I. Drivers of bank profitability in the euro area

By Mario Bellia and Guillaume Cousin ([1])

Abstract: *Bank profitability matters for financial stability and for monetary policy transmission. At the same time, bank profitability is affected by monetary policy decisions and by the broader macroeconomic environment. Over the past years, macroeconomic conditions have changed fundamentally. From being too low, inflation became far too high, triggering a strong tightening of monetary policy. The related rapid increase in interest rates has had different consequences for banks depending on their jurisdictions and regulatory environment and on their business models. Focusing on the euro area, this chapter explores the drivers of bank profitability and highlights how changes in macroeconomic conditions can affect it. The analysis is based on a vast dataset of bank-level data over 2009-2022 and uses a framework based on quantile regressions. This econometric tool allows us to account for bank heterogeneity when analysing the drivers of bank profitability and to infer the probabilistic distribution of the profitability of a representative euro-area bank. The analysis allows us to assess how the profitability of this representative bank may respond to different economic shocks, with a focus on shifts in the interest rate environment economic activity and NPL ratios. We find that the average bank profitability is driven by the level of the short-term interest rates in the sample. Hence, we find that the recent steep increase in short-term interest rates benefits bank profitability. However, a macroeconomic shock of a size similar to the one faced during the financial crisis would negatively impact bank profitability, despite the higher level of interest rates.*

I.1. Introduction

Bank profitability has gained interest since the 2008 Global Financial Crisis, as a relevant macroeconomic variable. While bank profitability has been high in the recent period, from a historical perspective, exiting the low interest rate environment, the March 2023 bank turmoil in the United States and in Switzerland has highlighted the importance of banks' financial health for economic and financial stability. These recent episodes have indeed provided a reminder of the importance of policy measures, including bank regulation and supervision and monetary policy decisions, on banks' financial health. In this context, the impact of the global steep increase in interest rates is largely debated in the press and the academic community. This chapter highlights the main discussions related to bank profitability. The chapter then investigates the main determinants of bank profitability. The use of quantile regressions, which accounts for bank heterogeneity, allows us to estimate the profitability distribution of a representative euro-area bank and to assess how its profitability would react to different shocks, with a focus on shocks in interest rates, economic activity and NPL ratios. For this purpose, we use a framework previously developed for analysing the impact of central bank digital currencies on bank profitability ([2]) and estimate quantile regressions on a large panel of individual euro-area banks. By estimating a profitability distribution on a large sample of banks, we can assess how the profitability distribution changes when the drivers of bank profitability are affected by a shock. In particular, our analysis highlights how bank profitability may react to lower economic activity or to changes in the interest rate environment. After highlighting conceptual issues related to bank profitability in Section I.2, the paper describes the data and the methodology used in Section I.3. Section I.4 provides our analysis of the drivers of bank profitability using quantile regressions on a large sample of banks. The estimate of the profitability distribution of a representative euro area bank can thus be built based on the previous regressions. Such distribution can be used to highlight how bank profitability is affected in different macroeconomic scenarios. Section I.5 concludes.

I.2. Conceptual issues related to bank profitability: bank profitability, financial stability and monetary policy

Bank profitability can be measured with accounting non-risk-adjusted return ratios such as the return on asset (ROA) or the return on equity (ROE), with ROE being dependent on companies' leverage. There are also risk-adjusted measures, such as the return on risk-weighted asset (RORWA, or operating profit over risk-weighted assets). The ROA (ROE) is the ratio of net income (after taxes) divided by total assets (equity). Banks' net income can usually be decomposed as net interest income plus non-interest income

([1]) The authors thank Matteo Salto, Leonor Coutinho, Eric Rucher, Stan Maes, Maria Tomova, Alberto Gilesi, and Markus Wintersteller, for their helpful comments. This chapter represents the authors' views and not necessarily those of the European Commission.

([2]) Bellia, M. and Calès, L., (2023), Bank profitability and central bank digital currency, JRC Working Papers in Economics and Finance, 2023/6.

and changes in loan loss provisions. The net interest income results from the margin between banks' income on interest-bearing assets (loans, securities portfolios, central bank reserves) and their expense on interest-bearing liabilities (deposits, wholesale funding, central bank funding). Non-interest income comprises income from fees and commissions. The relative size of the different income streams depends on banks' business model, their risk profile and on macroeconomic conditions.

Banks play a key role in the transmission of monetary policy and their financial health matters for monetary policy transmission and for economic activity. In the euro area, the ECB has emphasised the importance of adequate bank profitability for monetary policy transmission ([3]) and stressed that weak profitability could be a concern for financial stability. ([4]) Less profitable banks tend to contribute more to systemic risk although banks' contribution to systemic risk also depends on their business models and sources of profit. ([5]) Indeed, profitability allows banks to absorb potential losses and to build capital buffers, thereby smoothing shocks to economic activity, but also to pay out dividends and/or to buy back shares. Profits can also be used to make investments and make banks more competitive and more resilient to shocks. Profits are also linked to banks' riskiness. High profits can reflect excessive leverage and/or high risk taking, which can increase risks for bank stability and for the financial system. However, protracted low profitability constrains monetary policy. In an easing cycle, it impedes banks' ability to transmit lower policy rates to bank lending interest rates or to increase lending volumes and ease their credit standards. In a tightening cycle, protracted weak profitability can threaten banks' ability to cope with their counterparts' deteriorated creditworthiness and to eventually absorb losses.

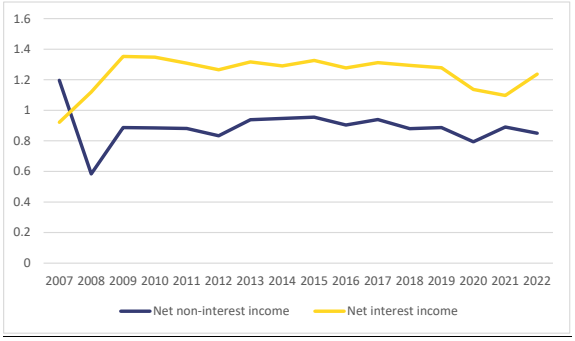
At the same time, monetary policy decisions have an impact on bank profitability. On the banks' funding side, central banks directly influence the cost of banks' refinancing operations, steer interbank market interest rates and influence the returns on banks' issued bonds and commercial paper and the remuneration of deposits. On the banks' asset side, monetary policy decisions influence the return on banks' central bank reserves and the returns of their assets, such as corporate and sovereign bonds, equity instruments, and loans with variable interest rates. Monetary policy decisions also, influence macroeconomic conditions, hence credit growth and households' and firms' creditworthiness. Overall, as institutions involved in maturity transformation, banks' interest income is sensitive to changes in the interest rate environment, although they can have opposite effects on banks' different sources of income. The level of short-term interest rates and the slope of the yield curve are usually positively associated to banks' net interest income. Higher interest rates improve banks' net interest income because interest rates on bank deposits cannot become negative – or only to a limited extent. Hence, the spread between the interest rate on deposits and the interest rate on loans tends to be smaller when rates are lower. Conversely, when interest rates increase, deposit rates tend to be sticky and to increase less than interest rates on loans. The slope of the yield curve also improves bank profitability due to banks' maturity transformation activity. At the same time, higher interest rates are also associated with higher loan-loss provisions due to higher risks of default. They are also associated with lower non-interest income, as higher rates can negatively impact the value of banks' securities portfolios (although the extent to which this is being reflected in a bank's accounts depends on accounting conventions and bank practices) and on securities' characteristics (including bonds maturity for instance). ([6]) Hence, the way interest rates affect bank profitability also depends on banks' business models, which translates in their balance sheet composition and their relative sources of income. ([7]) The overall impact of monetary policy decisions on bank profitability has been debated, not only in the low interest rate environment that followed the 2008 GFC, but also more recently when exiting the low interest rate environment. Some studies provided evidence that the low interest environment negatively affected bank profitability. ([8]) This impact is usually attributed to a decrease in banks' net interest margin. A study covering 3385 banks from 47 countries over

([3]) De Guindos, L. (2019), Challenges for bank profitability, Speech.
([4]) De Guindos, L. (2019), Euro area banks: the profitability challenge, Keynote speech
([5]) Xu et al. (2019), Bank Profitability and Financial Stability, IMF Working Paper N°2019/005.
([6]) Borio C. et al., (2015), The influence of monetary policy on bank profitability, BIS Working Paper N°514.
([7]) Bonaccorsi di Patti E., Palazzo F., (2018), Bank Profitability and Macroeconomic Conditions: Are Business Models Different?, Bank of Italy Occasional Paper N°436.
([8]) Borio C. et al., ibid.

2005-2013 estimated that a one percentage point decrease in interest rates implied an 8 basis points lower net interest margin. ([9]) While acknowledging that periods of low interest rates coincided with lower profitability, other studies argued that monetary policy easing was not conducive to lower profitability when considering the endogeneity of policy measures to the economic outlook. Thus, the association of lower rates and lower profitability would not reflect a causality from rates to profitability but would be the consequence of weak macroeconomic conditions. ([10]) A recent study emphasized that the way bank profitability reacted to low interest rates was not uniform across jurisdictions. ([11])

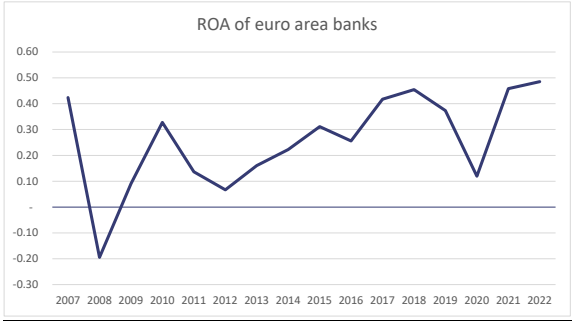
In the euro area, the aggregate net interest income decreased from 1.4% of banks' total assets in 2009 to 1.1% in 2021 before rebounding to 1.2% in 2022 (Graph I.1). Over the same period, banks' return on assets fluctuated with more volatility. It trended upward over 2012-2018 before decreasing abruptly in 2020 and recovering thereafter, reaching 0.48% in 2022 (Graph I.2). Despite the challenges posed by the COVID-19 pandemic, the EU banking system proved to be resilient, given also the support provided by EU regulatory bodies and supervisors. ([12])

Graph I.1: **Interest income and non-interest income**



(1) Euro area banks, as % of total assets
Source: ECB, CBD2 dataset

Graph I.2: **Return on assets**



(1) Euro area banks, as % of banks' total assets
Source: ECB, CBD2 dataset

Since 2022, the interest rate environment has changed fundamentally in the euro area. The ECB has tightened its monetary policy and proceeded to the steepest increase in its policy rates since the euro's inception. This chapter aims at highlighting how the profitability of euro-area banks might react to the new interest rate environment and to macroeconomic shocks more in general. Hence, we look at the drivers of bank profitability while taking into account the heterogeneity of banks.

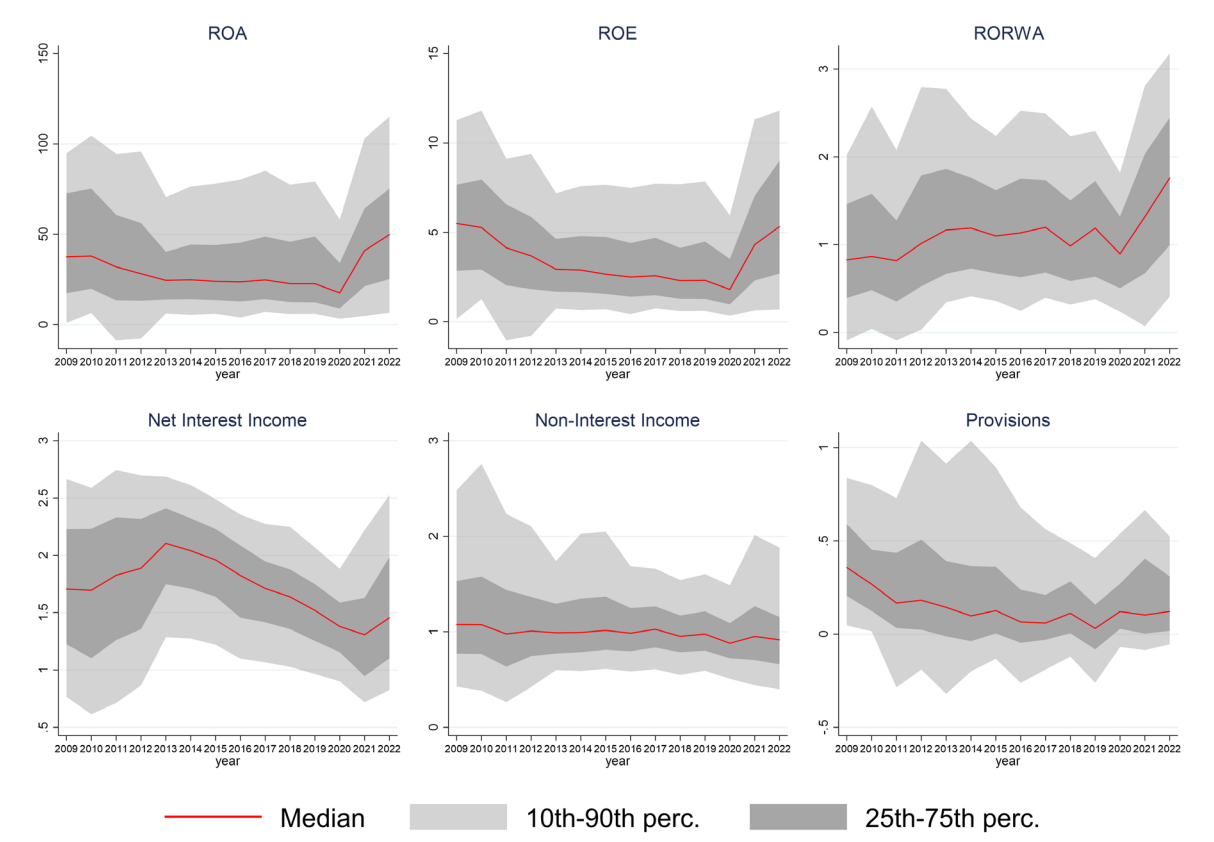
I.3. Database description and methodology

The following analysis focuses on a large cross-section of banks, sampled from the data provider Orbis Bankfocus, spanning the period from 2009 to 2022, at yearly frequency. We cover the 20 euro-area Member States, albeit the number of banks differs substantially across Member States given the different size of their banking systems and the presence of large banking groups that have subsidiaries across the euro area. We focus our analyses on commercial banks, cooperative banks, saving banks, bank holding companies, and Fintech banks, plus banks that are included in the list provided by the Single Supervisory Mechanism (SSM) included in the ORBIS database. We use the highest level of consolidation available, excluding subsidiaries, in order to avoid double-counting issues. We also impose to have at least 3 yearly

([9]) Claessens S. et al., (2018), "Low-For-Long" interest rates and banks' interest margins and profitability: Cross-country evidence, Journal of Financial Intermediation, Vol. 35, p.1-16.
([10]) Altavilla C. et al., (2017), Monetary policy and bank profitability in a low interest rate environment, ECB Working Paper Series N°2105
([11]) Windsor C. et al., (2023), The Impact of Interest Rates on Bank Profitability: A Retrospective Assessment Using New Cross-country Bank-level Data, Reserve Bank of Australia Research Discussion Paper 2023-05.
([12]) A detailed report on all measures and the impact on the banking sector is provided by EBA (2022) EBA closure report of Covid-19 measures Eba/rep/2022/32 16 December 2022.

observations per entity, and that the bank is still active. ([13]) We end up with 2016 entities that represents roughly 85% of the total assets of the euro area banking system.

Graph I.3: **Selected profitability measures, 2009-2022**



(1) averages across years of a set of selected measures of profitability for an unbalanced panel of 2160 banks. ROA values are in basis points of total assets. All other measures are in percentage of total assets.
Source: *Orbis B*

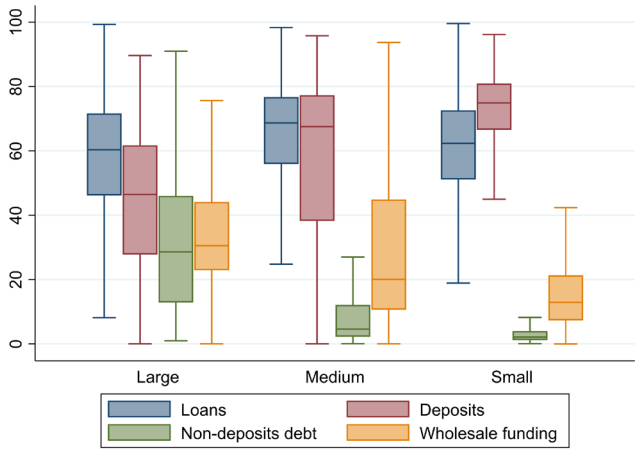
The sample of banks is quite heterogeneous in terms of size and business models. Our sample contains 99 large, 355 medium, and 1562 small banks. ([14]) Graph I.4 depicts the distribution of selected balance sheet ratios in our sample, in the period 2009-2022. In terms of loans to assets, most of the banks have a loan-to-asset ratio in the 50%-80% interval. The distribution of loan-to-asset ratio across bank size is quite homogenous, albeit medium and small banks have a slightly higher loan-to-asset ratios. The funding structure is the main source of difference across banks, in particular if one compares banks of different size. Small banks strongly rely on deposits for funding: the distribution of the deposit-to-asset ratio is quite concentrated between 70% and 80%. Large banks rely more on other sources of funding including non-deposit debt and wholesale funding. Notably, the dispersion of these variables is quite high across size categories, with the exception of non-deposit debt for small banks.

([13]) We acknowledge that there might be survivorship bias in our estimations of average profits, since we exclude the most problematic banks that failed or have been incorporated in other entities. Further, another source of upward bias could be state aids and public recapitalizations rolled over in the aftermath of the 2009 crisis.

([14]) Banks are categorised as small, medium, and large, applying a simple approach using EBA thresholds based on total assets. Large banks have total assets above EUR 30bn. Banks with total assets below EUR 3bn are considered small and banks with total assets between EUR 3bn and 30bn are considered medium.

We investigate the link between bank profitability and variables related to monetary policy and economic growth. As banks are heterogenous in terms of size, business models and sources of profits, such an analysis needs to account for bank heterogeneity, as shown by the literature on bank profitability. ([15])

Graph I.4: **Sample characteristics and business model, 2009-2022**



(1) Note: distribution of balance sheet components for an unbalanced panel of 2160 banks. All measures are in percentage of total assets. Outliers are excluded from the plot.
Source

For this purpose, our econometric analysis is based on quantile regressions. ([16]) This estimation model is useful when there is substantial heterogeneity in the data, as the relationship between variables might change across different parts of the profitability distribution of the sample of banks. It has already been applied to analyses of bank profitability in order to take into account banks' heterogeneity. ([17]) In our case, quantile regressions are estimated using a Correlated Random Effects model (CRE) to account for unobserved heterogeneity for each unit in the sample (i.e., fixed effects). ([18])

Once we have estimated the relevant parameters, we build the distribution of a representative bank's profitability as a function of the determinants specified in the previous regressions by fitting the quantile distribution obtained from the quantile regression with a parametric distribution. Once this distribution is estimated, it is possible to see how the different shocks to selected determinants of profitability impact the profitability of this representative euro-area bank. In particular, the shocks to the profitability determinants can be chosen to represent specific micro and macroeconomic shocks. A detailed explanation of the methodology is provided in Box I.1.

The determinants of profitability in our model are based on three group of variables: i) monetary policy developments, which are taken into account by including the overnight 3-months index swap rate (OIS 3M) as a proxy for short term rates and the country-specific slope of the yield curve, calculated as the difference between the ten-year and the two-year yields on sovereign bonds. For Member States where this indicator is not available, the average euro-area value is used. ii) macroeconomic and financial developments are controlled for by using the general equity market riskiness (the EURVIX, which is a volatility index based on the EUROSTOXX equity index) ([19]) and, as a measure of the economic activity, the real GDP growth rate from AMECO; iii) to take into account banks' business models and the strength of their balance sheets when analysing bank profitability, we include different bank-specific explanatory variables, namely the Equity to Asset ratio, the Non-Performing Loans (NPL) ratio, the Loans to Asset ratio, the Deposit to Asset ratio, and the Non-Interest Income to Asset ratio. We also control for banks' sizes by including the log of total assets in the model.

([15]) Bonaccorsi di Patti E., Palazzo F., ibid.
([16]) Unlike OLS regressions, which focus on the estimation of a conditional mean, quantile regressions allow to analyse the relationship in different "parts" of the profit distribution, especially in the tails. Quantile regressions do not make assumptions about the distribution of errors and provide robust estimates across different parts of the distribution.
([17]) See for instance an analysis covering 109 SSM-supervised banks over the 2007-2016 period in Elekdag, S. et al., (2019), *Breaking the Bank? A Probabilistic Assessment of Euro Area Bank Profitability*, IMF WP/19/254.
([18]) Wooldridge J. M., (2019), Correlated random effects models with unbalanced panels, Journal of Econometrics, Vol. 211-1, p. 137-150.
([19]) These data are taken from Refinitiv.

Box I.1: **Modelling the conditional distribution**

This box details the methodology used to model the conditional distribution of the profitability of a representative bank. We first estimate the quantile distribution of banks' profitability by using panel data quantile regression. The resulting quantile distribution of banks' profitability is an estimate of the distribution of the profitability of a synthetic bank, which is representative of the banks in the sample. In other words, we estimate the quantile function ( ) of the profitability of a representative bank using as a proxy the results of the panel quantile regressions. More formally, we consider the following equation:

$$Y_{i,c,t}^{Q} = \alpha_i + \beta^{Q} X_{i,c,t-1} + \gamma^{Q} Z_{c,t} + \mu_i^{Q} + \epsilon_{i,c,t}^{Q}$$

where $Y_{i,c,t}$ represents different profitability measures used in the analysis for bank *i*, in country *c* and for year *t* at different quantiles Q, $X_{i,c,t-1}$ represents a set of bank-specific components lagged by one period (Equity to Asset ratio, Non-Performing Loans (NPL) ratio, Loans to Asset ratio, Deposit to Asset ratio, and Non-Interest Income to Asset ratio), $Z_{c,t}$ represents a set of country-specific explanatory variables that includes the overnight 3-months index swap, the slope of the term structure of sovereign yields, the Real GDP growth rate, and the EURVIX, a volatility index based on the EUROSTOXX index. μ_i are banks fixed effects. The quantile regressions are estimated by including the time averages of the covariates (Correlated Random Effects models, or CRE, in the spirit of Wooldridge, 2019) ([1]) to account for unobserved heterogeneity for each unit in the sample (fixed-effects). The regressions are estimated for quantiles Q that go from the 5th to 95th included.

Finally, we fit the quantile distribution with a parametric distribution to get a fully described distribution of a representative bank's profitability. ([2]) Practically, the distribution is fitted against the skewed t-distributions developed by Azzalini, A. and Capitanio, A. (2003) ([3]) which is chosen for its flexibility and its parsimony. Formally:

$$f(y;\rho,\sigma,\gamma,\upsilon) = \frac{2}{\sigma} t\left(\frac{y-\rho}{\sigma};\upsilon\right) T\left(\gamma\frac{y-\rho}{\sigma}\sqrt{\frac{\upsilon+1}{\upsilon+\left(\frac{y-\rho}{\sigma}\right)^2}};\upsilon+1\right)$$

where t(·) represents the probability density function (PDF) and T(·) the cumulative density function (CDF) of the Student's t distribution, and the parameters $\{\rho,\sigma,\gamma,\upsilon\}$ represent the location, the scale, the slant, and the degrees of freedom, respectively. As the skewness parameter γ and the degrees of freedom υ vary, this distribution can accommodate both skewness and heavy tails. The fit is obtained by choosing the four parameters which minimize the squared distance between the estimated quantile function and the quantile function of the skewed t-distribution to match the 5, 25, 75, and 95 percent quantiles. Finally, several shocks, described bellows, are applied. The resulting quantile distribution shows its potential impact on the profitability of the representative bank.

([1]) Wooldridge J. M., (2019), *Ibid*

([2]) The same methodology is used in Bellia, M. and Calès, L., Bank profitability and central bank digital currency - JRC Working Papers in Economics and Finance, 2023/6, European Commission, 2023, JRC133796; Elekdag, S., Malik, S., and Mitra, S. (2020). Breaking the bank? a probabilistic assessment of euro area bank profitability. Journal of Banking & Finance, 120:105949; Adrian, T., Boyarchenko, N., and Giannone, D. (2019). Vulnerable growth. American Economic Review, 109(4):1263–89.

([3]) Azzalini, A. and Capitanio, A. (2003). Distributions generated by perturbation of symmetry with emphasis on a multivariate skew t-distribution. Journal of the Royal Statistical Society: Series B (Statistical Methodology), 65(2): 367-389.

I.4. Results

I.4.1. Quantile regressions

We present our analysis on different measures of profitability, namely the Return on Assets (ROA), the Return on Equity (ROE), and a risk-adjusted measure, the Return on Risk-weighted Assets (RORWA). Results are similar and do not depend substantially on the measure chosen. Table I.1 shows the results for a subset of quantiles used in the analysis (from the 10th to the 90th). The coefficient of the short-term rate (OIS 3M) is positive and highly significant at all quantiles and monotonically increasing. This is also the

case for real GDP growth. This indicates that an increase in the short-term rate tends to increase bank profitability and that bank profitability increases with economic activity. The effect is larger for banks that are more profitable (in the higher quantiles). In the same vein, Deposits to Assets and Non-Interest Income to Assets display a positive coefficient, albeit not monotonically increasing across quantiles. The regression coefficient before the slope of the yield curve is positive and significant for quantiles higher than the 30th, monotonically increasing. The volatility of the stock markets (EURVIX) is negatively associated to banks' ROA and coefficients are highly significant across quantiles (excluding the tails), showing that profitability tends to decrease when the riskiness of the financial market increases. The same applies to the NPL ratio: an increase in the share of non-performing loans tends to reduce substantially the ROA.

Table I.1: **Quantile regressions - Return on Assets (ROA)**

ROA	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
OIS 3M	1.844***	3.487***	4.504***	4.636***	4.997***	5.164***	5.117***	6.036***	4.972***
	(0.574)	(0.664)	(0.436)	(0.592)	(0.477)	(0.510)	(0.664)	(0.871)	(1.286)
Slope	0.000	0.008	0.017*	0.020**	0.038**	0.035***	0.045***	0.073***	0.076***
	(0.012)	(0.009)	(0.010)	(0.010)	(0.015)	(0.013)	(0.010)	(0.017)	(0.022)
Size	3.795**	-0.068	-1.270	-2.338*	-4.697***	-5.215***	-4.867**	-2.079	-1.288
	(1.475)	(1.550)	(1.431)	(1.386)	(1.673)	(1.936)	(1.987)	(2.212)	(4.895)
Real GDP Growth	0.630***	0.820***	0.847***	0.872***	0.964***	1.090***	1.305***	1.569***	1.507***
	(0.083)	(0.087)	(0.078)	(0.073)	(0.079)	(0.094)	(0.107)	(0.144)	(0.235)
Eurvix (-1)	-0.075	-0.114***	-0.102***	-0.120***	-0.084*	-0.166***	-0.238***	-0.249***	-0.119
	(0.048)	(0.042)	(0.037)	(0.045)	(0.044)	(0.053)	(0.066)	(0.075)	(0.108)
Equity to Assets (-1)	0.153	0.283	0.286	0.303	0.464*	0.483*	0.556	0.768**	0.564
	(0.196)	(0.213)	(0.217)	(0.247)	(0.257)	(0.290)	(0.378)	(0.368)	(0.476)
NPL Ratio (-1)	-0.227***	-0.354***	-0.333***	-0.327***	-0.298*	-0.258**	-0.382**	-0.387**	-0.352***
	(0.072)	(0.078)	(0.079)	(0.123)	(0.158)	(0.119)	(0.166)	(0.186)	(0.114)
Loans to Assets (-1)	0.060	0.034	0.122***	0.138***	0.204***	0.261***	0.228***	0.195***	0.035
	(0.047)	(0.047)	(0.043)	(0.052)	(0.051)	(0.063)	(0.064)	(0.074)	(0.104)
Deposits to Assets (-1)	0.109**	0.120*	0.154***	0.137**	0.168***	0.135**	0.140	0.140	0.140
	(0.050)	(0.066)	(0.052)	(0.059)	(0.061)	(0.061)	(0.085)	(0.108)	(0.161)
Non Inter. Income to Assets (-1)	0.173	-0.079	1.219***	1.613	0.621*	1.240	1.395***	1.212*	1.699
	(0.362)	(0.524)	(0.214)	(1.785)	(0.319)	(0.771)	(0.267)	(0.698)	(1.186)
R2	0.030	0.171	0.230	0.249	0.250	0.253	0.252	0.243	0.222
Obs	15282								
FE	By Bank								

Standard errors in parentheses
** p<0.10 ** p<0.05 *** p<0.01*

Source: Orbis Bankfocus, own calculations

Similar results in terms of interpretation and significance are presented in Table I.2 for the Return on Equity (ROE). The coefficient of the slope of the yield curve is positive and significant from the 40th to the 80th quantiles. Non-interest income to assets appears to be a less powerful predictor for ROE with respect to the ROA estimation.

Table I.3 reports the results for the RORWA. We notice that the significance of the variables is similar to the one of the ROE and ROA, albeit the coefficients display less variability across quantiles. The short-term rate (OIS 3M), real GDP growth, and NPLs are still good predictors for the RORWA, as well as the slope of the yield curve.

In our analysis, the slope of the yield curve, which is a measure of banks' intermediation margin, seems to matter less than the level of the short-term rate for bank profitability. A similar study covering the 2007-2016 period found that neither higher short-term rates nor a steeper slope of the yield curve were conducive of higher bank profitability. The relatively muted impact of the slope of the yield curve for bank profitability could reflect the fact that higher long-term rates reduce the valuation of long-term securities thus negatively impact profitability. ([20]) Our different assessment of the impact of short-term

([20]) Elekdag, S. et al., ibid.

rates could relate to the different period we cover (2009-2022), as the large increase in banks' reserves from 2016 to 2022 should make bank profitability more sensitive to the level of the short-term rate.

Table I.2: **Quantile regressions - Return on Equity (ROE)**

ROE	**0.10**	**0.20**	**0.30**	**0.40**	**0.50**	**0.60**	**0.70**	**0.80**	**0.90**
OIS 3M	0.284***	0.336***	0.438***	0.580***	0.636***	0.682***	0.729***	0.754***	0.616***
	(0.063)	(0.067)	(0.068)	(0.064)	(0.062)	(0.072)	(0.082)	(0.084)	(0.118)
Slope	0.000	0.001	0.003	0.005***	0.007***	0.011***	0.012***	0.013***	0.007
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.004)
Size	0.408**	0.159	0.094	-0.054	-0.145	-0.160	0.087	0.282	0.341
	(0.169)	(0.205)	(0.147)	(0.167)	(0.180)	(0.200)	(0.259)	(0.292)	(0.387)
Real GDP Growth	0.082***	0.096***	0.097***	0.087***	0.098***	0.113***	0.145***	0.171***	0.157***
	(0.010)	(0.009)	(0.008)	(0.009)	(0.008)	(0.012)	(0.011)	(0.015)	(0.023)
Eurvix (-1)	-0.011*	-0.017***	-0.010**	-0.009*	-0.011*	-0.014**	-0.024***	-0.025***	-0.020
	(0.006)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.009)	(0.012)
Equity to Assets (-1)	-0.011	-0.082***	-0.128***	-0.182***	-0.224***	-0.227***	-0.259***	-0.278***	-0.293***
	(0.023)	(0.024)	(0.021)	(0.021)	(0.035)	(0.029)	(0.038)	(0.061)	(0.061)
NPL Ratio (-1)	-0.032***	-0.036***	-0.035***	-0.030**	-0.030*	-0.037*	-0.033	-0.048**	-0.035***
	(0.008)	(0.008)	(0.011)	(0.015)	(0.016)	(0.019)	(0.027)	(0.019)	(0.013)
Loans to Assets (-1)	0.007	0.006	0.015***	0.018***	0.026***	0.031***	0.027***	0.015	0.001
	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)	(0.007)	(0.011)	(0.013)
Deposits to Assets (-1)	0.014**	0.010	0.013*	0.018**	0.015**	0.015	0.020**	0.025*	-0.004
	(0.006)	(0.008)	(0.007)	(0.007)	(0.007)	(0.010)	(0.010)	(0.013)	(0.016)
Non Inter. Income to Assets (-1)	-0.022	0.002	0.118	0.095	0.061	0.092*	0.098	0.182	0.266***
	(0.042)	(0.034)	(0.168)	(0.212)	(0.091)	(0.048)	(0.092)	(0.178)	(0.053)
R2	0.006	0.090	0.155	0.174	0.185	0.186	0.182	0.178	0.164
Obs	15282								
FE	By Bank								

Standard errors in parentheses
** p<0.10 ** p<0.05 *** p<0.01*

Source: Orbis Bankfocus, own calculations

Table I.3: **Quantile regressions - Return on Risk-Weighted Assests (RoRWA)**

RoRWA	**0.10**	**0.20**	**0.30**	**0.40**	**0.50**	**0.60**	**0.70**	**0.80**	**0.90**
OIS 3M	0.107***	0.168***	0.197***	0.189***	0.192***	0.182***	0.185***	0.194***	0.174***
	(0.027)	(0.020)	(0.019)	(0.017)	(0.017)	(0.018)	(0.020)	(0.024)	(0.033)
Slope	0.000	0.000	0.001***	0.001***	0.001***	0.002***	0.002***	0.002***	0.003***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Size	0.035	0.061	0.086*	0.131***	0.129**	0.083	0.067	0.040	-0.152*
	(0.050)	(0.045)	(0.049)	(0.051)	(0.058)	(0.065)	(0.072)	(0.101)	(0.081)
Real GDP Growth	0.018***	0.022***	0.029***	0.033***	0.039***	0.042***	0.050***	0.057***	0.058***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.006)
Eurvix (-1)	-0.000	-0.000	-0.002*	-0.004**	-0.004**	-0.003*	-0.004**	-0.006**	-0.003
	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)
Equity to Assets (-1)	-0.001	-0.007	-0.007	-0.013	-0.016	-0.025**	-0.034***	-0.045***	-0.050***
	(0.005)	(0.005)	(0.007)	(0.009)	(0.010)	(0.010)	(0.009)	(0.016)	(0.011)
NPL Ratio (-1)	-0.007***	-0.009***	-0.010***	-0.013***	-0.012***	-0.015***	-0.017***	-0.018**	-0.021***
	(0.002)	(0.003)	(0.002)	(0.003)	(0.004)	(0.005)	(0.006)	(0.007)	(0.003)
Loans to Assets (-1)	0.001	0.000	0.000	-0.000	0.001	0.003	0.003	0.004	-0.002
	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Deposits to Assets (-1)	0.003*	0.004**	0.006***	0.008***	0.010***	0.011***	0.010***	0.011***	0.011***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)
Non Inter. Income to Assets (-1)	-0.005	0.002	-0.002	0.004	0.004	0.027**	0.024***	0.018	0.017
	(0.011)	(0.025)	(0.018)	(0.048)	(0.057)	(0.012)	(0.008)	(0.022)	(0.030)
R2	0.033	0.082	0.115	0.122	0.125	0.123	0.120	0.111	0.094
Obs	13746								
FE	By Bank								

Standard errors in parentheses
** p<0.10 ** p<0.05 *** p<0.01*

Source: Orbis Bankfocus, own calculations

I.4.2. Distribution fitting and shocks

We first estimate the average illustrative profitability distribution, which will be used as the baseline distribution for the purpose of understanding the impact of shocks on profitability. This profitability distribution is computed based on the variables included in the quantile regressions. In particular, the baseline is evaluated at sample means, where each explanatory variable takes the sample average over 2009-2022 as initial value. We use the quantiles estimation to calculate the values at different quantiles, and subsequently we fit a *t-skewed* distribution. The final parametric distribution can then be interpreted as the profitability distribution of a "representative bank" which has all characteristics set at the average in the sample. ([21])

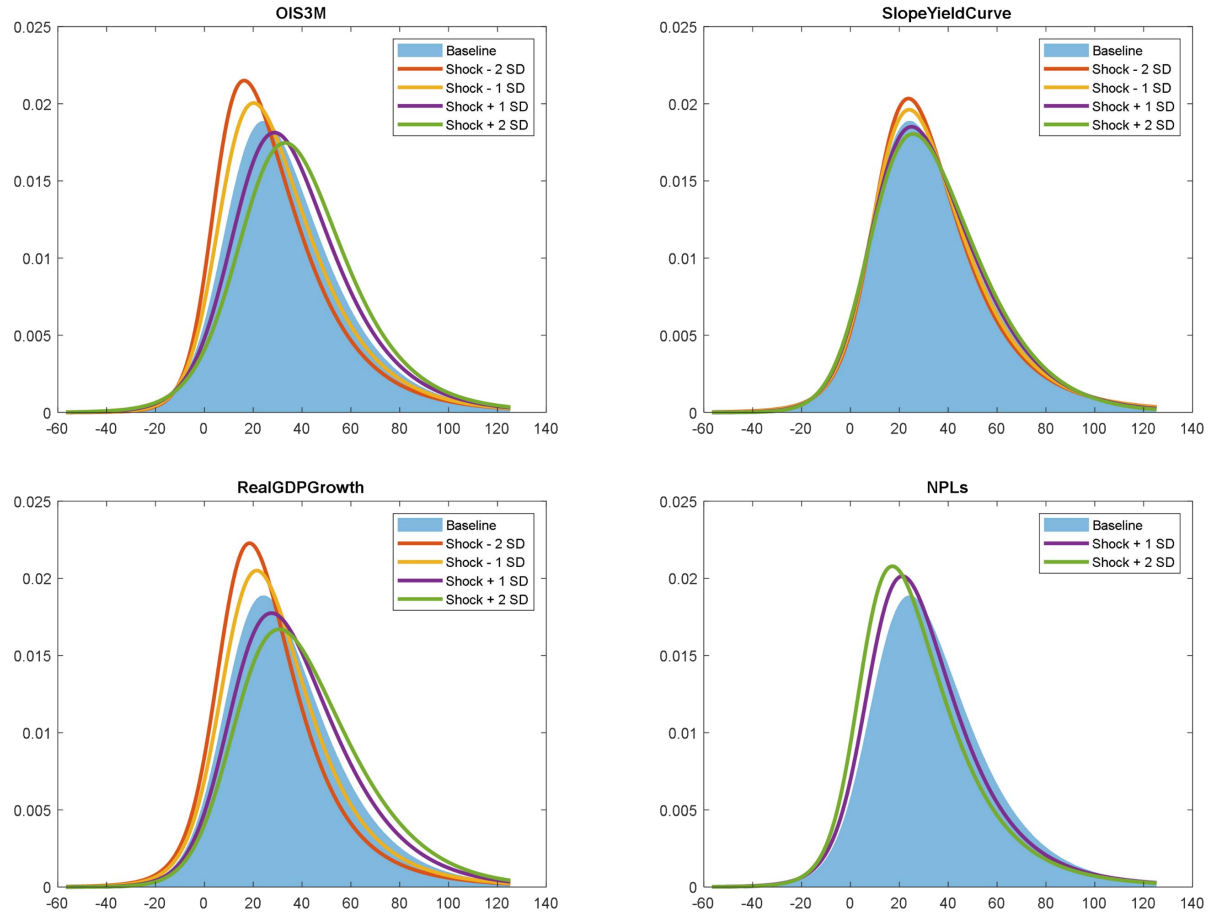
Once the baseline is set, one can apply shocks of different sizes to the selected relevant variables. As we are interested in the effect of potential macroeconomic shocks, we shock the OIS 3M, the slope of the domestic yield curve, real GDP Growth, and the NPL ratio. These four variables are representative of different exogenous shocks. In order to understand the functioning of the shock, Graph I.5 presents the impact of each shock separately on the profitability distribution. As said above, the shock on the OIS 3M is aimed at measuring the effect of monetary conditions on bank profitability. The slope of the yield curve, instead, could be related to changes in expectations about future interest rates and to unconventional monetary policy measures. A positive shock on these variables refers to an increase in interest rates (for the OIS 3M) or a steepening of yield curve. Both tend to lead to an increase in the profitability of the representative bank in our empirical estimation (in the quantile regressions), as the fitted distributions would be shifted to the right (or, conversely, to the left in case of a negative shocks). Similarly, a positive shock in terms of real GDP growth is clearly beneficial for bank profitability. On the contrary, a higher NPL ratio would reduce the overall profitability distribution of the representative bank. Given the current historical lower level of NPLs, we are only considering positive shocks to this variable (i.e. and increase of NPLs, and not a decrease of NPLs).

To show the order of magnitude of the impact on ROE, Graph I.5 plots the distribution under a shock in which each variable increases or decreases by one or two standard deviations. The standard deviation is calculated using our sample data and our time period. For example, the OIS 3M has an average value of -0.10%, with a standard deviation of 0.61. The different shocks would imply that the OIS 3M would stand at 0.51% (+ 1SD), 1.12% (+ 2SD), -0.71% (-1SD), or -1.32% (-2 SD). This calculation method applies the four different explanatory variables considered above, and illustrates how changes in these variables affect the profitability distribution. For the NPLs, as pointed out before, we are only considering an increase of the stock of non-performing exposures, given the statistics of our sample (average of 5.19% and SD of 8.06%). ([22])

([21]) i.e., all exogenous variables are set at their sample means.

([22]) According to Ari, Anil, Sophia Chen, and Lev Ratnovski. "The dynamics of non-performing loans during banking crises: A new database with post-COVID-19 implications." Journal of Banking & Finance 133 (2021): 106140 "In crises with high NPLs, the peak NPL ratio is 22 percent on average. In a few exceptional cases, the peak NPL ratios exceed 50 percent". Given the statistics of our sample, a 2 SD shock is about 16%, which added on top of the sample NPL ratio average yields 21.5%, a value close to the average peak reported from the authors.

Graph I.5: **Return on assets and estimated distributions**



(1) Estimated profitability distribution based on quantile regressions. ROA values are in basis points.
Source: *Orbis B*

There are several caveats that need to be considered before discussing the results. First, the results of the quantile regressions include three important crises (2009, 2011 and 2020). Second, the analysis should be considered as a static assessment of what might happen in case of a shock *ceteris paribus*. We are not considering the relation between changes in our explanatory variables, or potential reactions from banks or from Governments or other supervisors. The estimations are thus conditional on all the events and interventions that occurred from 2009 to 2022 and cannot be extended to forecast future profitability. Instead, they have to be taken as estimations of the profitability distribution conditional to several variables and conditional to historical economic conditions over the period. Furthermore, the model does not take into account possible lags in the crossed effects of the variables and their interaction, with the possible presence of multi-collinearity and omitted variables. This can imply, for instance, that the model cannot isolate the effects of higher interest rates or lower growth from that of higher NPLs on profitability, as those usually come later.

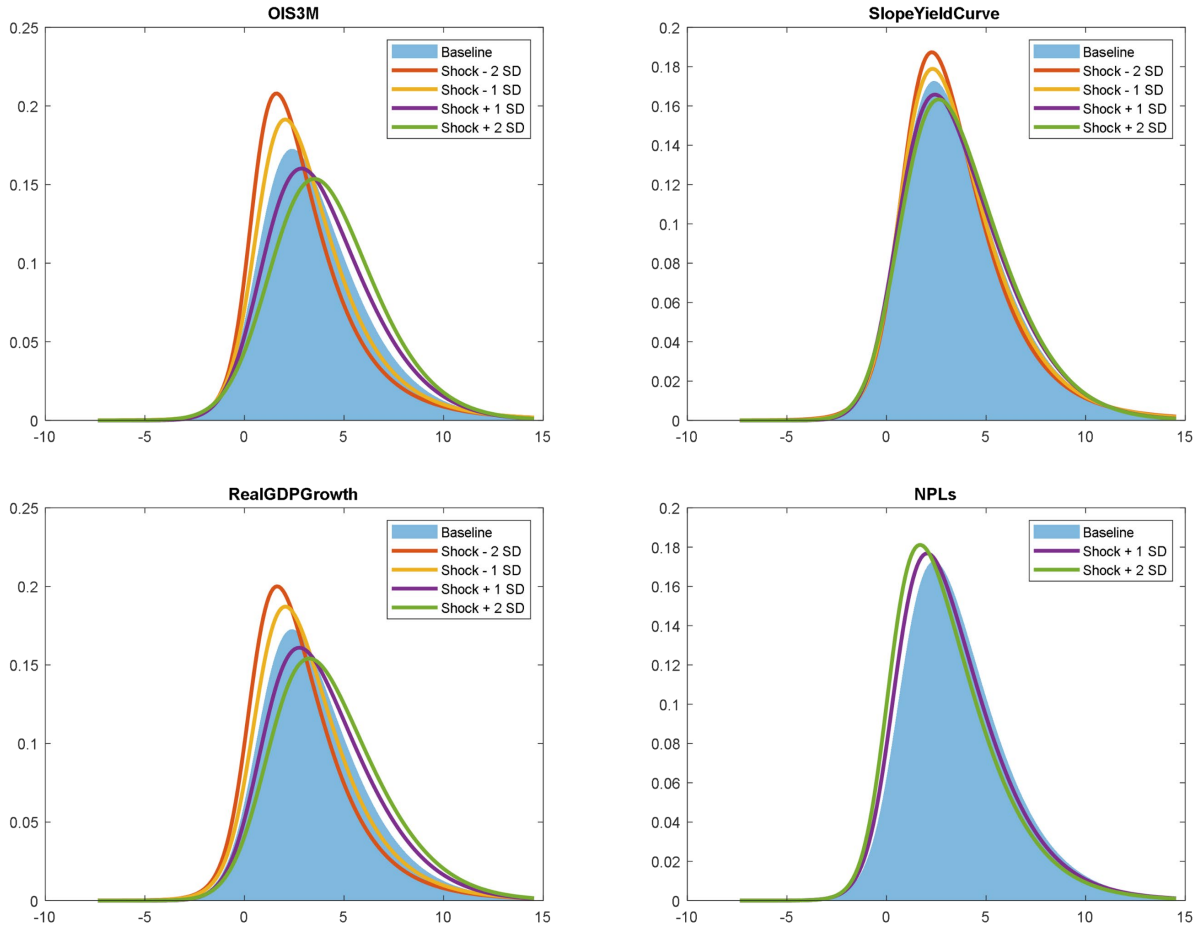
Table I.4 reports the average values of the profitability measures for the baseline (which are the averages of the fitted parametric distributions) and for the different shocks of ± 1 SD and ± 2 SD. The results show that the largest reduction in profitability is expected when there is a standalone strong contraction of economic activity. Changes in the slope of the yield curve have only a marginal effect on banks profitability. Instead, changes in the short-term interest rate (OIS 3M) and increases in the NPL ratio have a strong impact on bank profitability. Graph I.6 and I.7 depict graphically the resulting distributions for the ROA and the RORWA.

Table I.4: **Average profitability measures for the historical baseline and after shocks on selected variables**

	Baseline	-2 SD	-1 SD	+1SD	+2 SD
ROA	34.4				
OIS 3M		29.2	31.8	37.0	39.6
Slope		34.3	34.3	34.5	34.6
Real GDP Growth		27.9	31.1	37.7	41.0
NPL				31.6	28.8
ROE	3.6				
OIS 3M		3.0	3.3	3.9	4.2
Slope		3.5	3.5	3.6	3.7
Real GDP Growth		2.9	3.2	3.9	4.3
NPL				3.3	3.0
RORWA	1.2				
OIS 3M		1.0	1.1	1.3	1.5
Slope		1.2	1.2	1.2	1.3
Real GDP Growth		1.0	1.1	1.4	1.5
Deposits to Assets				1.2	1.1

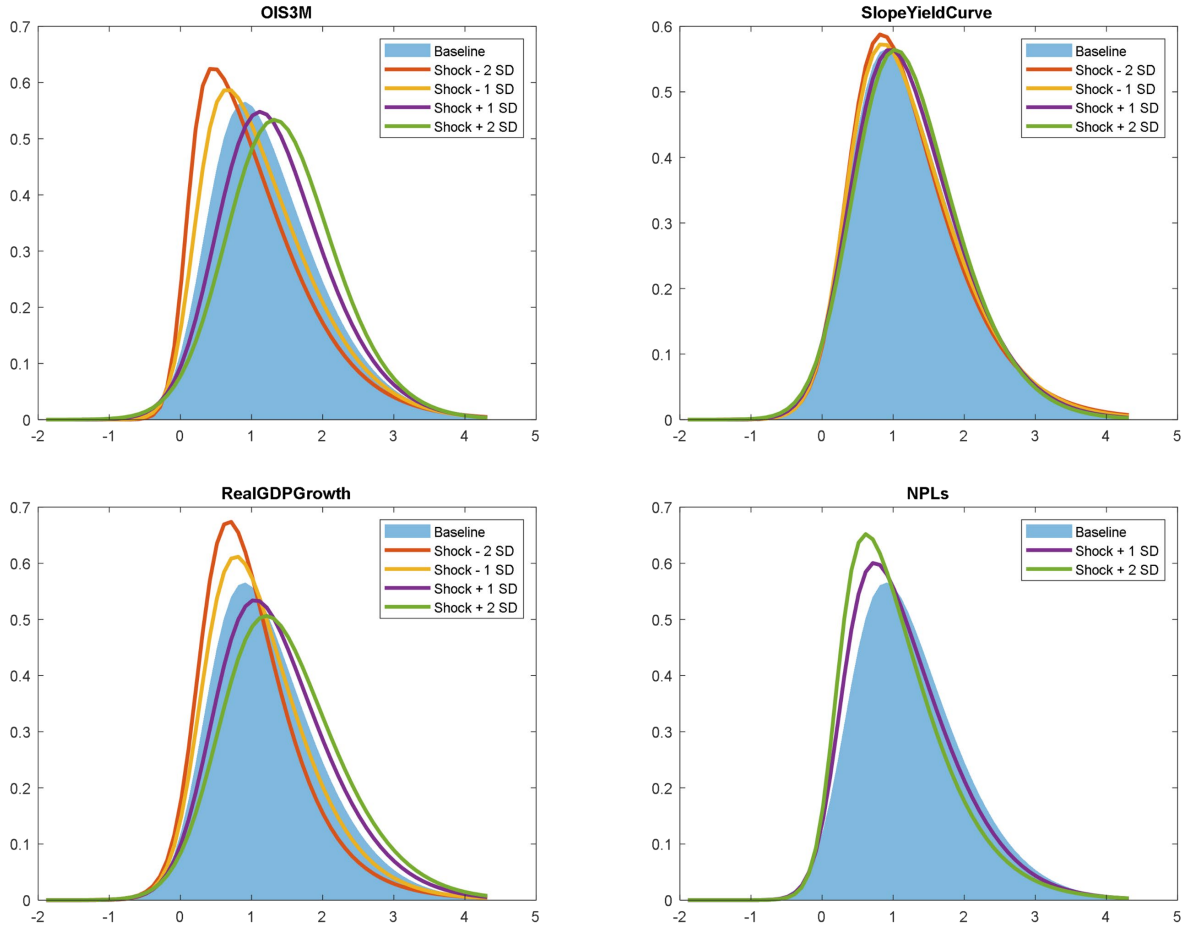
(1) ROA in bps; ROE in %
Source: Own calculations

Graph I.6: **Return on equity and estimated distributions**



Estimated profitability distribution based on quantile regressions. ROE values are in percentage. The baseline represents the profitability distribution estimated from historical data using quantile regressions.
Source: *Orbis Bankfoc*

Graph I.7: **Return on risk-weighted assets and estimated distributions**



(1) Estimated profitability distribution based on quantile regressions. RORWA values are in percentage. The baseline represents the profitability distribution estimated from historical data using quantile regressions.
Source: *Orbis Ba*

Table I.5: **Average profitability measures for the historical baseline and after combined shocks**

	Baseline	1 SD	2 SD
ROA	34.4		
Scenario 1		25.6	18.0
Scenario 2		31.0	27.6
ROE	3.6		
Scenario 1		2.7	1.8
Scenario 2		3.3	3.0
RORWA	1.2		
Scenario 1		0.9	0.7
Scenario 2		1.1	1.1

(1) ROA in bps; ROE and RoRWA in %. The baseline represents the profitability distribution estimated from historical data using quantile regressions.
Source: Own calculations

Once the impact of shocks to separate variables are understood, it is useful to build two alternative scenarios where all variables are simultaneously affected by coherent shocks. In particular, we selected two set of shocks, with the following characteristics:

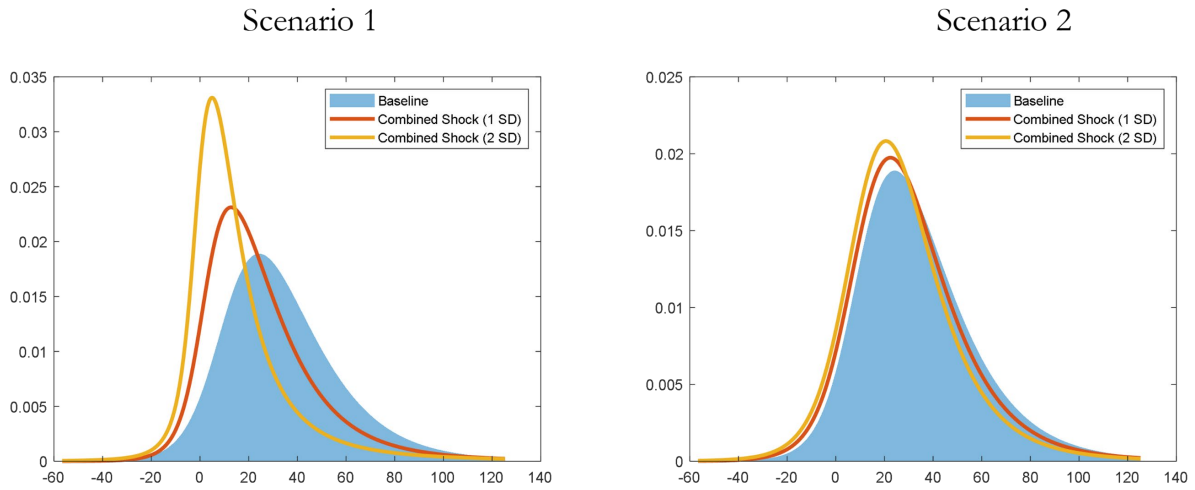
Scenario 1 (a classical demand driven recession): OIS 3M decreases, slope decreases (flattening of the yield curve), negative shock to GDP Growth, increase of NPLs.

Scenario 2 (a supply driven slump): OIS 3M increases, the slope increases (steepening of the yield curve), negative shock to GDP Growth, increase of NPLs.

Scenario 1 can be seen as a worst-case scenario, where all variables are shocked in a way that reduces profitability. In Scenario 2, interest rates are increased (due for example to an increase in inflation) with a negative shock to economic growth and an increase of NPLs. In both cases, we consider shocks in which each variable is increased (or decreased) by one or two SD. The results are presented in Table I.5 for the averages of the representative distributions and

graphically on Graph I.8 for the ROA. We anchor our discussion on the results of the ROA, since they are very similar to the results related to the ROE, and RORWA. Scenario 1 is the most severe. It implies a relative reduction of profits of around 25% (47%) when considering a 1 SD (2 SD) negative shock for the explanatory variables considered. The average value of the representative distribution moves from 34.3 bps to 18.1 in the 2 SD scenario. Graphically, the distribution is more skewed to the left, with more probability on the negative part of the distribution. The comparison between Scenario 1 and Scenario 2 shows that the favourable interest rate environment (at least from a bank perspective, with a positive rate shock and a steeper yield curve) is able to at least partially offset the impact of the negative shock on economic activity and preserve the actual profitability.

Graph I.8: **Combined scenario for the ROA**



(1) Note: Estimated profitability distribution after applying combined shocks. ROA values are in basis points. The baseline represents the profitability distribution estimated from historical data using quantile regressions.

Source: Own calculations

Finally, in order to have shocks that are internally coherent, we use the Commission forecasts data for 2024 for GDP and the underlying technical assumptions for interest rates, and a scenario that mimics the historical conditions in the aftermath of the GFC as of end 2009. The input data, as well as the results of our model, are reported in Table I.6. As we can see from the input data presented in the top block of the table, the current economic environment is completely different with respect to the historical averages, in particular for interest rates. Indeed, over the last three years the OIS has risen substantially (from a negative value to 2.3% in 2022), as well as GDP growth. Banks' profitability has increased accordingly. ROA and ROE have almost doubled between 2019 and 2022.

Table I.6: **Estimated profitability in different macroeconomic conditions**

Input data	Year 2019	Year 2020	Year 2021	Year 2022	GFC (2009)	EC forecasts and assumptions (2024)
OIS 3M	-0.4	-0.47	-0.5	2.3	0.4	3.6
Slope	0.28	0.31	0.78	0.6	1.9	-0.9
Real GDP Growth	1.6	-4.67	5.6	3.3	-4.5	1.3
ROA	33.5	25.3	45.3	52.1	26.6	48.4
ROE	3.3	2.6	4.9	5.8	2.8	5.4
RORWA	1.3	1	1.4	1.7	1.0	1.9

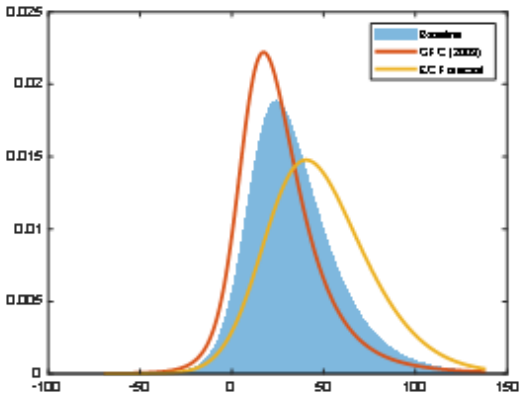
(1) The first three columns represent the averages for 2019 (pre-COVID), 2021 and 2022 for our sample. We compare these past macroeconomic conditions to the expected economic conditions as in our Commission 2023 Summer Interim Forecast for the year 2024. ROA in bps; ROE and RoRWA in %. In the GFC scenario, we assume a +2SD increase in NPLs.
Source: European Commission 2023 Summer Interim Forecast, Ameco, Refinitiv, own calculations

When comparing different scenarios, our model allows us to understand the factors that can explain the recovery of bank profitability from its GFC level to its 2022 level for instance. Bank profitability in 2009 was roughly half the 2022 level. The main determinants of this difference are the low short-term interest rate, the negative GDP growth, and the level of NPLs in 2009 compared to 2022. The slope of the yield

curve, despite being at its highest level, only marginally counterbalanced these factors. The results for 2020, when the COVID pandemic led to a severe economic downturn, also show how negative GDP growth is associated to weaker bank profitability.

The model can also be used to roughly assess how bank profitability could evolve in a more favourable scenario as the one emerging from the Commission Summer 2023 interim macroeconomic forecasts. Under this scenario and underlying assumptions, the results show that profitability, as an average of the profitability distribution, would be expected to be slightly lower in 2024 than in 2022 but larger than the historical fitted baseline estimation. The baseline has shorter tails ([23]) and is more concentrated around the average value (see Graph I.9). The average ROA under the expected conditions for 2024 from the Commission 2023 summer interim forecast scenario would stand at 48.3 bps, with respect to 34.3 bps for the historical baseline distribution, and 52.1 bps under the economic conditions of 2022 in our sample (see the comparison in Table I.6). The underlying reason is that the inverted slope of the yield curve and the lower economic growth have a large negative impact on a part of the banks on the left tail of the distribution. Notably, despite a projected lower economic growth and an inverted yield curve, high short-term interest rates appear to at least partially counterbalance the effects of the economic slowdown and the peculiar term structure of interest rates.

Graph I.9: **Return on assets - GFC and EC Forecast scenarios**



(1) Estimated profitability distribution after a shock comparable to the 2009 GFC and using EC forecast data for he 2024. ROA values are in basis points. The baseline represents the profitability distribution estimated from historical data using quantile regressions.
Source: Own calculations

The above results should however be interpreted with caution since there are several important caveats and model limitations, as already indicated. First of all, the estimated quantile regressions are based on a sample period that span at least three financial crises, with subsequent extraordinary measures in terms of liquidity provision and low (negative) interest rates. In addition, state aids and banks' recapitalizations with public money could have altered substantially the average bank profitability, especially in the aftermath of the 2009 GFC. Given that we are only including banks that have not failed, there might also be a survivorship bias in our data sample. Further, the analysis is a static assessment based on econometric estimations, without any causal interpretation. Finally, we are not considering any reaction from the banks, which might change their business model or adapt in different ways to the new environment.

I.5. Conclusion

Banks play a pivotal role in the transmission of monetary policy, and their profitability is of substantial significance in this context, influencing monetary policy transmission. Profitability allows banks to absorb potential losses and build capital buffers, effectively mitigating shocks to the broader economic landscape, but it may also be used to pay out dividends, buy back shares, or to increase banks resilience. However, higher profits could also reflect excessive risk-taking, posing issues for the stability of the banking system.

The global surge in interest rates has had divergent impacts on banks, contingent upon their unique business models and regulatory contexts. This chapter summarises historical trends in euro area bank profitability and delves into their principal determinants. To achieve this, we estimate a set of quantile regressions on a large dataset of individual European banks. This allows us to gauge how shifts in the

([23]) The measure of how tails are heavy or not is called kurtosis. Tail heaviness or lightness suggests whether the data distribution is flatter or less flat. Heavier tails suggest the presence of large outliers, while short tails usually imply less outliers.

drivers of bank profitability, triggered by various shocks, alter the distribution of profitability. Specifically, our analysis shows how bank profitability is affected by economic downturns and changes in the interest rate environment.

With important caveats, our findings suggest that the most substantial reduction in profitability occurs during a pronounced economic contraction accompanied by a low interest rate environment. Scenario analyses demonstrate that a favourable interest rate environment, characterised by a positive short-term interest rate, can partially offset the impact of a slowdown of the economy and help maintain profitability. Furthermore, a shock comparable to the 2009 GFC would reduce substantially (by one half) the profitability of the representative bank. ([24]) Instead, by using Commission forecasts data for 2024, our model suggests that all measures of profitability would be slightly lower with respect to the profits reported for 2022. High interest rates appear to at least partially counterbalance a slower projected economic growth.

([24]) Even if this is modelled using a large, unbalanced panel of EA banks, it does not prevent that a significant number of banks might have negative profitability measures. In fact, in the fitted distribution the probability of having a negative ROA is about 5%, and almost double to 9% when considering a GFC scenario.