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This paper analyzes the risk sensitivity of lending rates among euro area banks using detailed AnaCredit data. The analysis indicates that for each percentage point increase in the probability of default (PD), banks increase lending spreads to non-financial corporations by approximately 9 basis points. This relatively low sensitivity may be partly attributed to the through-the-cycle nature of PDs. The study also reveals that better-capitalised banks exhibit higher sensitivity, likely due to greater caution in risk assessment and more accurate risk pricing by banks with larger equity stakes. Additionally, the results show increased risk sensitivity for firms with lower PDs, larger banks, and in less competitive loan markets. The sensitivity remains consistent across different phases of the monetary cycle but intensifies for firms with lower PDs during recent tightening and easing phases.

1 Introduction

The paper utilizes detailed AnaCredit data to assess the risk sensitivity of lending rates by euro area banks during the recent monetary cycle.

A bank's primary defense against losses is its operating income. Properly pricing credit risk, known as risk-based pricing, is essential for maintaining bank solvency and overall financial stability, which in turn ensures the smooth transmission of monetary policy through the credit channel. Understanding how banks price credit risk and how this sensitivity varies across different banks, firms, and loan characteristics is crucial for making informed decisions on monetary, macroprudential, and supervisory policies.

This paper examines the risk sensitivity of lending rates in the euro area, utilizing detailed AnaCredit loan-level data from 2021 to 2024 to analyse three aspects of risk-based pricing. First, we establish a causal relationship between the lending spread and the PD, providing insights into risk-based sensitivity among euro area banks. Second, we explore the heterogeneity of this relationship based on loan, firm, and bank characteristics. Finally, we assess whether the sensitivity of this relationship varies across different phases of the monetary cycle. During the study period, monetary policy underwent significant shifts: from negative rates to severe tightening between June 2022 and September 2023, followed by a gradual easing. This allows us to identify bank risk-taking behaviour across different phases of the monetary cycle.

The literature on how banks price credit risk highlights borrower-specific factors, macroeconomic conditions, and market competition as key drivers of risk premia (Bharath & Shumway, 2008; Jiménez & Saurina, 2006). However, there is significant heterogeneity in loan pricing, particularly influenced by bank size and capital adequacy. Larger banks tend to offer lower rates due to economies of scale and cheaper funding sources, while smaller banks may charge premiums to offset higher costs (Berger & Udell, 2002; Petersen & Rajan, 1995). Well-capitalised banks generally price loans more favourably due to lower funding costs (Gambacorta, 2008), although higher capital requirements have been shown to increase the cost of credit (Behn et al., 2016; di Patti et al., 2023). Additionally, relationship banking often results in lower rates due to trust and better information flow (Petersen & Rajan, 1994).

The global financial crisis (GFC) has reignited the debate on the link between short-term interest rates and bank risk-taking, known as the risk-taking channel of monetary policy. Many argue that prolonged low interest rates before the crisis fuelled an asset price boom, leading financial intermediaries to increase leverage and take excessive risks (Borio & Zhu, 2008; Adrian & Shin, 2009). Although theoretical models[1] offer mixed predictions on the relationship between interest rates and risk-taking, empirical evidence generally agrees that risk-taking is higher during periods of low interest rates. This is particularly true for banks with lower capitalisation (Delis & Kouretas, 2011; Jimenez et al., 2014; Ioannidou et al., 2015; Dell'Ariccia et al., 2017; Paligorova & Santos, 2017), smaller banks (Buch et al., 2014), and banks engaged in non-traditional banking activities (Altunbas et al., 2010). Additionally, Maddaloni and Peydro (2011) provide evidence of increased risk-taking when supervision standards are less stringent.

The results show low risk sensitivity of lending rates that increases for banks with more capital, larger banks and for firms of better credit quality.

The findings suggest that banks raise lending spreads to NFCs by roughly 9 basis points for each percentage point increase in the PD. This sensitivity appears rather low as the difference in lending spread between a firm at the 90th percentile of the PD distribution and a firm at 10th percentile is only 36 basis points. This low sensitivity likely follows from the through-the-cycle nature of PDs. The study also highlights that banks with higher capitalisation show greater sensitivity, likely because they are more cautious in their risk assessments and pricing. Furthermore, the results indicate that firms with lower PDs, larger banks, and those operating in less competitive markets experience higher risk sensitivity. While sensitivity remains relatively stable across different monetary phases, it becomes more pronounced for firms with lower PDs during recent tightening and easing periods, when also market competition plays a more significant role, with lower sensitivity observed in more competitive markets.

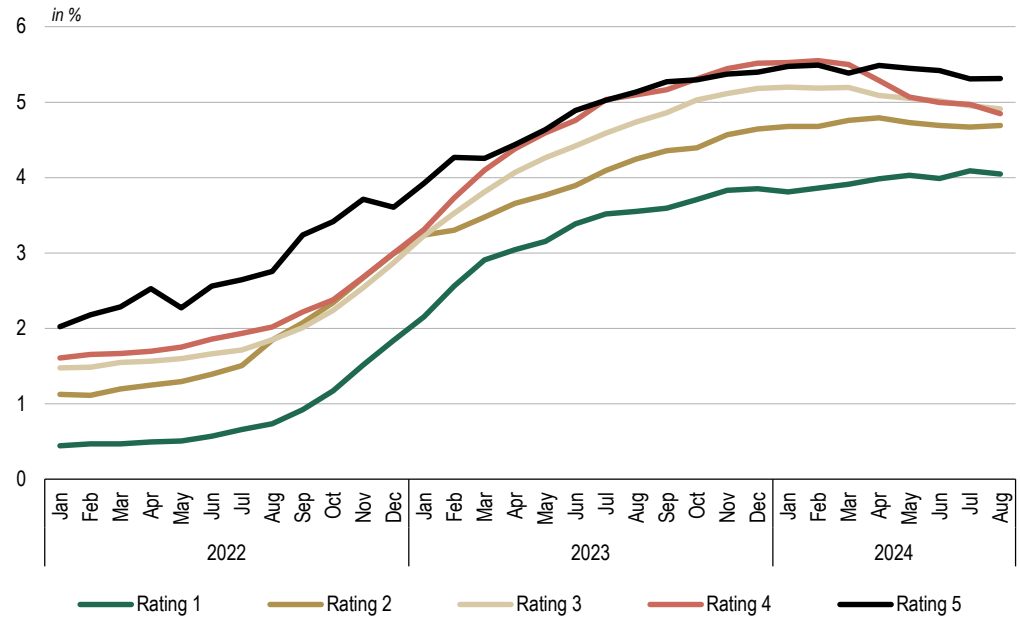
2 Risk premia evolution between 2021 and 2024

Risk premia have decreased following the start of monetary tightening in mid-2022.

Figure 1 illustrates the evolution of lending rates on new loans across five firm credit quality categories, or ratings, based on PDs from AnaCredit. As expected, lending rates show an increasing trend across all ratings, with firms in rating 1 (least risky) paying the lowest rates, and those in rating 5 (most risky) paying the highest—although not consistently so. Potentially more interesting, however, during the tighten-

[1] Higher interest rates reduce risk-taking by shifting investments to safer assets and raising investment hurdles (Fishburn and Porter, 1976; Chodorow-Reich, 2014). Conversely, they increase bank risk-taking due to asymmetric information and limited liability, leading to excessive risks, especially for less capitalised banks (Hellmann et al., 2000; Acharya and Viswanathan, 2011). The overall impact depends on how banks adjust their lending rates and capital structure (Rajan, 2005; Dell'Ariccia and Marquez, 2013; Dell'Ariccia et al., 2014).

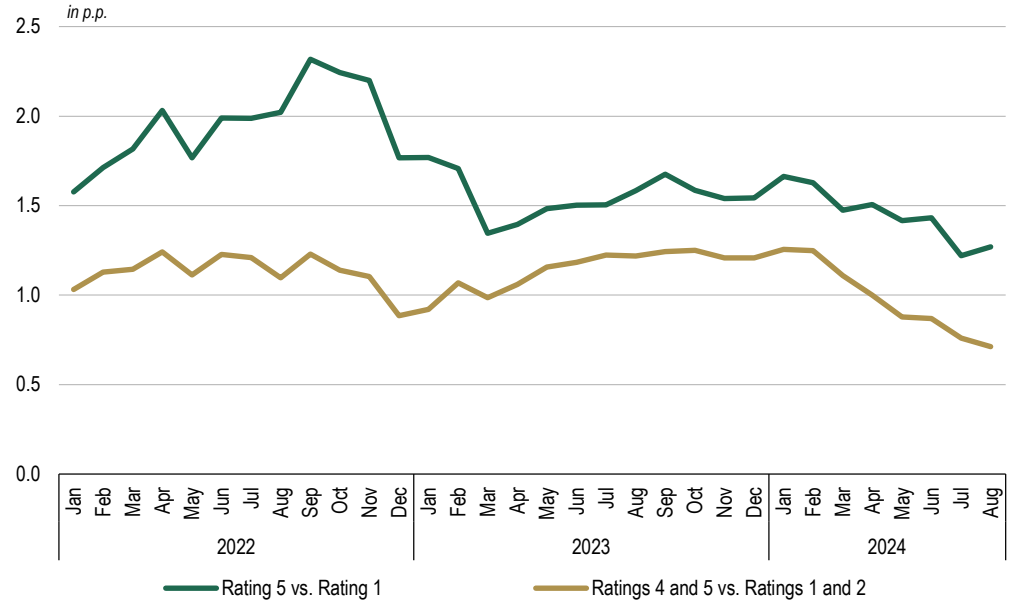
Figure 1: **Lending rates over rating classes**



Note: Rating assignment is based on PD reported by banks. Rating thresholds are set to uniformly distribute new loans across five rating classes from 2021m1 to 2024m8. This gives the following thresholds: Rating 1: PD <= 0.35%, Rating 2: 0.35% < PD <= 0.76%, Rating 3: 0.76% < PD <= 1.73%, Rating 4: 1.73% < PD <= 3.47%, Rating 5: PD > 3.47%.
Source: AnaCredit, Banka Slovenije calculations.

ing phase, rates rose less for riskier firms. Figure 2 highlights this with the green line showing the difference in lending rates between rating 5 and rating 1 borrowers. The risk premium dropped sharply after the tightening began, levelled off, and declined further in early 2024. Similar conclusion for the latter period follows when we include also borrowers with ratings 4 and 2 in the pool of higher and lower risk borrowers, respectively (gold line in Figure 2).

Figure 2: **Risk premia**



Note: The risk premium is the rate difference between higher-risk (rating 5 or the average of ratings 4 and 5) and lower-risk borrowers (rating 1 or the average of ratings 1 and 2).
Source: AnaCredit, Banka Slovenije calculations.

Countercyclical dynamics of risk premia over the monetary cycle suggests that the transmission of policy rates to bank lending rates varies depending on the risk profile of the borrowing firm.

While lower transmission to riskier borrowers might be beneficial for banks in the long-run by lowering the incidence of default due to inability to repay the higher credit burden, it also points towards a potentially higher risk taking by banks by lowering the premium charged for riskier firms. However, confounding factors, such as shifts in credit portfolio structures, stronger loan demand from safer firms or specificities of loan contracts could also explain this.

3 Risk-based sensitivity estimates

The analysis below is structured into three main parts. First, we establish a causal relationship between the spread and PD. Second, we investigate the heterogeneity of this relationship based on loan, firm, and bank characteristics. Finally, we assess whether the sensitivity of this relationship varies across different phases of the monetary cycle. The estimates are derived from the following equation:

$$Spread_{ibft} = \alpha + \beta PD_{bft} + X_{ibft}^{Loan} + X_{mt}^{Market} + \delta_{b|ILS|t} + \varepsilon_{ibft}$$

where we use index *i* for loans, *b* for banks, *f* for firms, *t* for time and *m* for markets. Spread is the difference between lending rate and the corresponding reference rate.[2] PD is our measure of firm riskiness, whereas β captures the degree of risk-based pricing. We use AnaCredit data on new loans to NFCs in the period from January 2021 to August 2024.[3]

Using PD as a measure of risk has distinct advantages and limitations.

A key advantage is that PD reflects banks' internal assessments of a firm's default probability, providing an intentional, ex-ante measure of risk-taking by banks. Moreover, banks typically have access to more extensive information than what is observable to an econometrician, as they gather additional insights through relationships with firms.[4] However, an important limitation is that PD data are available only for banks adopting the Internal Rating-Based (IRB) regulatory approach. Consequently, our sample is restricted to 53% of new loan contracts (from 2021 onwards) and 61% of

[2] We use the spread reported in AnaCredit for variable-rate and mix-rate loans, whereas for fix-rate loans we calculate the spread between lending rate and OIS rate with the same maturity.

[3] We exclude observations with a reported PD below 0.03%, as this represents the floor stipulated in Basel/CRD regulations. We also filter out observations where the PD exceeds 10% or the lending rate is above 30% to mitigate the influence of outliers.

[4] Whether banks utilize this information for more accurate risk assessment is another matter. Banks may have an incentive to underreport risk to alleviate the pressure of loan-loss provisions on capital, particularly during economic downturns when they face an increased number of loan defaults (see, for instance, Brezigar-Masten et al., 2015).

the total loan volume.[5] It should also be kept in mind that PDs are designed for regulatory purposes and aim to capture firm riskiness through-the-cycle. Hence, they vary less over the cycle compared to point-in-time estimates used for loan-loss provisions, but should nevertheless still provide a reliable relative ranking of firm riskiness.

Detailed loan-level data are required to identify risk-based sensitivity.

The set of control variables are aimed at alleviating five potential cofounding factors: bank, firm and loan characteristics, economic conditions and market competition. First, financial health, cost structures, and strategies of banks influence loan pricing. These are controlled via bank-time fixed effects. Second, firm characteristics like collateral capacity and bargaining power, which affect both loan spread and PD estimates, are accounted for with industry-location-size-time fixed effects. Third, banks mitigate credit risk by adjusting non-interest loan terms, such as requiring collateral, extending maturity and limiting loan size for riskier firms. We directly control for all these factors. Fourth, broader economic factors are addressed using time and time-country fixed effects embedded in more granular FE controls described earlier. Finally, market competition, defined at the NUTS3 regional level, is addressed by measuring the number of competing banks within the region.[6]

For each percentage point increase in the PD, banks raise lending spread by about 10 basis points.

Table 1 shows the risk-based sensitivity analysis of lending rates for new loans, incorporating factors sequentially as described earlier. The estimates are stable, ranging from 0.128 in a basic model to 0.091 in a fully specified model with controls for bank, firm, and loan characteristics, as well as competition. This sensitivity appears relatively low, which may be partly due to the aforementioned through-the-cycle nature and hence slow changes in PDs. According to the estimates, a firm at the 90th percentile of the PD distribution, with a PD of 4.5%, is expected to be charged a lending spread that is 36 basis points higher compared to a firm at the 10th percentile with a PD of 0.5%.

Table 1: **Impact of firm default probability on bank lending spreads**

	(1)	(2)	(3)	(4)	(5)
Impact of 1pp increase in PD	0.128***	0.105***	0.095***	0.091***	0.091***
Bank-time fixed effects		✓	✓	✓	✓
Firm-time fixed effects			✓	✓	✓
Loan-specific factors				✓	✓
Competition					✓
R2	0.019	0.593	0.670	0.697	0.697
Number of observations	9,956,318	9,954,708	9,929,903	9,308,805	9,308,805

Note: The table presents the estimated effect of firm riskiness, as measured by banks with PD, on lending spreads for new loans. The sample includes euro area IRB banks issuing new loans to NFCs from January 2021 to August 2024. Competition is measured as the log of banks per NUTS3 market. Loan factors include maturity, collateral, rate fixation, and size. Significance: * p < 0.10, ** p < 0.05, *** p < 0.01. Standard errors are clustered at bank level.

[5] The representation varies significantly across countries, being higher in more advanced banking system. Three countries with the highest representation: BE (90%), FI (79%) and NL (72%). The lowest: CY, MT (0%), SI (12%).

[6] As an alternative we use also Herfindahl-Hirschman Index, which does not change the results.

Source: AnaCredit, own estimates.

Next, we examine whether risk-based sensitivity varies with characteristics of banks, firms, loans, and the market competition. Specifically, we analyse the heterogeneity of the PD impact based on determinants such as market competition, bank size, firm size (both measured by total assets), bank capitalisation (measured by the leverage ratio), the level of PD, and whether the loan is fixed-rate. For all determinates except the last, we create a dummy variable that equals one if the determinant's value exceeds the median. These dummy variables are then interacted with the PD.[7]

Risk-based sensitivity is stronger for firms with lower PDs, for larger and better-capitalised banks and in less competitive markets.

Table 2 shows that sensitivity to PD is notably higher when PDs are below the median. Specifically, a 1pp increase in PD leads to a 0.24pp rise in lending rates for firms with PDs below the median, compared to just 0.07pp for those above the median. The average PDs are 0.8% for the lower PD group and 3.1% for the higher PD group, making the impact of a 1pp PD increase more significant in relative terms for firms with lower PDs. This suggests that banks consider changes in the relative riskiness of higher-quality firms to be more important and adjust the spread accordingly.

Table 2: **Heterogeneity of risk-based loan pricing**

Interaction factor:	Competition	Fix rate loans	Bank size	Firm size	Leverage ratio	PD
PD	0.097***	0.105***	0.056***	0.107***	0.080***	0.243***
PD × I(Factor above median)	-0.012**	0.014	0.071***	-0.015	0.068**	-0.172***
Factor	0.001	-0.004***		-0.002**		0.002***
R2	0.697	0.697	0.654	0.693	0.720	0.698
Number of observations	9,308,805	9,308,805	6,830,437	8,197,272	8,554,014	9,308,805

Note: The table presents the estimates of heterogeneous impact of PD on lending spread. For each factor, the sample is split to observations below and above median (except for fix rate loans). Bank and firm size are both measured with total assets. Leverage ratio is defined as a ratio between bank capital and assets. Significance: * p < 0.10, ** p < 0.05, *** p < 0.01. Standard errors are clustered at bank level.
Source: AnaCredit, own estimates.

The results in Table 2 indicate that risk-based sensitivity is higher in better-capitalised banks. Specifically, banks with a leverage ratio below the median (11%) increase their lending spread by 8 basis points for each percentage point increase in PD. In contrast, banks with a leverage ratio above the median show an increased sensitivity of 14.8 basis points. This may be due to the limited liability of banks; with more capital at stake, bank owners have more to lose and thus may be more cautious in risk assessment and the corresponding sensitivity of lending rates. A similar conclusion can be drawn from the interaction with bank size, which could be attributed to stringent regulatory capital requirements and consequently higher capital levels in larger banks.[8]

As expected, risk sensitivity is higher in markets with fewer competing banks. This suggests that in the presence of greater competition, banks might engage in more

[7] Using dummy variables with interaction terms simplifies the interpretation of results, as the impacts are compared across only two groups. Additionally, interactions involving dummy variables are not influenced by potential outliers that might otherwise affect the estimated interaction term with continuous variables.

[8] Generally, larger banks have more complex risk profiles due to their diverse operations and global reach. Consequently, their capital requirements are higher, primarily through the following buffers: the Systemic Risk Buffer (SRB), the Global Systemically Important Institutions (G-SII) buffer, and the Other Systemically Important Institutions (O-SII) buffer.

risk-taking (decreasing PD-spread sensitivity) to offer more favourable terms to firms, although the estimated interaction term is relatively low in value (-1.2 bps). A similar conclusion can be drawn for fixed-rate loans and firm size, both of which are statistically significant but economically negligible.

Lastly, we estimate whether differences in risk pricing emerge across various phases of the monetary cycle. To do so, we divide the sample into three distinct periods: (1) "Negative Rates", covering January 2021 to June 2022; (2) "Tightening", spanning July 2022 to September 2022; and (3) "Easing", extending from October 2023 to August 2024. Each period is interacted with the PD to measure risk sensitivity specific to that phase. Additionally, we incorporate interactions with bank, firm, and loan factors to analyse whether the heterogeneous effects vary across the different monetary cycle phases.

Risk-based sensitivity shows minimal variation across monetary regimes, but it intensifies for firms with lower PDs in the tightening and easing phases.

As shown by the baseline results in Table 3, sensitivity remains consistently at 0.09 across all phases.[9] However, when heterogeneities are introduced, intriguing patterns emerge. The most noteworthy heterogeneity lies again in the relationship with the level of PD. Previously, we established a stronger sensitivity for lower PD values. The results in Table 3 (last column) further indicate an increasing sensitivity to lower PD levels across the monetary cycle. A 1pp rise in low PD led to a 21 bps increase in lending rate during the negative interest rate phase, increasing to 25 bps in the tightening phase and to 27 bps in the easing phase.

Table 3: **Heterogeneity of risk-based loan pricing in different phases of monetary cycle**

Interaction factor:	Baseline	Competition	Fix rate loans	Bank size	Firm size	Leverage ratio	PD
PD × I(Negative rates)	0.092***	0.092***	0.066***	0.056***	0.109***	0.079***	0.215***
PD × I(Tightening)	0.088***	0.099***	0.103***	0.054***	0.100***	0.077***	0.253***
PD × I(Easing)	0.094***	0.107***	0.084***	0.060***	0.110***	0.086***	0.269***
PD × I(Neg. rates) × (Factor above med.)		0.002	0.045**	0.082***	-0.013	0.061**	-0.145***
PD × I(Tightening) × (Factor above med.)		-0.022***	-0.028	0.065***	-0.009	0.076***	-0.184***
PD × I(Easing) × (Factor above med.)		-0.031***	0.021	0.059***	0.030**	0.068*	-0.194***
R2	0.697	0.697	0.698	0.654	0.696	0.720	0.698
Number of observations	9,308,805	9,308,805	9,308,805	6,830,437	8,197,272	8,554,014	9,308,805

Note: The table presents the estimates of heterogeneous impact of PD on lending spread. For each factor, the sample is split to observations below and above median (except for fix rate loans). Bank and firm size are both measured with total assets. Leverage ratio is defined as a ratio between bank capital and assets. Significance: * p < 0.10, ** p < 0.05, *** p < 0.01. Standard errors are clustered at bank level.
Source: AnaCredit, own estimates.

The results indicate a heightened role of competition since the beginning of the tightening phase and a more sensitive loan pricing for larger firms following the recent policy rate cut.

The impact of competition on loan pricing was observed only during the tightening and easing phases of the monetary cycle. This can be attributed to the greater flexibility banks have in adjusting their pricing strategies when interest rates are higher. Dur-

[9] Running pair-wise Wald test reveals that none of the coefficients is statistically different from the remaining two.

ing these phases, banks are more likely to engage in competitive pricing to attract borrowers, as the higher rates provide them with a larger margin to maneuver. Consequently, the impact of competition becomes more pronounced, leading to variations in loan pricing.

In line with the finding of increased risk-based sensitivity over the monetary cycle for lower-risk firms, the results indicate more sensitive loan pricing for larger firms following the recent policy rate cut. Specifically, during the easing period, the lending rate response to a 1 percentage point increase in PD rose by 3 basis points for firms with above-median size. Larger firms are generally lower risk on average due to their diversification and greater capacity to absorb shocks.

4 Conclusion

This study reveals that the risk sensitivity of lending rates in the euro area is generally low but varies based on bank capitalisation, size, and firm credit quality. Banks tend to increase lending spreads by approximately 9 basis points for each percentage point rise in the probability of default, with higher sensitivity observed in banks with greater capitalisation and larger size. The findings also indicate that firms with lower PDs and those in less competitive markets experience higher risk sensitivity, particularly during periods of monetary tightening and easing. These insights underscore the importance of considering bank and firm characteristics, as well as market conditions, in understanding risk-based pricing in the euro area.

Higher sensitivity of spreads for firms with lower PD values, which intensifies over the monetary cycle, carries relevant implications for monetary policy.

The findings partially explain the disparities in transmission observed in Figures 1 and 2, demonstrating that rate hikes lead to a larger (smaller) adjustment in spreads for more (less) creditworthy borrowers. From a bank perspective, this is might be advantageous: higher-quality firms, being less likely to default despite increased borrowing costs, provide a more stable income stream through interest earnings. However, from an economic standpoint, this may be less beneficial. Loan allocation, at least in terms of pricing, becomes more favourable to riskier firms, which tend to be less stable and generate lower long-term value.

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