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Determinants of the Profitability and Stability of Euro Area Banks During the Ice Age of Interest Rates

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Abstract

In this paper we analyze the determinants of bank profitability and stability during the period of null or negative policy rates (2012 - 2022) for a large sample of banks established in Euro area countries. The results show that higher capitalization, credit quality and income diversification increase profitability and stability, while other covariates play a role mainly in influencing bank profits, but not bank resilience. Empirical outcomes suggest that the banks specialization has an impact on banks' financial results in periods of null or negative interest rates.

Keywords: bank profitability, bank stability, monetary policy, Euro Area

1. Introduction

Monetary policy conducted by central banks has a crucial impact on the financial system. The setting of policy rates, in fact, determines key benchmarks for financial markets, which shape the yield curve from the anchor of short-term rates, and for commercial banks, which must decide on lending and borrowing rates for customers.

Following the major international financial crisis originating from the bursting of the subprime mortgage bubble, major central banks significantly reduced the level of policy rates. In the Eurozone, the theoretical limit of zero interest rates on bank deposits ("Zero Lower Bound" - ZLB) was first reached on July 11, 2012, and exceeded in June 2014, when the ECB embarked on the unprecedented path of negative deposit rates ("Negative interest rate policy" - NIRP), maintaining this approach until the second half of 2022, when rates were first raised back to 0 and then soared to counter the surge in inflation. Hence, for about a decade, Euro area banks have experienced zero or negative deposit rates, while the main refinancing rate has fluctuated between zero and 0.75 percent over the same period.

In literature the effect of NIRP on banks' profitability and stability is mainly unclear, both theoretically and empirically.

In effect, on the one hand the reduction of policy interest rates can result in a collapse of banks' margin (namely the Net Interest Margin – NIM). As pointed out by several contributions, when the yield curve flattens and the banks adjust lending and borrowing rates for customers downwards, the outcome is likely to be a narrowing NIM (Alessandri and Nelson, 2015; Borio et al., 2017; Claessens et al., 2018): banks are reluctant to push borrowing rates below zero to preserve a sound relationship with customers and this attitude put a floor on the bottom side of interest spreads. Moreover, the behavioral reaction to these declining profits profile can be a soaring risk appetite by the bank managers, with adverse effects on banks' soundness.

On the other hand, negative rates are likely to produce an increase in asset values and lower credit risks, with a beneficial effect on bank profitability and stability. In effect, observation of bank profitability dynamics during NIRP period in the Euro Area does not show any collapse in bank profits; monetary accommodation has supported the economy, reducing flows of new non-performing loans, while the growth of financial markets has enabled the generation of streams of non-interest incomes (Lopez et al., 2020).

Given this trade-off between positive and negative effects of NIRP on banks profitability and stability, it is not surprising that financial outcomes differed from bank to bank depending on their business model and their specific features (Lopez-Penabad et al., 2022). This paper aims to shed light on these determinants of banks' profitability and soundness, studying a sample of 2,065 banks established in the Euro Area over the period 2012-2022.

Compared to previous papers that have been interested in the topic of bank profitability and stability during periods of negative or zero rates, our paper has several distinctive aspects. First, the dataset analyzed covers the entire period of negative or zero rates in the Euro area; moreover, the choice to examine a cohesive monetary area makes the sample

analyzed more homogeneous. Embracing an approach now considered classic in the literature, estimations employ a dynamic model; the variables of interest are mainstream measures on bank profitability, while several competing papers focus on NIM. Similarly, consistent with a broad strand of literature following Stiroh and Rumble (2006) for measuring diversification we use two different variables, namely non-interest income exposure and an HHI index of revenue sources. Finally, we introduce a novel hypothesis about the role of funding in explaining profitability and stability of banks during NIRP periods.

The paper is organized as follows. Section 2 briefly reviews the literature and introduces the research hypotheses. Section 3 presents the sample analyzed and discusses the research methodology used to analyze the data. Section 4 presents and discusses the results of the empirical analysis. Section 5 concludes.

2. Brief Literature Review and Research Hypotheses

There is an enormous amount of evidence in the literature concerning the determinants of bank profitability and stability (among others, Adusei, 2015; Ali and Puah, 2018; Berger et al., 2010a; Berger et al., 2010b; Brissimis and Delis, 2008; De Young and Rice, 2004a; De Young and Rice, 2004b; Klingelhöfer and Sun, 2019; Kohler, 2014; Kohler, 2015; Lepetit et al., 2008; Mergaerts and Vander Vennet, 2016; Nguyen et al., 2012; Pham et al., 2021; Rossi et al., 2018; Sanya and Wolfe, 2011; Uhde and Heimeshoff, 2009); however, the works which investigate these relationships during ZLB or NIRP periods are relatively scarce (Altavilla et al., 2018; Bikker and Vervliet, 2018; Borio, et al., 2017; Hanzlik and Teply, 2020; Jobst and Lin, 2016; Lopez et al., 2020; Lopez-Penabad et al., 2022; Molyneux et al., 2019). Since several papers focus on the effect of NIRP on NIM, their set-up is mainly focused on the macroeconomic determinants of banks profitability; in this paper we use a different approach which focuses on more comprehensive measures of profitability (namely Roaa and Roae). Hence, we are interested in exploring bank-specific covariates which can shape the feature of banks' business model and, therefore, explain their profitability and stability.

According to previous literature, we focus on covariates which proxy size (Barth et al., 2023; Berger and Bouwman, 2013; Chernykh, 2014; Clark et al., 2018; Mare, 2015), capitalization (Dietrich and Wanzenried, 2014), credit quantity and quality (Abreu and Mendes, 2001; Demirguc Kunt and Huizinga, 2000; Goddard et al., 2013), operational efficiency (Dietrich and Wanzenried, 2014; Goddard et al., 2013; Molyneux and Thorton, 1992), income diversification (Berger et al., 2010a; Berger et al., 2010b; De Young and Rice, 2004a; De Young and Rice, 2004b; Kohler, 2014; Kohler, 2015; Lepetit et al., 2008; Mergaerts and Vander Vennet, 2016; Paltrinieri et al., 2021; Rossi et al., 2020; Stiroh 2004; Stiroh and Rumble, 2006) and funding strategies (Chiorazzo et al., 2018; Lopez-Penabad et al., 2022; Mare, 2015).

Size is expected to matter during NIRP periods. Large banks should be more capable of adjusting their funding costs (Lopez et al., 2020), reducing the pressures on NIM; moreover, they could more easily exploit economies of scale (Goddard et al., 2004) and switch their offer to customers toward new services. About this latter topic it is worth noting that business diversification strategies entail higher costs (including training) which can be a decisive obstacle for small banks.

Altavilla et al. (2018) find that regulatory capital ratio, credit quality and efficiency play a role in explaining bank profitability during a period of negative rates. As expected, lower efficiency (coherently with Athanasoglou et al., 2008; Garcia-Herrero et al., 2009) and credit quality produce adverse effects on profitability, while the opposite holds for capitalization.

Regarding the business model, Lopez-Penabad et al. (2022) use three variables that control for asset composition, funding and diversification of revenue sources in a study about the determinants of profitability and stability for a sample of 2,596 banks from 29 European countries. Empirical results show that a higher amount of credits has a positive effect on NIM and a negative effect on Roa; a greater share of wholesale funding has opposite effects, although the coefficients are significant only with reference to the NIM. The presence of non-interest revenues has a negative impact on NIM, while no statistically significant relationships are found for Roa. With reference to bank stability, where measured with the Z-Score, wholesale funding and orientation towards lending show a positive sign, while non-interest revenues are associated with a negative coefficient.

Funding and revenue diversification appear to be interesting determinants of banks' profitability and stability. The former covariate has a twofold role in these dynamics. On the one side, the cost of funding is a crucial component of NIM and, in a broader sense, of each profitability margin of a bank. It has been noted that while ECB deposit rates were negative, the banking system offered a floor at least equal to zero to customer deposit rates. While the rate charged on loans to customers is progressively adjusted downwards according to market conditions, this floor generates a squeezing effect on NIM. However, this source of funding is likely to be the cheapest one for the bank, since other market operations were regulated at positive (or at least null) rates, including MRO carried out within the Eurosystem. Therefore, a high share of customer deposits over total liabilities appears to be beneficial for the bank, stably granting satisfaction to its funding needs at a convenient price.

As regards income diversification, the effect of the existence of different streams of revenues does not automatically guarantee higher profitability or stability. In fact, as pointed out by Stiroh and Rumble (2006), sometimes the beneficial "portfolio effects" deriving from low covariance/correlation between sources of revenues can be offset or overcome by the variance experienced by one of them: for example, this can happen with interest and non-interest incomes, where the latter are usually characterized by higher volatility over time. However, we need to separate the outcome of these dynamics on profitability and stability; a higher share of non-interest income should boost profits (particularly during periods of low rates, when the provisions of services to customers counterbalance the expected fall of NIM) but can produce more instability over time given its natural volatility.

A different effect is expected to occur when an explicit measure of income diversification is considered. When the streams of revenues are almost balanced, we can expect lower returns and higher stability; the opposite occurs when a bank has a clearly prevailing income source.

Considering the above, we introduce the following hypotheses that will be tested on the collected data base. In a period of zero or negative interest rates:

H_1: a greater size and regulatory capital increase bank profitability and stability;

H_2: higher exposure to customer lending reduces bank profitability and stability;

H_3: higher credit risks and inefficiency reduce bank profitability and stability;

H_4: a higher share of non-interest incomes increases bank profitability and reduces stability;

H_{4a}: greater revenue diversification reduces bank profitability but enhances stability;

H_5: a higher share of customer deposits increases bank profitability and stability.

3. Data and Methodology

We collect data for the period 2012-2022 for commercial, cooperative and saving banks established in Euro Area countries; the source is the Bank Focus dataset. Only Euro Area countries are included for the entire period under analysis. For balance sheets, consolidated and individual balance sheets (codes U1, U2, and C1 in Bank Focus) are considered, avoiding double counting according to the approach suggested by Duprey and L é(2012).

The resulting sample consists of 2,065 entities and is unbalanced due to the entry and exit of players from the market during the period examined: Table 1 illustrates the distribution of the analyzed banks by specialization and country.

Table 1. Sample composition by country and specialization

	Specialization			
Country	**Commercial**	**Cooperatives**	**Savings**	**Total**
Austria	22	23	3	**48**
Belgium	13	1	3	**17**
Cyprus	27	1	0	**28**
Estonia	7	0	0	**7**
Finland	18	96	7	**121**
France	71	71	12	**154**
Germany	36	725	366	**1,127**
Greece	4	3	0	**7**
Ireland	9	2	0	**11**
Italy	61	238	9	**308**
Luxemburg	17	0	2	**19**
Malta	7	1	1	**9**
Netherland	16	1	0	**17**
Portugal	16	6	75	**97**
Slovakia	8	0	0	**8**
Slovenia	7	0	1	**8**
Spain	20	48	11	**79**
Total	**359**	**1,216**	**490**	**2,065**

The data show that cooperative banks largely dominate the sample, accounting for more than half of it. Likewise, Germany has a decisive impact on the sample because of the high number of cooperative and saving banks established in the country. For these reasons, in the robustness tests (section 4.1) the analysis is conducted by excluding Germany from the sample and separating cooperative banks from commercial and saving banks.

The target variables in our analysis are the Return on average assets (Roaa), Return on average Equity (Roae) and the Z-Score, the latter accounting for bank stability, while the former two variables measure bank profitability.

Return on average assets and Return on average equity are widely used measures of bank profitability in the literature (furthermore, an interesting analysis on the limits of these profitability measures is developed in ECB, 2010 and ECB, 2018). Though they are generally positively correlated with each other, they provide different indications because of the different denominator aggregate of the variable formula: indeed, Roaa is dependent on the size of the bank, while Roae is sensitive to the presence of higher or lower levels of equity.

The Z-Score is a particularly popular measure in the literature for measuring bank stability (Boyd and Graham, 1986; Chiaramonte et al., 2015; Poghosyan and Čihák, 2011; Roy, 1952; Strobel, 2011; Vazquez and Federico, 2012): it is calculated as:

$$Z - SCORE = \frac{ROA + \frac{Equity}{Total\ Assets}}{\sigma_{ROA}}$$

In this paper, we use the approach of Chiaramonte et al. (2015), calculating ROA volatility using three years of data (the current year plus two lags); the alternative approach, which uses quarterly infra-annual data to determine ROA volatility, is not applicable to the sample under analysis due to an excessive number of missing values.

To test H_1 we use two variables. Size is calculated as the natural logarithm of Total Assets; this is an extremely well-known measure used in the literature to test the effect of scale on banks' earnings or stability dynamics. Given that rates of return first zeroed out and then moved into negative territory during the period examined, we expect that smaller banks (usually local banks with a strong focus on traditional services) have had greater difficulties from both a profitability and stability perspective. We therefore expect a positive sign of the coefficient associated with the Size variable in all estimates. Regulatory Capital is approximated by the variable Equity on Total Assets; again, the expectation is for a positive coefficient associated with this variable. In fact, higher capital endowment should allow banks better funding conditions in the market, more flexibility in lending policies (including higher riskiness of loans, being able to boast higher capital requirements in terms of supervision), with beneficial effects on both profitability and stability.

H_2 postulates that greater exposure to customer lending reduces bank profitability and stability; the covariate by which we measure this is Customer Loans & Advances on Total Assets. The erosion of interest margins resulting from the collapse in rates of return over the period examined should have penalized the banks most exposed to the lending sector; we therefore expect negative sign from the coefficient associated with this covariate in all estimates.

Since the burst of the subprime mortgage bubble, one of the most critical aspects of European banks' balance sheets has been the share of impaired loans, which has reached critical levels in several countries. Since this is a very relevant item for both profitability and stability, we have included a variable that accounts for credit quality in the estimates; according to H_3 we expect a negative coefficient in all regressions. The same result is expected with reference to efficiency; to measure this we use the most widely used covariate in the literature in this area, namely cost-income-ratio. In a period of tight margins, higher inefficiency should indeed translate into lower profitability and stability.

In the past, regulators and policymakers have often called on banks to develop greater revenue diversification to enjoy portfolio effects and have greater operational flexibility in different phases of the business cycle. Following an established approach in the literature (Stiroh and Rumble, 2006), we use two different variables to control for the level of diversification of revenue sources for banks. The first variable (Nonsh) is calculated as the share of Non-Interest Income on Operating Revenues; it then expresses the bank's ability to generate service revenues, and the expectation is that this attitude has increased the bank's profitability in the period examined. These revenues are likely to have greater volatility than those from interest income, and therefore the effect on bank stability is not necessarily positive; then, according to literature, we expect a negative sign of the coefficient associated to this covariate in banks' stability estimations.

An increase in service revenues does not in itself guarantee diversification; in fact, when they prevail, a further increase in them represents a phenomenon of concentration. To solve this problem, we introduce a variable that explicitly measures the level of sources of revenues diversification (Div). This covariate is constructed according to the approach of a Herfindahl Hirschman Index:

$$Div = 1 - [Nonsh^2 + (1 - Nonsh)^2]$$

The variable takes a minimum value of 0 when the bank has only one revenue source (from services or interest) and a maximum value of 0.5 when the two revenue sources contribute equally to operating profits. According to H_{4a}, in the period examined we expect Div to present a negative sign in profitability estimations and a positive one in stability estimations.

Finally, funding policies are assessed through Customer Deposits on Total Funding Excluding Derivatives. In the period analyzed, banks reduced the rate paid on client current accounts in a similar manner to the ECB's reduction on bank deposits; however negative rates were not passed on to clients, who enjoyed a kind of floor on the rates applied to contracts. In any case, funding from clients took place at rates competitive with market ones and constituted a buffer for banks' liquidity; we therefore expect the coefficient associated with this covariate to be positive in all estimates.

Table 2 describes the variables used and the expected signs of the coefficients, while Table 3 illustrates the descriptive statistics.

Table 2. Variables description and expected sign of coefficients

		Expected sign for	
Variables	**Description**	**Profitability**	**Stability**
Roaa	Return on average assets	/	/
Roae	Return on average equity	/	/
Z-Score	Natural logarithm of [(Roaa + Equity/Total Assets)/Roaa volatility]. Roaa volatility is calculated as the standard deviation of ROAA using three years (t, t-1, t-2) of data	/	/
Size	Natural logarithm of total assets	+	+
Capitalization	Equity on total assets	+	+
Loans	Customer loans & advances on total assets	-	-
Impaired loans	Impaired loans on gross customer loans and advance	-	-
Inefficiency	Cost-to-income ratio	-	-
Nonsh	Non-interest income on operating revenues	+	-
Div	Income diversification. calculated as: 1 – [(Nonsh)^2 + (1-Nonsh)^2]	-	+
Funding	Customer deposits on total funding excluding derivatives	+	+

Table 3. Descriptive statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
ROAA	12,254	0.322	0.423	-1.619	2.259
ROAE	12,254	3.483	4.775	-19.201	24.680
Z-SCORE	12,254	5.255	1.601	-0.793	9.787
Size	12,254	14.208	1.950	8.152	21.704
Capitalization	12,254	9.771	3.550	3.146	26.351
Loans	12,254	61.048	15.896	11.220	90.073
Impaired loans	12,254	4.284	5.594	0.018	34.904
Inefficiency	12,254	72.006	14.835	33.752	130.648
Nonsh	12,254	39.243	13.242	0.060	99.700
Div	12,254	44.179	7.415	0.121	50.000
Funding	12,254	79.063	17.520	12.009	100.000

The data show significant variability in bank profitability, as well as a wide range of stability conditions. The average picture that emerges from Table 3 tells of a system made up largely of small/medium-sized, well-capitalized banks, with a low level of impaired loans, predominantly oriented toward lending and with a significant component of interest income, although the level of diversification is high overall; funding from customers is prevalent.

Table 4 shows the correlation matrix among the covariates used in this study; no critical values emerge.

Table 4. Correlation matrix

	Size	Capitalization	Loans	Impaired loans	Inefficiency	Nonsh	Div	Funding
Size	1							
Capitalization	-0.3145*	1						
Loans	0.0390*	-0.0337*	1					
Impaired loans	-0.0185*	0.0633*	-0.1029*	1				
Inefficiency	-0.1450*	-0.0466*	-0.1181*	0.0259*	1			
Nonsh	0.1843*	-0.0192*	-0.2797*	0.0652*	0.1068*	1		
Div	0.0922*	-0.1063*	0.0692*	-0.0161	0.0630*	0.2972*	1	
Funding	-0.4132*	0.0435*	-0.0945*	-0.1485*	0.2106*	-0.2154*	-0.0567*	1

Note: * indicate statistical significance at the 5% level.

To estimate the effect of the many explanatory variables on bank profitability and stability we use the following equation:

$$\Pi_{i,t} = \Pi_{i,t-1} + \gamma X_{i,t} + c_i + \varepsilon_{i,t}$$

where Π is respectively equal to the Return on average assets, Return on average equity and Z-Score in the three different set-ups used to test the research hypotheses; X is the vector of bank-specific variables previously described, c is the constant term and and ε_i is the error term. All estimates include year dummies; interacted year-country and year-specialization dummies are also included in several tests to control for macroeconomic factors and specialization-linked dynamics. Estimates are conducted with a fixed-effect dynamic panel, in accordance with the results of the Hausman test; an estimate employing a static model is also included for comparison. To reduce the presence of outliers, the variables underwent light winsorization (1% each tail).

4. Discussion of Findings

Table 5 shows the results of the estimates for the determinants of Roaa during the examined period.

Table 5. Baseline estimation (dependent variable ROAA, full sample)

	(1)	(2)	(3)	(4)	(5)
VARIABLES	ROAA	ROAA	ROAA	ROAA	ROAA
L.ROAA		0.13***	0.12***	0.14***	0.12***
		(0.025)	(0.024)	(0.024)	(0.023)
Size	0.12**	0.10**	0.15***	0.10**	0.16***
	(0.051)	(0.046)	(0.046)	(0.046)	(0.046)
Capitalization	0.04***	0.04***	0.04***	0.04***	0.04***
	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)
Loans	-0.00**	-0.00*	-0.00***	-0.00*	-0.00***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Impaired loans	-0.03***	-0.02***	-0.02***	-0.02***	-0.02***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Inefficiency	-0.01***	-0.01***	-0.01***	-0.01***	-0.01***

	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Nonsh	0.00***	0.00***	0.00***	0.00***	0.00***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Div	-0.00**	-0.00**	-0.00**	-0.00**	-0.00**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Funding	0.00***	0.00***	0.00**	0.00***	0.00**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	-0.97	-0.75	-1.52**	-0.86	-1.58**
	(0.767)	(0.698)	(0.686)	(0.699)	(0.687)
Year dummies	*YES*	*YES*	*YES*	*YES*	*YES*
Year-Country dummies			*YES*		*YES*
Year-Spec dummies				*YES*	*YES*
Observations	12,254	12,254	12,254	12,254	12,254
R-squared	0.24	0.25	0.36	0.27	0.37
Number of banks	2,065	2,065	2,065	2,065	2,065

Notes: This table presents the impact of several bank-specific covariates on ROAA, using a static and dynamic fixed effect panel model. Bank and time fixed effect are used. Interacted year-country dummies and year-specialization dummies are included respectively in regressions 4 and 5. Bank profitability is measured as the Return on Average Assets (ROAA). The natural logarithm of total assets (Size), equity to total assets (Capitalization), customers loans and advances to total assets (Loans), impaired loans on gross customer loans and advance (Impaired loans), cost to income ratio (Inefficiency), non-interest income on operating revenues (Nonsh), 1-HHI built on Nonsh (Div) and customer deposits on total funding excluding derivatives (Funding) are the bank-specific control variables. Robust standard errors are in parentheses. ***, **, * indicate statistical significance at the 1%. 5% and 10% level, respectively.

The coefficients are essentially stable in sign and significance across the different set-ups.

Size is associated with a positive coefficient and is highly statistically significant; the same result is observed with reference to capital endowment. Overall, the two results confirm H_1.

Regarding specialization toward credit granting, the coefficient remains negative in all estimates, with slight variations in the statistical significance found; as expected, the squeezing effect of NIRP on NIM penalized banks more exposed to lending activity. Hence, H_2 is confirmed with reference to Roaa.

In a period of margin compression, Hypothesis H_3 postulates that higher levels of impaired loans and inefficiency are negative factors for bank profitability; this assumption is confirmed by the results in Table 5. This outcome has been observed frequently during the aftermath of subprime crisis and testify that sound bank management starts from the basics: cost efficiency and wise credit policies.

The results of the estimates with respect to the Nonsh and Div variables in turn confirm H_4 and H_{4a}; greater exposure to service revenues increases Roaa, while higher levels of revenue diversification reduce it. In a period characterized by particularly expansive monetary conditions (which resulted in very positive financial market performances) the best performance is achieved by entities that know how to decisively orient their business model toward non-interest income.

Finally, H_5 is confirmed by the positive sign associated with the variable Funding: the presence of a high proportion of funding from depositors generates a benefit for the banks in the sample, increasing their profitability.

Overall, the explanatory quality of the variables used appears high, especially where the interacted year-country dummies that approximate the change in the macroeconomic framework in the different countries included in the sample are considered.

Table 6 shows the results of the estimates with reference to the other variable used to measure the profitability of the banks in the sample, namely Roae.

Table 6. Baseline estimation (dependent variable ROAE, full sample)

	(1)	(2)	(3)	(4)	(5)
VARIABLES	ROAE	ROAE	ROAE	ROAE	ROAE
L.ROAE		0.11***	0.11***	0.12***	0.11***
		(0.026)	(0.026)	(0.026)	(0.026)
Size	0.75*	0.57	1.09***	0.65	1.15***
	(0.428)	(0.403)	(0.385)	(0.408)	(0.395)
Capitalization	0.20***	0.19***	0.23***	0.20***	0.23***
	(0.060)	(0.055)	(0.060)	(0.055)	(0.060)
Loans	-0.02**	-0.02*	-0.03***	-0.02*	-0.03***
	(0.010)	(0.009)	(0.008)	(0.009)	(0.008)
Impaired loans	-0.32***	-0.29***	-0.24***	-0.28***	-0.24***
	(0.027)	(0.026)	(0.030)	(0.026)	(0.029)
Inefficiency	-0.11***	-0.11***	-0.10***	-0.11***	-0.10***
	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)
Nonsh	0.03**	0.03**	0.05***	0.03**	0.05***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Div	-0.04*	-0.03*	-0.03	-0.03	-0.03
	(0.021)	(0.020)	(0.018)	(0.020)	(0.018)
Funding	0.03***	0.03***	0.01	0.03***	0.01
	(0.010)	(0.010)	(0.009)	(0.010)	(0.009)
Constant	-0.23	1.34	-5.89	-0.17	-6.42
	(6.506)	(6.106)	(5.828)	(6.212)	(5.971)
Year dummies	*YES*	*YES*	*YES*	*YES*	*YES*
Year-Country dummies			*YES*		*YES*
Year-Spec dummies				*YES*	*YES*
Observations	12,254	12,254	12,254	12,254	12,254
R-squared	0.23	0.24	0.35	0.26	0.35
Number of banks	2,065	2,065	2,065	2,065	2,065

Notes: This table presents the impact of several bank-specific covariates on ROAE, using a static and dynamic fixed effect panel model. Bank and time fixed effect are used. Interacted year-country dummies and year-specialization dummies are included respectively in regressions 4 and 5. Bank profitability is measured as the Return on Average Equity (ROAE). The natural logarithm of total assets (Size), equity to total assets (Capitalization), customers loans and advances to total assets (Loans), impaired loans on gross customer loans and advance (Impaired loans), cost to income ratio (Inefficiency), non-interest income on operating revenues (Nonsh), 1-HHI built on Nonsh (Div) and customer deposits on total funding excluding derivatives (Funding) are the bank-specific control variables. Robust standard errors are in parentheses. ***, **, * indicate statistical significance at the 1%. 5% and 10% level, respectively.

Overall, the results appear in line with those previously described; all the coefficients maintain the sign found in Table 5 estimates, but some statistical significance is lost. Coefficients associated with variables Div and Funding lose statistical significance where the model controls for country effects (or, relative to the Div variable alone, for the specialization effect): the H_{4a} and H_5 hypotheses are thus not confirmed in all the setups. In contrast, the other hypotheses (H_1 through H_4) are confirmed by the data.

Finally, Table 7 shows the results referring to the determinants of bank stability.

Table 7. Baseline estimation (dependent variable Z-SCORE, full sample)

VARIABLES	(1) Z-SCORE	(2) Z-SCORE	(3) Z-SCORE	(4) Z-SCORE	(5) Z-SCORE
L.Z-SCORE		0.33***	0.32***	0.33***	0.32***
		(0.011)	(0.011)	(0.011)	(0.011)
Size	-0.31***	-0.20**	-0.18**	-0.22***	-0.22**
	(0.102)	(0.082)	(0.089)	(0.085)	(0.092)
Capitalization	0.06***	0.06***	0.06***	0.06***	0.06***
	(0.012)	(0.010)	(0.011)	(0.010)	(0.011)
Loans	-0.00	-0.00	0.00	-0.00	0.00
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Impaired loans	-0.02***	-0.01***	-0.02***	-0.02***	-0.02***
	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)
Inefficiency	-0.00	-0.00	-0.00*	-0.00	-0.00*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Nonsh	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Div	0.01***	0.01***	0.01***	0.01***	0.01***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Funding	0.00	0.00	-0.00	0.00	-0.00
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	8.37***	5.38***	5.41***	5.75***	5.86***
	(1.448)	(1.161)	(1.285)	(1.207)	(1.330)
Year dummies	*YES*	*YES*	*YES*	*YES*	*YES*
Year-Country dummies			*YES*		*YES*
Year-Spec dummies				*YES*	*YES*
Observations	12,254	12,254	12,254	12,254	12,254
R-squared	0.03	0.15	0.19	0.15	0.19
Number of banks	2,065	2,065	2,065	2,065	2,065

Notes: This table presents the impact of several bank-specific covariates on Z-SCORE, using a static and dynamic fixed effect panel model. Bank and time fixed effect are used. Interacted year-country dummies and year-specialization dummies are included respectively in regressions 4 and 5. Bank stability is measured as the Z-SCORE. The natural logarithm of total assets (Size), equity to total assets (Capitalization), customers loans and advances to total assets (Loans), impaired loans on gross customer loans and advance (Impaired loans), cost to income ratio (Inefficiency), non-interest income on operating revenues (Nonsh), 1-HHI built on Nonsh (Div) and customer deposits on total funding excluding derivatives (Funding) are the bank-specific control variables. Robust standard errors are in parentheses. ***, **, * indicate statistical significance at the 1%. 5% and 10% level, respectively.

The coefficient associated with bank size is negative and highly significant, while the coefficient associated with capital endowment is positive and statistically significant: H_1 is thus only partially confirmed with reference to bank stability. This outcome can be due to the fact that usually small banks have a higher level of regulatory capital, then increasing their Z-Score figures.

Specialization in customer lending is associated with coefficients with unstable sign and consistent absence of statistical

significance; with respect to the Z-Score, H_2 is therefore not confirmed.

Low credit quality and inefficiency are associated with negative coefficients; in the case of the cost income ratio, the statistical significance of the coefficients is variable. H_3 is thus partially confirmed relative to bank stability.

On the topic of revenue sources, the estimates have negative coefficients for the Nonsh variable and positive coefficients for Div; the latter are always strongly statistically significant. The results appear consistent with a view a'la Stiroh and Rumble (2006), where non-interest income can increase profitability, but its volatility can undermine stability; for its part, diversification can offer benefits from a basket effect, contributing to bank stability. Considering these observations, H_4 is not confirmed due to the absence of adequate statistical significance of the coefficients, while H_{4a} is confirmed.

Finally, H_5 is not confirmed with reference to bank stability; again, the coefficients associated with the variable Funding do not exhibit adequate statistical significance.

4.1 Robustness Checks

The sample of banks analyzed, as evidenced by the data in Table 1, consists of one-third German cooperative banks. As a robustness test of the results previously described, the model was estimated by excluding Germany and separating cooperative banks from commercial and saving banks.

Table 8 shows the results of the estimates without German banks.

Table 8. Baseline estimation (excluding Germany)

	(1)	(2)	(3)
VARIABLES	ROAA	ROAE	Z-SCORE
L.ROAA	0.10***		
	(0.023)		
L.ROAE		0.09***	
		(0.027)	
L.Z-SCORE			0.34***
			(0.016)
Size	0.16***	1.02**	-0.09
	(0.053)	(0.510)	(0.097)
Capitalization	0.04***	0.24***	0.06***
	(0.007)	(0.068)	(0.012)
Loans	-0.00***	-0.04***	-0.00
	(0.001)	(0.010)	(0.002)
Impaired loans	-0.02***	-0.25***	-0.02***
	(0.003)	(0.031)	(0.004)
Inefficiency	-0.02***	-0.18***	-0.01***
	(0.001)	(0.012)	(0.001)
Nonsh	0.00**	0.03**	-0.00
	(0.001)	(0.016)	(0.002)
Div	-0.00*	-0.02	0.00*
	(0.002)	(0.021)	(0.003)
Funding	0.00***	0.01	-0.00
	(0.001)	(0.011)	(0.002)
Constant	-1.15	0.76	3.84***
	(0.823)	(8.083)	(1.419)
Year dummies	*YES*	*YES*	*YES*
Year-Country dummies	*YES*	*YES*	*YES*
Year-Spec dummies	*YES*	*YES*	*YES*
Observations	6,076	6,076	6,076
R-squared	0.44	0.42	0.27
Number of banks	938	938	938

Notes: This table presents the impact of several bank-specific covariates on bank's profitability and stability using a dynamic fixed effect panel model (excluding German banks from the sample). Bank and time fixed effect, interacted

year-country dummies and year-specialization dummies are used. Bank profitability is measured as the Return on average assets (Roaa) and the Return on Average Equity (ROAE); bank stability is measured as the Z-SCORE. The natural logarithm of total assets (Size), equity to total assets (Capitalization), customers loans and advances to total assets (Loans), impaired loans on gross customer loans and advance (Impaired loans), cost to income ratio (Inefficiency), non-interest income on operating revenues (Nonsh), 1-HHI built on Nonsh (Div) and customer deposits on total funding excluding derivatives (Funding) are the bank-specific control variables. Robust standard errors are in parentheses. ***, **, * indicate statistical significance at the 1%. 5% and 10% level, respectively.

The coefficients associated with the different covariates remain overall unchanged from the estimates previously shown; statistical significances change marginally; therefore, out estimates are robust to the drop of the most present country in the whole sample. Overall, the picture described in Section 4 is confirmed; the interpretive ability of the estimates measured by the coefficient R-squared improves slightly compared to the full sample.

In a second test we separate cooperative from commercial and saving banks; the results of this robustness check are contained in Table 9.

Table 9. Baseline estimation (cooperative vs non-cooperative banks)

	COOPERATIVE BANKS			NON-COOPERATIVE BANKS		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	ROAA	ROAE	Z-SCORE	ROAA	ROAE	Z-SCORE
L.ROAA	0.06**			0.14***		
	(0.029)			(0.031)		
L.ROAE		0.05			0.13***	
		(0.041)			(0.032)	
L.Z-SCORE			0.29***			0.34***
			(0.015)			(0.016)
Size	0.01	0.30	-0.58***	0.24***	1.72***	-0.05
	(0.038)	(0.453)	(0.136)	(0.064)	(0.576)	(0.112)
Capitalization	0.05***	0.30***	0.10***	0.04***	0.25***	0.05***
	(0.008)	(0.092)	(0.020)	(0.008)	(0.075)	(0.012)
Loans	-0.00***	-0.04***	0.00	-0.00**	-0.04***	-0.00
	(0.001)	(0.012)	(0.003)	(0.001)	(0.012)	(0.003)
Impaired loans	-0.02***	-0.23***	-0.02***	-0.02***	-0.23***	-0.02***
	(0.003)	(0.038)	(0.007)	(0.005)	(0.042)	(0.005)
Inefficiency	-0.01***	-0.09***	-0.01***	-0.01***	-0.10***	0.00
	(0.001)	(0.011)	(0.002)	(0.001)	(0.009)	(0.001)
Nonsh	0.00	0.02	-0.00	0.01***	0.07***	-0.01***
	(0.001)	(0.020)	(0.003)	(0.001)	(0.018)	(0.002)
Div	-0.00	-0.03	0.01*	-0.00	-0.02	0.01*
	(0.002)	(0.025)	(0.005)	(0.002)	(0.024)	(0.003)
Funding	0.00	0.00	-0.00	0.00**	0.00	0.00
	(0.001)	(0.016)	(0.003)	(0.001)	(0.013)	(0.003)
Constant	0.64	7.03	10.88***	-3.11***	-16.73*	3.43**
	(0.551)	(6.650)	(1.933)	(1.024)	(9.147)	(1.656)
Observations	6,787	6,787	6,787	5,467	5,467	5,467
R-squared	0.37	0.38	0.19	0.40	0.38	0.22
Number of banks	1,216	1,216	1,216	849	849	849

Notes: This table presents the impact of several bank-specific covariates on cooperative and non-cooperative bank's profitability and stability using a dynamic fixed effect panel model. Bank and time fixed effect, interacted year-country dummies and year-specialization dummies are used. Bank profitability is measured as the Return on average assets (Roaa) and the Return on Average Equity (ROAE); bank stability is measured as the Z-SCORE. The natural logarithm of total assets (Size), equity to total assets (Capitalization), customers loans and advances to total assets (Loans), impaired loans on gross customer loans and advance (Impaired loans), cost to income ratio (Inefficiency), non-interest income on operating revenues (Nonsh), 1-HHI built on Nonsh (Div) and customer deposits on total funding excluding derivatives

(Funding) are the bank-specific control variables. Robust standard errors are in parentheses. ***, **, * indicate statistical significance at the 1%. 5% and 10% level, respectively.

Analysis of the coefficients associated with the different variables indicates that the two sub-samples share a common underlying framework but show some differences.

The variable Size is associated with significant coefficients in the profitability estimates of non-cooperative banks, while this occurs only with reference to stability for the sub-sample of cooperative banks. Usually, cooperative banks are small entities focused on traditional borrowing and lending strategies; these estimates suggests that a higher size can improve cooperative banks resilience, while it is not able to differentiate profitability profiles. This can occur since the scale which allows diversification strategies is far beyond the usual size of a cooperative bank. Capitalization, on the other hand, appears significant and associated with a positive coefficient in all estimates, independently by the business model.

Specialization in customer lending has a negative impact on profitability for both sub-samples, while no statistically significant impact on stability is found; if we match these results with those linked to the Impaired Loans, it emerges that what matters for stability is not the amount of loans, but their quality.

H_3 is mainly confirmed by the data results; only the cost income ratio is not found to be associated with a statistically significant coefficient in non-cooperative banks stability estimates. The variable Nonsh appears significant only in the sub-sample of non-cooperative banks, with positive sign in the estimates related to profitability and negative sign in the one devoted to bank stability; Div maintains positive sign and slight statistical significance in both sub-samples with respect to the Z-Score.

Finally, the variable Funding appears to play a limited role in explaining the profitability and stability dynamics of the two sub-samples under consideration; its contribution is only relevant for Roaa in the sample of non-cooperative banks, where a positive and statistically significant coefficient is found.

5. Conclusions

Bank profitability and stability are crucial for modern economies. The Basel Accords have progressively increased capital requirements, and the advent of several sequential crises (subprime mortgages, sovereign debt, Covid19) has created strong critical elements for bank balance sheets, through non-performing loans, losses on government securities held in the portfolio, and uncertainty in customers' economic conditions. Lower profitability means lower ability to generate capital internally and lower attractiveness for potential investors: thus, the concerns raised after the introduction of NIRP regarding the possible collapse of banks' margins were well funded. However, this collapse did not occur; the banking system has adapted to the new framework, trying to find opportunities among the threats.

Our results indicate that sound bank management, which includes high levels of regulatory capital, good credit quality, and a sound diversification of sources of revenues, improves both profitability and stability during NIRP times. Other covariates (such as efficiency, specialization in credit supply to customers, non-interest income) have an impact on profitability but during the period under scrutiny did not significantly affect the banks' stability.

Overall, the results of the econometric analysis suggest that even in periods characterized by extreme economic-financial conditions, the principles of sound and prudent bank management remain a safeguard for the profitability and stability of banks. In this context, the ability to diversify the set of revenue sources appears to be an important element of flexibility, and explains the continuous calls from supervisory authorities to increase the size of banks, which can also be achieved through the creation of banking groups.

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