097	-1.405448	0.1617
RESID(-9)	-0.175238	0.118644	-1.477004	0.1415
RESID(-10)	-0.044190	0.104624	-0.422373	0.6733
RESID(-11)	0.064695	0.092357	0.700482	0.4846
RESID(-12)	0.058066	0.089917	0.645775	0.5193

R-squared	0.175777	Mean dependent var	2.45E-17
Adjusted R-squared	0.049333	S.D. dependent var	0.013524
S.E. of regression	0.013186	Akaike info criterion	-5.692373
Sum squared resid	0.030604	Schwarz criterion	-5.236945
Log likelihood	608.6220	Hannan-Quinn criter.	-5.508144
F-statistic	1.390162	Durbin-Watson stat	2.013566
Prob(F-statistic)	0.107446		

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Appendix E Heteroscedasticity Test of Residues (White)

Reproduction at the level of Table 12

Heteroskedasticity Test: White
Null hypothesis: Homoskedasticity

F-statistic	1.688251	Prob. F(15,188)	0.0561
Obs*R-squared	24.21694	Prob. Chi-Square(15)	0.0615
Scaled explained SS	20.77090	Prob. Chi-Square(15)	0.1443

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 01/06/26 Time: 21:02
Sample: 2006M10 2023M09
Included observations: 204

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000973	0.002350	0.414150	0.6792
D(LOGNFSC(-1))^2	-0.019717	0.033267	-0.592696	0.5541
D(LOGNFSC(-2))^2	0.014506	0.034769	0.417219	0.6770
D(LOGNFSC(-3))^2	0.040879	0.032996	1.238914	0.2169
D(LOGNFSC(-4))^2	-0.027223	0.029681	-0.917184	0.3602
D(LOGNFSC(-5))^2	-0.002326	0.029635	-0.078485	0.9375
D(LOGNFSC(-6))^2	0.067334	0.029261	2.301171	0.0225
D(LOGNFSC(-7))^2	0.036853	0.029799	1.236735	0.2177
D(LOGNFSC(-8))^2	-0.003663	0.028260	-0.129605	0.8970
PR^2	-0.000889	0.117539	-0.007562	0.9940
NPLRATIO^2	-0.018268	0.010685	-1.709591	0.0890
LOGBILL^2	3.24E-06	3.11E-06	1.042375	0.2986
D2009^2	6.97E-05	0.000129	0.538777	0.5907
D2012^2	-6.77E-05	7.50E-05	-0.903410	0.3675
D2016^2	0.000101	8.67E-05	1.171020	0.2431
LOGNFSC(-1)^2	-4.04E-06	4.40E-06	-0.917059	0.3603

R-squared	0.118710	Mean dependent var	0.000182
Adjusted R-squared	0.048395	S.D. dependent var	0.000259
S.E. of regression	0.000253	Akaike info criterion	-13.65152
Sum squared resid	1.20E-05	Schwarz criterion	-13.39127
Log likelihood	1408.455	Hannan-Quinn criter.	-13.54624
F-statistic	1.688251	Durbin-Watson stat	2.048200
Prob(F-statistic)	0.056112		

Appendix E Structural Failure Tests

Reproduction at the level of Table 13

Quandt-Andrews unknown breakpoint test
Null Hypothesis: No breakpoints within 15% trimmed data
Varying regressors: PR NPLRATIO LOGBILL LOGNFSC(-1)
Equation Sample: 2006M10 2023M09
Test Sample: 2009M05 2021M03
Number of breaks compared: 143

Statistic	Value	Prob.
Maximum LR F-statistic (2016M06)	13.10292	0.0000
Maximum Wald F-statistic (2016M06)	52.41168	0.0000
Exp LR F-statistic	4.330714	0.0000
Exp Wald F-statistic	22.91456	0.0000
Ave LR F-statistic	5.840530	0.0000
Ave Wald F-statistic	23.36212	0.0000

Note: probabilities calculated using Hansen's (1997) method

Appendix F Analyse du Changement des Mécanismes

Reproduction at the level of Table 14

Dependent Variable: D(LOGNFSC)
Method: Least Squares
Date: 01/06/26 Time: 21:53
Sample (adjusted): 2006M10 2023M09
Included observations: 204 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.872892	0.533188	1.637120	0.1033
D(LOGNFSC(-1))	-0.209741	0.072105	-2.908830	0.0041
D(LOGNFSC(-2))	-0.199221	0.067898	-2.934118	0.0038
D(LOGNFSC(-3))	-0.180800	0.068398	-2.643353	0.0089
D(LOGNFSC(-4))	-0.229964	0.066587	-3.453601	0.0007
D(LOGNFSC(-5))	-0.221636	0.065943	-3.361035	0.0009
D(LOGNFSC(-6))	0.026595	0.065871	0.403745	0.6869
D(LOGNFSC(-7))	-0.230978	0.061963	-3.727702	0.0003
D(LOGNFSC(-8))	-0.194013	0.061420	-3.158791	0.0019
PR	1.073674	1.240670	0.865399	0.3879
NPLRATIO	-0.224371	0.138546	-1.619470	0.1071
LOGBILL	0.001998	0.018954	0.105392	0.9162
LOGNFSC(-1)	-0.033887	0.011668	-2.904363	0.0041
D2009	-0.032617	0.009124	-3.574918	0.0004
D2012	-0.009259	0.006619	-1.398921	0.1635
D2016	1.014101	1.424356	0.711972	0.4774
D2016*PR	-0.837461	1.281586	-0.653457	0.5143
D2016*NPLRATIO	-2.389290	0.472089	-5.061104	0.0000
D2016*LOGBILL	0.112145	0.038414	2.919396	0.0039
D2016*LOGNFSC(-1)	-0.134596	0.079565	-1.691651	0.0924

R-squared	0.505179	Mean dependent var	0.005605
Adjusted R-squared	0.454083	S.D. dependent var	0.017951
S.E. of regression	0.013263	Akaike info criterion	-5.714767
Sum squared resid	0.032367	Schwarz criterion	-5.389461
Log likelihood	602.9062	Hannan-Quinn criter.	-5.583175
F-statistic	9.886912	Durbin-Watson stat	1.844204
Prob(F-statistic)	0.000000		

Appendix J Joint Stability Test of Mechanisms

Reproduction at the level of Tables 15 and 16.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	8.596960	(3, 184)	0.0000
Chi-square	25.79088	3	0.0000

Null Hypothesis: C(17)=0, C(18)=0, C(19)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(17)	-0.837461	1.281586
C(18)	-2.389290	0.472089
C(19)	0.112145	0.038414

Restrictions are linear in coefficients.

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