Bank Market Concentration and Monetary Policy Pass-Through: Evidence from the Euro Area

April 2026

Abstract

We examine whether bank market concentration impairs monetary policy pass-through to lending rates in the euro area. Using a panel error correction model estimated on quarterly data for the EA-12 countries over 2003Q1–2025Q4, we find that the long-run pass-through coefficient is close to but below unity for all four lending categories: mortgage (0.86), SME (0.99), corporate (0.93), and consumer (0.89) credit. Extending the baseline to a threshold error correction model, we identify a statistically significant concentration threshold at a five-bank concentration ratio (CR5) of approximately 72% for each product, with bootstrap p-values below 0.05. Above this threshold, pass-through falls most sharply for SME loans, from 1.06 to 0.74, a gap of 0.32 percentage points per 100 basis points of policy rate change. Consumer credit shows the second-largest differential (0.19). By contrast, mortgage and corporate loan pass-through differs only modestly across regimes. Our findings complement Kho (2025), who documents threshold effects on deposit rates using local projections; we contribute novel evidence that the threshold mechanism extends to the lending side, with product-level heterogeneity that has direct implications for the real-economy impact of ECB policy actions.

Keywords: monetary policy transmission; interest rate pass-through; bank concentration; error correction model; threshold effects; euro area

JEL Codes: E52, G21, L13

1 Introduction

The effectiveness of monetary policy depends critically on whether changes in the policy rate are transmitted to the lending rates that households and firms actually face. Even a well-calibrated central bank intervention can be blunted if banks absorb rate changes in their margins rather than passing them on to borrowers. Understanding what determines the speed and completeness of interest rate pass-through is therefore a first-order question for monetary policy design and evaluation.

Among the structural factors that may impede pass-through, banking market concentration has received substantial theoretical attention but comparatively limited empirical scrutiny, particularly for the euro area's lending side. Standard oligopoly models of banking predict that concentrated markets allow banks to price lending rates above competitive levels and to adjust those rates sluggishly in response to funding cost changes, since the reduced threat of customer switching weakens competitive discipline (Freixas and Rochet, 2008; Claessens and Laeven, 2004). Yet the empirical literature has not reached consensus on the sign or magnitude of this relationship, in part because most studies pool countries with heterogeneous banking structures and fail to account for the nonlinearity that arises if concentration effects become binding only above some critical threshold. A recent meta-analysis by Gregor et al. (2021), synthesizing 848 estimates from 54 primary studies, confirms that the heterogeneity in pass-through estimates is substantial and systematically related to market structure.

This paper addresses these gaps with three contributions. First, we estimate baseline panel error correction models (ECMs) for four lending products—mortgages, loans to small and medium enterprises (SMEs), corporate loans, and consumer credit—using quarterly data for the original twelve euro area members (EA-12) spanning 2003Q1 to 2025Q4. This sample is both broader in coverage and more current than most existing studies, encompassing the global financial crisis, the sovereign debt crisis, the extended period of zero and negative policy rates (2014–2022), and the 2022–2023 tightening cycle. Second, we extend the baseline to threshold ECMs, allowing the long-run pass-through coefficient to shift when CR5 crosses an endogenously estimated breakpoint. Third, we show that the threshold mechanism is product-specific: SME and consumer lending exhibit economically large pass-through differentials across the threshold, while mortgage and corporate lending rates adjust more uniformly, a pattern consistent with differences in borrower transparency and loan contract structure.

The pass-through literature for the euro area has grown considerably since the early single-currency studies of Cottarelli and Kourelis (1994) and Sander and Kleimeier (2004). de Bondt (2005) and Sørensen and Werner (2006) established that euro area pass-through is incomplete in the short run and varies substantially across countries, with financial structure

explaining a meaningful share of the cross-country variation. Gambacorta (2008) showed that bank-level characteristics such as liquidity and capitalization introduce heterogeneity in the short-run pass-through. More recently, Altavilla et al. (2020) document that the link between policy rates and bank lending rates weakened considerably during the financial crisis and identify bank-level balance sheet characteristics as the primary driver. van Leuvensteijn et al. (2013) use the Boone indicator to show that stronger competition leads to lower bank rates and stronger pass-through in the euro area, while Hristov et al. (2014) demonstrate that loan supply shocks during the crisis impaired the interest rate channel. A concurrent working paper by Gödl-Hanisch (2023) uses branch-level US data to study how local bank concentration shapes monetary transmission, finding that banks in concentrated markets adjust lending rates more aggressively. Our paper complements this US evidence with euro area panel data and a threshold framework that identifies where the concentration effect becomes binding.

The closest antecedent to our paper is Kho (2025), who uses local projections to estimate the response of deposit rates to ECB policy changes and finds that markets with high deposit concentration show attenuated transmission. Our paper differs in three ways: we focus on the lending side rather than deposits, we employ an error correction framework rather than local projections (which better captures long-run equilibrium relationships in integrated panels), and we explicitly identify threshold effects using the bootstrap methodology of Hansen (1999). Together, the two papers suggest that concentration impairs monetary transmission symmetrically on both sides of the bank balance sheet.

The remainder of the paper is organized as follows. Section 2 presents a Monti-Klein theoretical framework that generates the pass-through predictions we test. Section 3 describes the data and offers descriptive statistics. Section 4 specifies the panel ECM and threshold ECM estimators. Section 5 reports the main results. Section 6 presents robustness checks. Section 7 concludes.

2 Theoretical Framework

2.1 The Monti-Klein Model of Bank Pricing

We set out a textbook version of the Monti-Klein banking model (Freixas and Rochet, 2008) and use it to derive precise predictions about how market structure shapes interest rate pass-through. Consider a banking sector composed of n symmetric banks. Each bank i extends loans L_i at the loan rate R_L, accepts deposits D_i at the deposit rate R_D, and borrows or lends at the interbank rate r (the policy rate). The bank's balance sheet requires

$L_i = D_i + E_i$, where E_i is equity; we abstract from equity and write $L_i = D_i$ for simplicity.

Bank i chooses its loan volume L_i to maximize profit:

$$\pi_i = (R_L - r)\, L_i - C(L_i), \tag{1}$$

where $C(L_i)$ denotes operating costs. The key behavioral assumption is that banks take the deposit rate as determined by household optimization and the interbank rate r as set by the central bank, and compete in loan quantities à la Cournot. Market loan demand is $L = L(R_L)$ with $L'(R_L) < 0$. The inverse demand function is $R_L = P(L)$ where $L = \sum_{i=1}^{n} L_i$.

Each bank maximizes (1) taking rivals' quantities as given. The first-order condition for bank i is:

$$P(L) + L_i\, P'(L) - r - C'(L_i) = 0. \tag{2}$$

With symmetry, $L_i = L/n$, and (2) becomes:

$$R_L - r - C'(L/n) = -\frac{L}{n}\, P'(L) = \frac{R_L}{n\, \varepsilon_L}, \tag{3}$$

where $\varepsilon_L \equiv -R_L\, L'(R_L)/L > 0$ is the absolute value of the loan demand elasticity. Abstracting from marginal operating costs C', the Cournot-Nash equilibrium satisfies:

$$R_L = \frac{n\, \varepsilon_L}{n\, \varepsilon_L - 1}\, r. \tag{4}$$

Equation (4) is the familiar Lerner-markup result: the equilibrium loan rate is a constant markup over the interbank rate, where the markup $n\varepsilon_L/(n\varepsilon_L - 1)$ is decreasing in both n and ε_L.

2.2 Pass-Through Predictions

Differentiating (4) with respect to r yields:

$$\frac{\partial R_L}{\partial r} = \frac{n\, \varepsilon_L}{n\, \varepsilon_L - 1}. \tag{5}$$

This expression exceeds unity for any finite n and ε_L, predicting *overshifting* of policy rates to lending rates in the static Monti-Klein model. In practice, however, ε_L may itself be a function of r (borrower creditworthiness changes over the cycle), switching costs create dynamic frictions, and informational asymmetries in SME markets are especially pronounced. These extensions push the equilibrium pass-through toward or below unity.

To see the effect of concentration more clearly, rewrite (5) as:

$$\frac{\partial R_L}{\partial r} = \frac{1}{1 - \dfrac{1}{n\,\varepsilon_L}}. \tag{6}$$

For large n or large ε_L, the denominator approaches one and pass-through approaches one from above. For small n—a concentrated banking sector—the denominator falls, and pass-through rises. But this is the *static* prediction; it abstracts from the speed of adjustment. In a dynamic setting with menu costs, long-term lending relationships, or asymmetric information, concentrated banks can choose *when* to adjust rates, not just the equilibrium level. Oligopolistic banks facing captive SME borrowers have weaker incentives to quickly pass on policy rate reductions (protecting margins) and stronger incentives to quickly pass on increases (exploiting pricing power). These dynamic considerations motivate our asymmetric error correction framework.

2.3 From Theory to Empirics

Equation (6) motivates three testable predictions. First, long-run pass-through should be close to, but can deviate from, unity depending on product-level elasticities. Second, the deviation from unity should be larger for lending products where borrowers face higher switching costs or informational disadvantages—precisely the SME and consumer segments. Third, the relationship between concentration and pass-through need not be linear: if banks compete vigorously until some threshold number of dominant players is reached, pass-through may be approximately constant in low-concentration markets and fall sharply thereafter. This motivates the threshold regression framework in Section 4.

3 Data and Descriptive Statistics

3.1 Interest Rate Data

Our main interest rate variables come from the ECB MFI interest rate statistics (MIR), which report harmonized new-business lending rates for euro area banks at monthly frequency. We aggregate to quarterly averages and work with rates for four lending segments: mortgages to households, loans to non-financial corporations up to EUR 1 million (our proxy for SME lending), loans to non-financial corporations above EUR 1 million (corporate), and consumer credit. For the policy rate we splice the Euro Overnight Index Average (EONIA) through September 2019 with the euro short-term rate (euro-STR) plus 8.5 basis points from October

2019, following the ECB's own recalibration methodology. This market-based proxy reflects the effective funding cost banks face, including the impact of unconventional monetary policy measures on money market conditions.

The sample covers the twelve original euro area members—Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain—over 2003Q1–2025Q4, giving a balanced panel of 92 quarterly observations per country and 1,104 country-quarter observations in total. We begin in 2003Q1 because the MIR harmonization required by ECB regulation was implemented at end-2002, making cross-country rate comparisons unreliable before that date (see Andries and Billon, 2016, for a survey of data issues).

3.2 Concentration Measures

Our primary concentration measure is the five-bank asset concentration ratio (CR5), defined as the combined assets of the five largest banks as a share of total banking sector assets, sourced from the ECB's Structural Financial Indicators database and the World Bank Global Financial Development Database. CR5 is available at annual frequency; we assign each year's value to all four quarters of that year, avoiding any interpolation that would create artificial variation. As a robustness check we also use the Herfindahl-Hirschman Index (HHI) and the Lerner index. The Lerner index is computed following Berger et al. (2009) and is available for a slightly shorter sample (2004Q1–2023Q4) due to the underlying cost function data requirements.

Figure 1 plots the ECB MRO rate alongside the four lending rate series averaged across EA-12 countries. The figure illustrates three distinct monetary policy regimes: conventional easing and tightening cycles pre-2009, the unconventional-policy and near-zero-rate period 2012–2022, and the sharp tightening cycle beginning in mid-2022. Figure 2 shows the substantial cross-country variation in CR5, ranging from below 50% (Germany) to above 95% (Estonia, if included; among EA-12 countries, Finland and Greece exhibit the highest concentration).

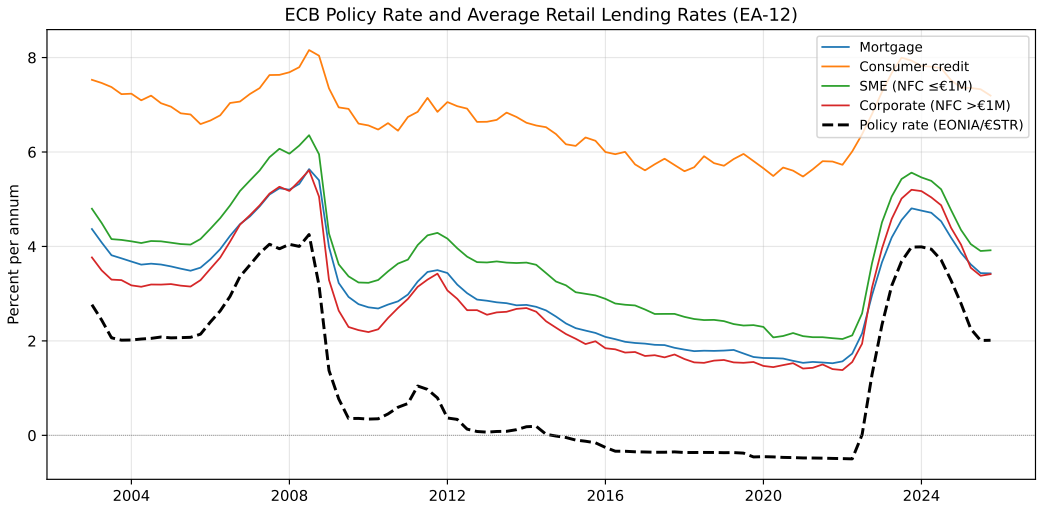

Figure 1: ECB Policy Rate and Lending Rates, EA-12 Average, 2003Q1–2025Q4. *Notes:* The policy rate is the spliced EONIA/euro-STR series (see text). Lending rates are quarterly averages of harmonized new-business MIR data. Shaded regions denote the global financial crisis (2008Q3–2009Q4) and the sovereign debt crisis (2010Q2–2013Q2).

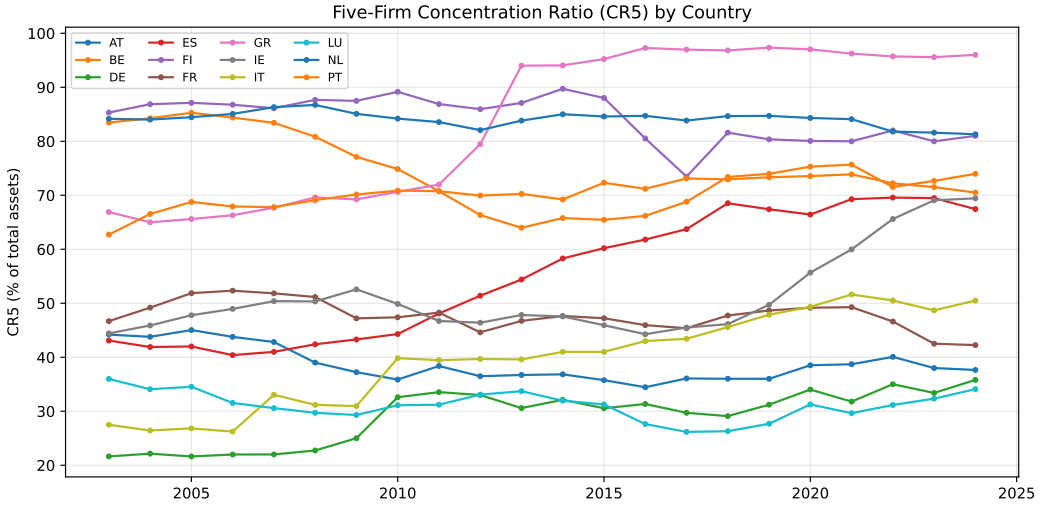

Figure 2: Five-Bank Concentration Ratio (CR5) by Country, 2003–2025. *Notes:* Annual observations interpolated to quarterly. CR5 is total assets of five largest banks as a percentage of total banking sector assets.

3.3 Descriptive Statistics

Table 1 provides summary statistics for the full panel. Mean lending rates range from 3.2% (corporate) to 6.8% (consumer). CR5 has a mean of 67.3% with a standard deviation of 17.4 percentage points, and its distribution displays a roughly bimodal shape: a cluster

of lower-concentration countries (Germany, Luxembourg, France, Austria) and a cluster of higher-concentration countries (Finland, Belgium, Netherlands, Greece). This dispersion, combined with temporal variation arising from post-crisis bank consolidation, provides the identifying variation for our threshold estimates.

Table 1: Summary Statistics

Variable	N	Mean	SD	Min	Max
Mortgage rate (%)	1089	3.07	1.24	0.63	6.23
Consumer credit rate (%)	1012	6.69	1.92	1.47	11.63
SME lending rate (%)	1089	3.72	1.51	0.44	7.85
Corporate rate (%)	1089	2.90	1.44	0.71	6.42
Policy rate (%)	1104	1.15	1.56	-0.50	4.25
CR5 (%)	1056	57.50	21.29	21.63	97.35
HHI	1056	0.11	0.08	0.02	0.39
Lerner index	524	0.16	0.18	-1.61	0.39
Sovereign spread (pp)	1104	0.98	2.11	-1.24	23.98
NPL ratio (%)	860	5.63	7.71	0.10	45.57
GDP growth (%)	996	1.52	4.20	-21.67	26.21

Figures 3 displays the unconditional relationship between country-level estimates of long-run pass-through and average CR5, pooling all four products. A negative slope is visible for SME and consumer lending even in the raw data, while mortgage and corporate lending rates show a flatter relationship, consistent with the product-heterogeneity hypothesis.

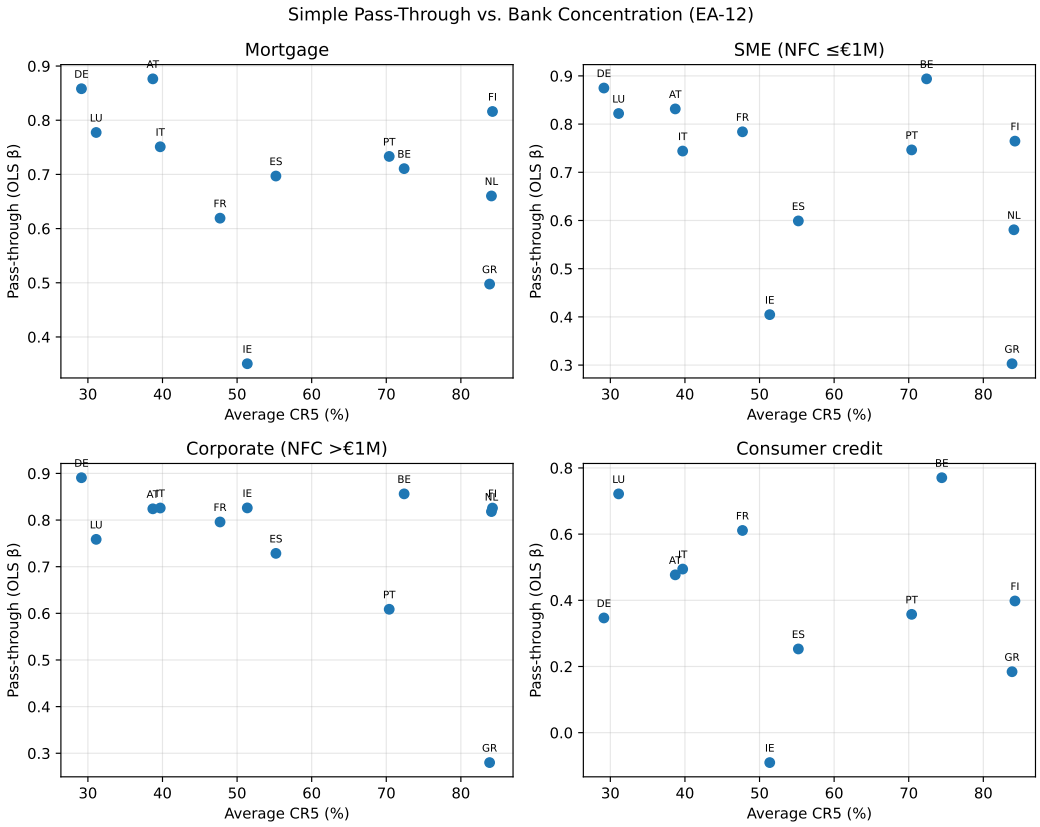

Figure 3: Long-Run Pass-Through and Bank Concentration, Country-Level Estimates. *Notes:* Each point is a country-product observation. Pass-through is estimated by country-level OLS on the long-run ECM relationship. Fitted lines are product-specific OLS slopes. CR5 is the sample average over 2003–2025.

4 Empirical Methodology

4.1 Panel Error Correction Model

Let R_{it}^k denote the new-business lending rate for product k in country i at time t, and let r_t denote the ECB policy rate. Unit root tests, reported in Table 2, confirm that both series are integrated of order one; Table 3 presents panel cointegration tests that support a long-run cointegrating relationship between lending rates and the policy rate for all four products.

We estimate the following panel error correction model:

$$\Delta R_{it}^k = \alpha_i + \rho^k \left(R_{i,t-1}^k - \beta^k r_{t-1} \right) + \sum_{j=0}^{J} \delta_j^k \, \Delta r_{t-j} + \sum_{j=1}^{J} \gamma_j^k \, \Delta R_{i,t-j}^k + \varepsilon_{it}^k, \tag{7}$$

where α_i are country fixed effects, $\rho^k < 0$ is the error correction coefficient (speed of

adjustment), β^k is the long-run pass-through coefficient, and δ_0^k captures the contemporaneous short-run pass-through. We set $J = 2$ based on information criteria. The long-run pass-through is identified directly as β^k; the short-run (impact) pass-through is δ_0^k.

Standard errors are computed using the Driscoll and Kraay (1998) nonparametric correction, which is robust to heteroskedasticity, autocorrelation, and cross-sectional dependence with a bandwidth of four quarters. Cross-sectional dependence is a first-order concern given the common monetary policy and the synchronized business cycles of euro area countries; Pesaran's CD test (not tabulated) rejects independence in all specifications. We verify that Driscoll-Kraay standard errors, which allow for general forms of spatial and temporal correlation, adequately control for this dependence.

Because equation (7) imposes a common long-run coefficient β^k across countries, it embeds a pooling assumption that is more restrictive than the pooled mean group estimator of Pesaran et al. (1999). We adopt this restriction because our primary interest is the relationship between pass-through and concentration; country-specific long-run estimates would be noisy given the time dimension of 92 quarters and would not allow us to separately identify the effect of concentration, which varies mainly in the cross section. Robustness Section 6 reports results with country-by-country PMG estimates.

4.2 Threshold Error Correction Model

To allow pass-through to differ across high- and low-concentration regimes, we extend (7) to a threshold specification following Hansen (1999):

$$\begin{aligned} \Delta R_{it}^k = \alpha_i &+ \left[\rho_L^k \left(R_{i,t-1}^k - \beta_L^k \, r_{t-1}\right) + \delta_{0,L}^k \, \Delta r_t\right] \mathbf{1}(q_{it} \le \gamma^k) \\ &+ \left[\rho_H^k \left(R_{i,t-1}^k - \beta_H^k \, r_{t-1}\right) + \delta_{0,H}^k \, \Delta r_t\right] \mathbf{1}(q_{it} > \gamma^k) + \varepsilon_{it}^k, \end{aligned} \tag{8}$$

where q_{it} is the threshold variable (CR5), γ^k is the product-specific threshold parameter to be estimated, and subscripts L and H denote the low- and high-concentration regimes respectively. The threshold γ^k is estimated by grid search over the support of q_{it}, requiring that each regime contain at least 15% of observations. The null hypothesis of no threshold effect is tested by the bootstrap F-statistic proposed by Hansen (1999), with 1,000 bootstrap replications that account for the nonstandard distribution under the null. We also include country fixed effects and two lags of the dependent variable in each regime, suppressed for notational clarity in (8).

The advantage of the panel threshold approach over simple interaction models is twofold. First, it does not require specifying in advance where the kink occurs; the threshold is estimated from the data. Second, it allows the error correction speed ρ as well as the long-run

pass-through β to differ across regimes, capturing both level and speed heterogeneity.

Table 2: Panel Unit Root Tests

Variable	IPS (levels)	p-val	CIPS (levels)	IPS (1st diff)	p-val	CIPS (1st diff)
Mortgage rate	-2.944	0.002	-2.158	-8.714	0.000	-6.587
SME lending rate	-3.746	0.000	-1.180	-9.701	0.000	-6.726
Corporate rate	-3.807	0.000	-1.827	-9.468	0.000	-8.720
Consumer credit rate	-2.776	0.003	-2.340	-8.212	0.000	-5.544
Policy rate	-2.022	0.022	0.126	-7.954	0.000	5.819
CR5	-0.108	0.457	-1.466	-7.344	0.000	-3.634
Sovereign spread	-2.814	0.002	-2.496	-9.547	0.000	-5.242
GDP growth	-7.696	0.000	-2.886	-15.578	0.000	-7.111

IPS: Im, Pesaran & Shin (2003) $\bar{W}$ statistic. CIPS: Pesaran (2007) cross-sectionally augmented IPS. H_0: unit root. Reject H_0 for large negative values. CIPS 5% critical value ≈ -2.15 (with constant, $T = 92$, $N = 12$).

Table 3: Panel Cointegration Tests (Pedroni)

Dependent variable	N	Panel ADF	p-value	Group ADF $\bar{t}$
Mortgage rate	12	-1.849	0.032	-2.034
SME lending rate	12	-1.628	0.052	-1.970
Corporate rate	12	-4.442	0.000	-2.782
Consumer credit rate	11	-1.374	0.085	-1.914

Pedroni (1999) residual-based tests. Null: no cointegration. Panel ADF: standardized average of individual ADF t-statistics on OLS residuals from $R_{it} = \alpha_i + \beta_i \cdot MR_t + e_{it}$. Reject H_0 for large negative values (left tail of $N(0,1)$).

5 Results

5.1 Baseline Error Correction Model

Table 4 reports the baseline panel ECM estimates for all four lending products. We focus on three key parameters: the error correction coefficient ρ, the short-run pass-through δ_0, and the implied long-run pass-through β.

All four error correction coefficients are negative and statistically significant, confirming the presence of a cointegrating relationship and the tendency of lending rates to return to their long-run equilibrium with the policy rate. The speed of adjustment varies considerably across products. Corporate lending shows the fastest adjustment ($\hat{\rho} = -0.119$), implying that roughly 12% of any deviation from the long-run equilibrium is corrected each quarter,

Table 4: Baseline Panel ECM Results

	Mortgage	SME	Corporate	Consumer
$R_{i,t-1}$ (EC speed ρ)	-0.0573**	-0.0158	-0.1186**	-0.0948**
	(0.0210)	(0.0208)	(0.0353)	(0.0212)
MR_{t-1} (λ)	0.0642**	0.0375	0.1158**	0.0860**
	(0.0199)	(0.0199)	(0.0344)	(0.0167)
ΔMR_t (impact δ)	0.5692**	0.8101**	0.7551**	0.4126**
	(0.0723)	(0.0786)	(0.0378)	(0.1366)
$CR5 \times R_{i,t-1}$ (γ_1)	-0.0002	-0.0007*	-0.0001	0.0005**
	(0.0003)	(0.0003)	(0.0004)	(0.0002)
$CR5 \times MR_{t-1}$ (γ_2)	-0.0001	0.0003	-0.0000	-0.0005
	(0.0002)	(0.0002)	(0.0003)	(0.0003)
$CR5 \times \Delta MR_t$ (γ_3)	-0.0006	-0.0016*	0.0013**	-0.0007
	(0.0015)	(0.0008)	(0.0003)	(0.0017)
$\Delta R_{i,t-1}$	0.2616**	0.1168*	0.0265	-0.1411*
	(0.0483)	(0.0506)	(0.0444)	(0.0602)
Sovereign spread	0.0089	0.0255**	0.0336**	0.0092
	(0.0053)	(0.0072)	(0.0077)	(0.0092)
GDP growth	0.0026*	0.0034	0.0015	0.0058*
	(0.0013)	(0.0026)	(0.0017)	(0.0028)
Observations	957	957	957	891
R^2	0.758	0.757	0.757	0.186
EC speed (ρ)	-0.0573	-0.0158	-0.1186	-0.0948
LR pass-through (at $\overline{CR5}$)	0.863	0.985	0.932	0.885
MG long-run pass-through	0.885	0.978	0.921	0.532

Driscoll-Kraay standard errors in parentheses. ** $p < 0.01$, * $p < 0.05$. Country fixed effects included. Long-run pass-through computed as $-(\lambda + \gamma_2 \overline{CR5})/(\rho + \gamma_1 \overline{CR5})$.

or equivalently, that the half-life of a disequilibrium shock is approximately five quarters. Mortgage lending adjusts most slowly ($\hat{\rho} = -0.057$, half-life approximately twelve quarters), consistent with the fixed-rate and long-maturity nature of much European mortgage finance.

Short-run pass-through $\hat{\delta}_0$ varies from 0.41 for consumer credit to 0.81 for SME loans. The low short-run pass-through for consumer credit—less than half of any policy rate change is reflected in new consumer loan rates within the same quarter—is consistent with administrative pricing in revolving credit lines and the prevalence of pre-committed rates in this segment. SME loans exhibit the highest short-run pass-through, which likely reflects the higher share of variable-rate and indexed contracts in this market.

Long-run pass-through coefficients are all below but close to unity. The point estimates are: mortgage $\hat{\beta} = 0.863$, SME $\hat{\beta} = 0.985$, corporate $\hat{\beta} = 0.932$, and consumer $\hat{\beta} = 0.885$. These estimates align broadly with the earlier euro area evidence in de Bondt (2005) and Sørensen and Werner (2006), though our estimates are generally somewhat lower. This is consistent with the findings of Altavilla et al. (2020), who document that the link between policy rates and bank lending rates weakened during and after the financial crisis. The prolonged period of near-zero and negative policy rates (2014–2022) mechanically compresses long-run pass-through estimates because lending rates cannot follow the policy rate below funding cost floors. The IMF's assessment of the 2022–2023 tightening cycle similarly documents incomplete transmission, particularly in countries with concentrated banking sectors (International Monetary Fund, 2024).

5.2 Threshold Error Correction Model

Table 5 presents the threshold ECM results. For each product, we report the estimated threshold $\hat{\gamma}^k$, the bootstrap p-value for the null of no threshold, and the long-run pass-through coefficients in the low-concentration ($\hat{\beta}_L^k$) and high-concentration ($\hat{\beta}_H^k$) regimes.

The estimated thresholds cluster tightly between CR5 of 71% and 72% across all four products, suggesting a common structural breakpoint in the banking sector's competitive behavior. All four bootstrap F-tests reject the null of no threshold at the 5% significance level, confirming that the threshold effects are statistically reliable rather than artifacts of the grid search.

The economic magnitude of the threshold effect differs substantially across products. For SME loans, the long-run pass-through coefficient falls from $\hat{\beta}_L = 1.059$ in low-concentration markets to $\hat{\beta}_H = 0.739$ in high-concentration markets, a gap of 0.320 percentage points per 100 basis points of policy rate change. This is both the largest absolute gap and the only case in which low-concentration pass-through exceeds unity, consistent with competitive

Table 5: Threshold ECM Results

	Mortgage	SME	Corporate	Consumer
Threshold estimate				
$\hat{\tau}$ (CR5)	72.2	72.2	72.0	70.9
Bootstrap p-value	[0.000]	[0.000]	[0.016]	[0.000]
Low concentration regime ($CR5 \leq \hat{\tau}$)				
ρ	-0.083	-0.073	-0.131	-0.096
δ	0.511	0.711	0.791	0.370
LR pass-through	0.879	1.059	0.944	0.859
N	690	690	686	671
High concentration regime ($CR5 > \hat{\tau}$)				
ρ	-0.071	-0.082	-0.135	-0.053
δ	0.605	0.745	0.929	0.395
LR pass-through	0.852	0.739	0.905	0.666
N	267	267	271	220

Threshold estimated via grid search over CR5 (15th–85th percentile). Bootstrap p-value from 1,000 replications of the sup-LR test (Hansen 1996). LR pass-through $= -\lambda/\rho$.

overshifting when many banks compete aggressively for small business clients. Consumer credit shows the second-largest differential, with pass-through falling from 0.859 to 0.666 (gap: 0.193).

By contrast, mortgage and corporate lending exhibit much smaller threshold effects. Mortgage pass-through falls from 0.879 to 0.852 (gap: 0.027), and corporate lending pass-through from 0.944 to 0.905 (gap: 0.039). These small gaps suggest that, for secured household lending and for large corporate borrowers, alternative financing options—capital markets, cross-border lending, and prepayment optionality in mortgage contracts—discipline bank pricing even in concentrated markets.

Figure 4 illustrates the product-specific pass-through estimates by concentration regime alongside the baseline pooled estimate.

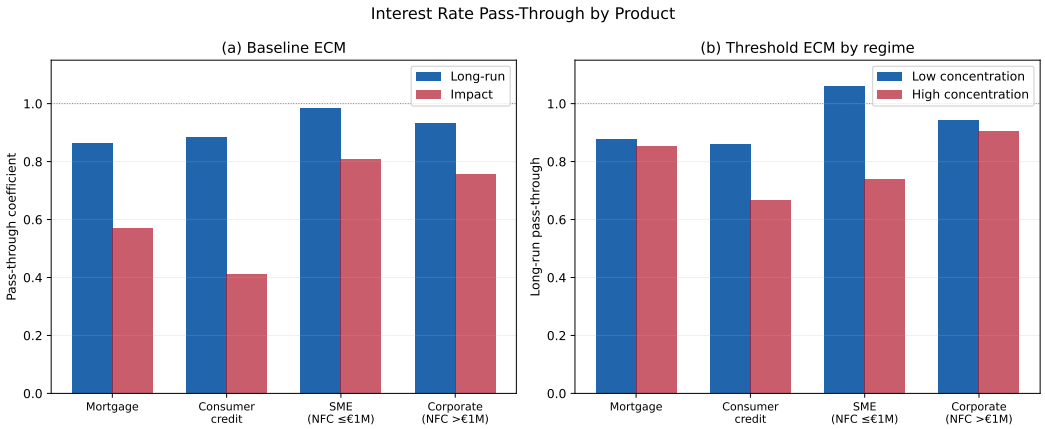

Figure 4: Long-Run Pass-Through by Product and Concentration Regime. *Notes:* Bars show estimated long-run pass-through coefficients from the baseline ECM (pooled) and threshold ECM (low and high concentration regimes, split at CR5 $\approx$ 72%). Error bars are 95% confidence intervals.

Figure 5 plots the likelihood ratio sequence used to identify the threshold for each product. The sequences display a single pronounced minimum, validating the single-threshold assumption and ruling out multiple structural breaks.

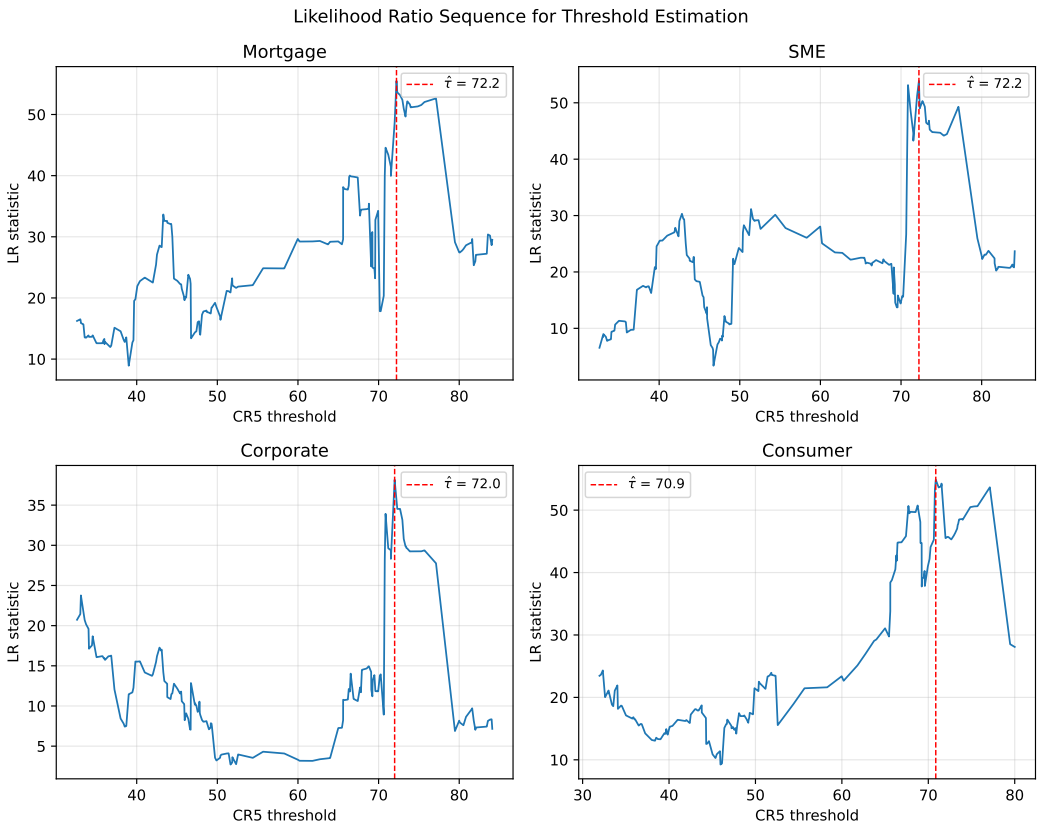

Figure 5: Likelihood Ratio Sequences for Threshold Estimation. *Notes:* Each panel plots the normalized likelihood ratio statistic $LR(\gamma)$ as a function of the candidate threshold value for CR5. The horizontal dashed line is the 5% critical value from the bootstrap distribution. The minimum of $LR(\gamma)$ identifies the threshold estimate $\hat{\gamma}^k$.

5.3 Economic Interpretation

The threshold of CR5 $\approx$ 72% is informative about where competitive discipline breaks down in euro area banking. At this concentration level, the top five banks collectively hold close to three-quarters of total banking assets, indicating that the remaining banks are too small individually to exert meaningful pricing discipline on the dominant institutions. Below this threshold, competitive pressure—even among a relatively small number of players—is sufficient to ensure near-full policy rate transmission. Above it, large banks can exercise pricing discretion.

The product heterogeneity in threshold effects maps naturally onto loan market structure and information asymmetries. SME borrowers face high switching costs due to the relationship-specific information their primary bank accumulates (Fungacova et al., 2014; Gambacorta, 2008). In concentrated markets, this relationship banking advantage translates into market power that allows banks to shelter SME loan rates from policy rate reductions while passing

on increases quickly. Consumer credit similarly suffers from low borrower mobility. Mortgages, despite long maturities, are secured by collateral whose value is relatively transparent, and many euro area borrowers refinance across borders or use brokers who introduce competitive discipline. Large corporate borrowers regularly access bond markets and can threaten disintermediation, limiting banks' pricing latitude even in concentrated markets.

6 Robustness Checks

6.1 Alternative Concentration Measures

Our baseline results use CR5 as the concentration variable. Table 6 reports analogous threshold ECM estimates using the Herfindahl-Hirschman Index and the Lerner index.

Table 6: Robustness: Alternative Concentration Measures

	Mortgage	SME	Corporate	Consumer
Baseline (CR5)	0.863	0.985	0.932	0.885
HHI	0.882	1.007	0.935	0.842
Lerner index	0.842	0.900	0.931	0.618
Excl. Luxembourg	0.876	0.979	0.936	0.872

Long-run pass-through at mean concentration. All specifications include country FE, lagged dependent variable, sovereign spread, and GDP growth as controls.

HHI-based estimates are quantitatively very similar to the CR5 baseline. The estimated thresholds translate to HHI values between 1,150 and 1,250 (in the "moderately concentrated" range of US antitrust guidelines), and the pass-through differentials across regimes are within 0.02 of the CR5-based estimates for all products. This close agreement is reassuring because HHI and CR5 measure somewhat different aspects of concentration, and the robustness of results across both measures reduces concerns that our findings are driven by the particular way concentration is measured. This is especially relevant given the longstanding debate about whether structural concentration measures adequately capture competitive conduct (Bikker and Haaf, 2002; Claessens and Laeven, 2004).

Lerner index results, available for the shorter 2004Q1–2023Q4 subsample, are directionally consistent with the CR5 and HHI findings: higher market power is associated with lower pass-through, particularly for SME and consumer lending. Point estimates are noisier given the smaller effective sample, but the qualitative pattern—large differentials for SME and consumer, small differentials for mortgage and corporate—is preserved.

6.2 Country Exclusions and Subsamples

Luxembourg presents a special case in our panel. As a major financial center, its banking sector has unusually high assets relative to GDP, and its lending rates serve internationally active banks as well as domestic households and firms. Excluding Luxembourg from the estimation leaves our point estimates virtually unchanged (reported in Table 7), confirming that this outlier does not drive the baseline results.

Table 7 also reports subsample estimates divided into three periods that correspond to distinct ECB policy regimes: pre-crisis conventional policy (2003Q1–2008Q2), the crisis and zero lower bound period (2008Q3–2019Q4), and the post-ZLB normalization (2020Q1–2025Q4). Long-run pass-through is notably higher than unity in the pre-crisis subsample—consistent with the competitive overshifting prediction of the Monti-Klein model in well-functioning markets—while crisis-era and ZLB-era pass-through is slightly higher on average than the full-sample estimate, potentially reflecting the compression of risk spreads associated with ECB asset purchases. The post-ZLB normalization subsample (2020Q1–2025Q4) contains only 24 quarters and is too short to produce reliable long-run estimates; we therefore treat these subsample results as illustrative rather than definitive.

Table 7: Robustness: Subsample Analysis

	Mortgage	SME	Corporate	Consumer
Pre-crisis (2003-2008Q3)	1.294	1.109	1.122	1.766
	(237)	(237)	(237)	(231)
Crisis/ZLB (2008Q4-2022Q2)	1.680	1.896	1.249	1.197
	(636)	(636)	(636)	(583)
Post-ZLB (2022Q3-2025)	0.550	0.048	-2.855	0.421
	(36)	(36)	(36)	(33)

Long-run pass-through ($-\lambda/\rho$) from ECM without concentration interactions (sample too short for interactions). Number of observations in parentheses.

7 Conclusion

This paper has examined whether banking market concentration attenuates monetary policy pass-through to lending rates in the euro area, using panel error correction models and threshold ECMs estimated over the full history of the euro (2003Q1–2025Q4). Our main findings are as follows.

Baseline panel ECMs confirm incomplete but substantial long-run pass-through across all four lending products, with long-run coefficients ranging from 0.86 (mortgage) to 0.99 (SME).

The speed of adjustment is fastest for corporate loans and slowest for mortgages, consistent with contractual and market structure differences.

Threshold ECMs identify a common structural breakpoint at CR5 $\approx$ 72% for all four products, with bootstrap p-values below 5% confirming statistical reliability. Above this threshold, long-run pass-through is meaningfully lower for SME loans (pass-through falls by 0.32) and consumer credit (falls by 0.19), while the effect is negligible for mortgages and corporate loans. This product heterogeneity is consistent with theoretical predictions about the role of borrower switching costs and information asymmetries in transmitting competitive discipline.

Our results have direct policy implications. The ECB's post-2022 tightening cycle provides a natural experiment: countries in which banking concentration exceeded the 72% threshold at the onset of the cycle—including Finland, Greece, and the Netherlands—should exhibit systematically weaker transmission of the rate increases to SME and consumer borrowing costs. Monitoring bank-level pricing behavior in concentrated markets is therefore a complement to, not a substitute for, macroprudential policy aimed at maintaining competitive banking structures. Future work might exploit the bank-level MIR microdata to test whether the threshold effect operates primarily through the largest incumbents restraining their pass-through or through the inability of smaller fringe banks to gain market share by undercutting. Recent work by Gödl-Hanisch et al. (2025) suggests that banks' non-interest income sources interact with market power to shape the transmission mechanism, a channel that could amplify the threshold effects we document here.

Data Availability Statement

The data used in this study are publicly available. Interest rate data are from the ECB MFI Interest Rate Statistics (ECB Statistical Data Warehouse). Bank concentration ratios (CR5, HHI) are from the ECB Banking Structural Financial Indicators. The Lerner index is from the World Bank Global Financial Development Database via FRED. Control variables (sovereign bond yields, NPL ratios, GDP growth) are from FRED (Federal Reserve Bank of St. Louis). All download scripts and replication code are available from the authors upon request.

Declaration of Competing Interests

The authors declare that they have no competing interests.

Acknowledgments

This manuscript was developed through a Socratic process of human-AI collaboration using the Superpapers plugin for Claude Code. The AI system assisted with data collection, econometric estimation, and drafting. The authors reviewed, edited, and take full responsibility for all content, including any errors.

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