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2023 macroprudential stress test of the euro area banking system

Bank resilience in a changing environment: challenges and opportunities

No 347

Contents

Abstract

This paper presents the updated macroprudential stress test for the euro area banking system, comprising around 100 of the largest euro area credit institutions across 19 countries. The approach involves modelling banks' reactions to changing economic conditions. It also examines the effects of adverse scenarios as defined for the European Banking Authority's 2023 stress test on economies and the financial system as a whole by acknowledging a broad set of interactions and interdependencies between banks, other market participants and the real economy. Our results highlight the resilience of the euro area banking system and the important role banks' adjustments play in the propagation of shocks to the financial sector and real economy.

JEL codes: C30, C53, C54, E52

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1 Non-technical summary

The 2023 macroprudential stress test provides additional insights into the resilience of the European banking sector relative to the latest EU-wide stress tests conducted by the European Central Bank (ECB)/European banking supervision and coordinated by the European Banking Authority (EBA).[1] The macroprudential stress test complements the microprudential exercise by (i) including the endogenous reaction of banks to the macroeconomic scenarios (which resemble those used in the EBA stress test), (ii) considering relevant amplification mechanisms between bank solvency and funding costs, and (iii) considering the feedback between the banking sector and the real economy. In line with the latest EBA stress test, it also incorporates the effects stemming from the phasing-out of non-conventional monetary policy. Compared with the microprudential exercise, the results are characterised by significant deleveraging, driven by an increase in credit risk, as well as a substantial shift in the liability structure and a rise in the cost of funding.

The assessment builds on a macro-micro model that includes individual euro area economies and significant banks (Budnik et al., 2023) and the two scenarios from the 2023 EU-wide stress-testing exercise. The model tracks the evolution of all euro area economies and that of 98 significant banks covering more than 80% of the euro area banking sector. The modelling of banks' behaviour relies on empirical relationships that represent banks' reactions in terms of lending volumes, pricing, liability structure and profit distribution.[2] The baseline scenario envisions an economic recovery, while the adverse one a protracted recession, exacerbated by an aggravation of geopolitical tensions leading to stagflation and rising interest rates. Recent macroeconomic developments proved to be more or less in line with the baseline scenario. It is important to note that the results reflect banks' balance sheets as of the end of 2022.

A key finding of the exercise is that the euro area banking sector remains resilient under the adverse scenario, with banks' deleveraging and de-risking partially offsetting heightened credit risk and reduced net interest income (NII). The system-level Common Equity Tier 1 (CET1) ratio is unchanged throughout the baseline scenario. However, the system-level CET1 ratio falls under the adverse scenario by approximately 2.5 percentage points by the end of 2025. The reduction of loans and the shift towards sovereign sector exposures lead to a reduction in risk weights and to a partial counterbalancing of losses related to credit risk.

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1 In the rest of this document, we refer to the EU-wide stress tests conducted by the ECB/European banking supervision and coordinated by the EBA as "EBA stress test" or "EU-wide stress-testing exercise".

2 Dividend payouts were updated to reflect the regulatory and fiscal landscape as of the end of 2022. While this comprises the phasing-out of the pandemic-related ban on dividend distributions, the national legislative initiatives on bank profit taxes introduced in 2023 are not included. As detailed in Budnik et al. (2023; Section 2.1.2), a management buffer level is estimated for each bank, and the dividend payout is determined based on the realised excess capital. This strategy allows us to approximate banks' decision-making processes regarding dividend distributions, taking into account the gradual relaxation of dividend restrictions that were put in place during the pandemic.

2 Introduction

The 2023 macroprudential stress test assesses how adjustments to banks' balance sheets in response to shocks feed back into the real economy. The exercise is based on the information collected during the latest EBA stress test in 2023 but departs from it by relaxing some of its key assumptions. The macroprudential stress test drops the static balance sheet assumption and allows banks to react to the changing macroeconomic environment and to adjust their assets and liabilities and their profit distribution policies. The model also allows for the curing and writing-off of non-performing loans (NPLs). Furthermore, the simulations account for the phasing-out of non-conventional monetary policy.

The exercise employs a large-scale model of individual banks and countries and applies the revised Banking Euro Area Stress Test (BEAST) framework. The BEAST model (Budnik et al., 2023) is a large-scale model of individual euro area banks and economies that captures bank adjustments and macro-financial amplification mechanisms. Having pioneered the examination of the dynamic relationship between the banking sector and economies through a microsimulation approach, the model has undergone significant expansion since 2018 (Budnik et al., 2019) to include an extensive representation of various prudential and regulatory policies. Since the previous macroprudential stress test, the model has been updated along several dimensions: the macro-block was updated, credit dynamics better reflect potential exogeneous supply shocks, and funding costs and structure better account for more recent evidence on the pass-through of monetary policy shocks (Section 4).

The assessment of bank resilience is based on the two scenarios employed in the 2023 EU-wide stress-testing exercise. The baseline scenario is based on the December 2022 broad macroeconomic projections, which envision an economic recovery. The adverse scenario is designed to reflect the main financial stability risks identified by the General Board of the European Systemic Risk Board (ESRB), namely a period of prolonged subdued economic growth coupled with high inflation, with the latter being partly driven by rising energy prices, potentially resulting in rising insolvencies among non-financial corporations (NFCs) and households.[3] Additionally, potentially increased geopolitical tensions and a depressed economic growth outlook lead to significant asset price corrections, following a broad-based tightening of financial conditions (Section 3).

The stress test results show that the euro area banking sector remains resilient under the adverse scenario. The depletion of the system-level CET1 ratio amounts to around 2.5 percentage points at the end of 2025 under the adverse scenario. At the end of the projection horizon, the weighted-average system-level CET1 ratio remains almost unchanged under the baseline scenario and drops to 13% under the adverse scenario. The impact of the stress test reveals significant variability across banks, reflecting their diverse business models and heterogeneous

[3] See ESRB (2023).

geographical and sectoral exposures. All banks retain sufficient capital under the baseline scenario to cover their capital requirements. Under the adverse scenario, banks accounting for 27.6% of banking sector risk-weighted assets (RWAs) breach the combined buffer requirement. The number of banks breaching the maximum distributable amount (MDA) triggers in 2025 is 12, and only four of them, accounting for 5.1% of banking system Risk Weighted Assets (RWA), experience a sufficiently large capital depletion that pushes them below the minimum capital requirement. Compared with the microprudential exercise, the number of banks breaching the MDA trigger is significantly lower as banks adjust their lending behaviour in view of the economic downturn.

Under the adverse scenario, the key drivers of depletion include heightened credit risk, represented by an uptick in impairments, and a surge in funding costs. The non-performing loans (NPL) ratio for non-financial private sector loans increases from 2.4% in 2022 to 6.2% by 2025 under the adverse scenario. The rise in credit losses from additional provisioning needs signals increased financial stress within the non-financial private sector, reflecting the economic challenges simulated under the adverse scenario. Furthermore, average funding costs rise by approximately 150 basis points as reference rates increase and banks rely on more costly sources of funding.

These negative dynamics are partially offset by banks' reactions to navigate the economic downturn. The macroprudential stress test captures how banks' strategic adjustments to their balance sheets under stress feed back into the real economy. This approach allows for a more comprehensive understanding of the banking sector's resilience. Particularly under the adverse scenario, the growth of credit to the non-financial private sector decreases markedly, underscoring how banks' mitigating strategies, such as reducing exposure to riskier assets and curtailing lending, play a pivotal role in navigating economic downturns.

By deleveraging and de-risking, banks reinforce their own solvency positions but negatively affect economic growth. Under the adverse scenario, the reduction of loans (Chart 9) and the reshuffle of exposures toward the sovereign sector (Chart 11) lead to a reduction in risk weights, partially offsetting losses related to credit risk. This behaviour on the one hand safeguards banks' solvency but on the other negatively contributes to economic growth and exacerbates the sovereign-bank nexus. Furthermore, under the adverse scenario, bank profitability faces significant headwinds, turning negative on aggregate. Euro area banks remain slightly profitable in 2023, primarily driven by higher net interest income (NII) resulting from a continued widening of margins. However, by 2024 and 2025, the rise in banks' funding costs and the deceleration of the economy begin to pose headwinds to profitability.

This paper is structured as follows. The next section summarises our modelling approach. Section 3 briefly presents the baseline and adverse scenarios that are taken from the latest EBA stress test. Section 4 describes the main developments of the model since the last macroprudential stress test report. Section 5 illustrates the main stress test results. Section 6 elaborates on selected aspects of the scenarios from a macroprudential perspective.

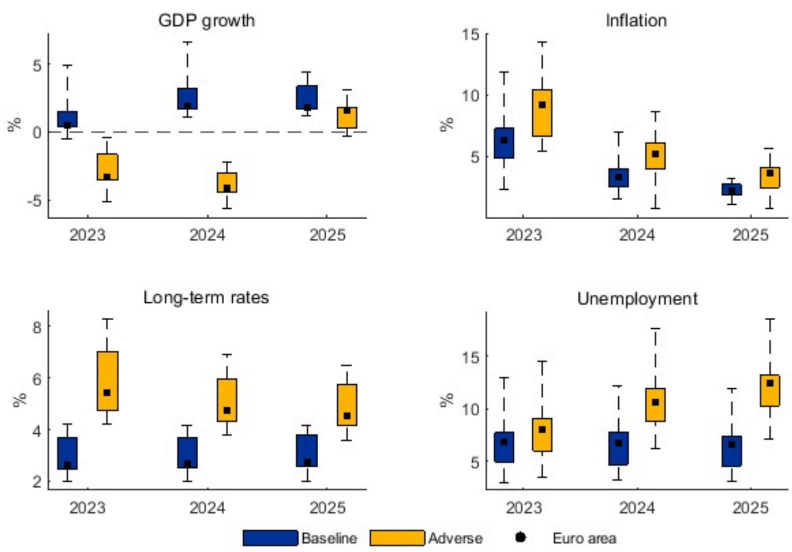
3 Macroeconomic scenarios[4]

As in the EBA stress test, the baseline scenario[5] assumes a marked slowdown in economic activity followed by a rebound in 2024 and 2025 (Chart 1). The energy crisis that unfolded in 2022, the decline in global economic activity, tightened financial conditions and high inflation rates place a drag on euro area economic growth due to increased production costs and receding real incomes in 2023. Over the following two years a stabilised energy market, the resolution of supply bottlenecks and increased foreign demand result in a rebound in real GDP growth to 1.9% and 1.8% in 2024 and 2025, respectively. Inflation rates remain elevated, and both short-term and long-term interest rates increase. Rising market expectations derived from futures rates imply a notable increase in average short-term market rates, with the one-year euro swap rate rising to 3.7% in 2023 and subsequently falling to 3.2% in 2025. In contrast to the upward-sloping yield curve in 2022, the baseline scenario assumes a partially inverted yield curve for each year of the scenario, consistent with a long-run anchoring of expected inflation (Chart 2).

Chart 1

Main macroeconomic developments for the baseline and adverse euro area scenarios

(percentages, projected)



Source: ESRB (2023).
Notes: Distribution of macroeconomic variables under the baseline and adverse annual scenarios across euro area countries. Whiskers denote the minimum and maximum across euro area countries. Black dots denote euro area averages.

4 The baseline macro-financial scenario is based on December 2022 projections from the EU national central banks, and the adverse macro-financial scenario was designed by the ESRB's Task Force on Stress Testing in close collaboration with the ECB. The scenario was approved by the ESRB's General Board and sent to the EBA on 23 January 2023. More detailed descriptions of the scenarios for the 2023 exercise can be found on the EBA's and ESRB's websites.

5 Eurosystem staff macroeconomic projections for the euro area, December 2022.

The adverse scenario[6] instead reflects an intensification of supply constraints, leading to a stronger recession and more intense inflationary pressure. Aggravated geopolitical tensions under the adverse scenario further disrupt global supply chains, triggering rising commodity prices and adverse trade shocks. Compared with the baseline scenario, real GDP growth further deteriorates in 2024, with a rebound only in 2025. Thus, unlike the baseline scenario, the adverse scenario initially features a further increase in inflation rates compared with the starting point. High inflation expectations lead to much tighter financing conditions. Relative to the baseline scenario, market interest rates under the adverse scenario show an even steeper increase relative to 2022 (Chart 2). Euro swap rates increase by around 150-180 basis points across maturities relative to the baseline scenario. The yield curve is partially inverted under the adverse scenario as well, indicating that even though inflation rises sharply in 2023 and remains high over the course of the scenario, inflation expectations are still anchored in the long run.

Overall, the baseline scenario does not seem to be systematically more optimistic or pessimistic relative to available realised data and current macroeconomic projections. Compared with the realised values for 2023 and the updated ECB forecasts, euro area inflation under the baseline scenario is about 1 percentage point higher than realised inflation in 2023, and persistently higher than current projections.[7] Real GDP growth for the euro area, on the other hand, is close to realised values in 2023, but the baseline scenario for the following two years is more optimistic than current projections. Long-term rates under the baseline increase less than realised ones, and current projections see them about 0.6 percentage points higher, while unemployment rates are slightly above realised and currently projected values.

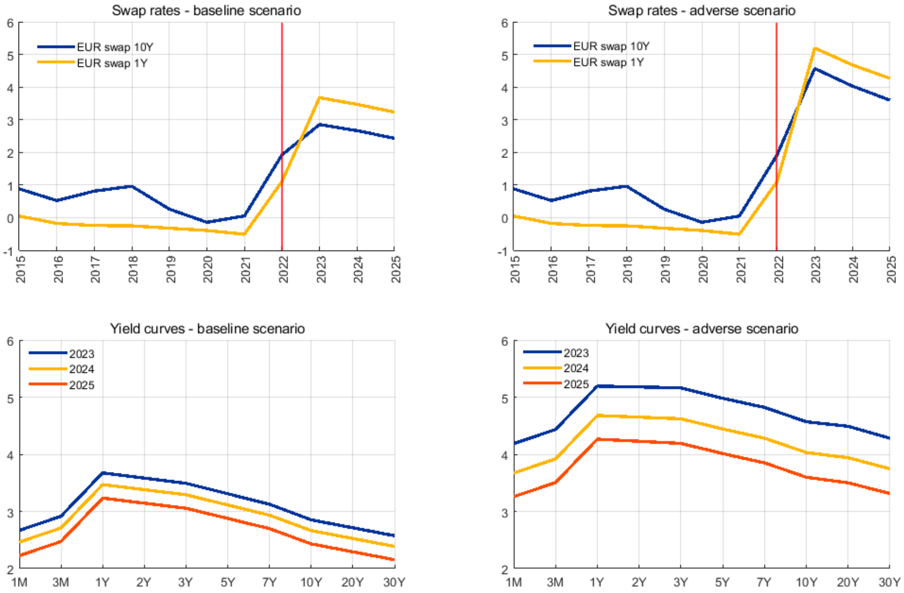
6 See ESRB (2023).

7 Eurosystem staff macroeconomic projections for the euro area, December 2023.

Chart 2

EUR swap rates and yield curves under the baseline and adverse scenarios

(percentages)



Source: ESRB (2023).
Notes: Development of swap rates and yield curves in the baseline and adverse annual scenarios. Upper panels: time series for EUR swap rates at different maturities, with the start of the scenario period marked by the vertical line. Lower panels: term structures (with maturity tenors on the x-axis) in each year of the baseline and adverse scenarios.

4 Methodological developments in macroprudential stress test modelling

The macroprudential stress-testing exercise employs the BEAST model, a large-scale model linking the macroeconomy and the banking system. The model features a macroeconomic block comprising the 19 euro area economies and captures dynamic interdependencies of aggregate real and financial variables as well as cross-country spillovers via trade linkages (Budnik et al., 2023). The model includes a banking block with a detailed and granular representation of 98 significant banks, their individual balance sheets and profit and loss accounts.

4.1 Updates to the model since the 2021 macroprudential stress test

Enhancements were required to better capture the shifts in the economic landscape and the interaction between macro-financial variables and bank behaviour that occurred since the pandemic. In the macroeconomic block, improvements were made to enhance the model's estimation when incorporating extreme shocks and allowing for changes in shock volatility. These changes ensure the model's robustness and accuracy in capturing the complexities of the economic environment, especially in the face of unforeseen and severe disruptions. For the banking block, key adjustments focused on modelling credit dynamics and the pass-through of monetary policy to rates and volumes for both assets and liabilities. These adjustments aim to refine the model's representation of how monetary policy affects credit dynamics and influences the overall resilience of banks. Improving the understanding of these interactions is essential for a more accurate depiction of the banking sector's response to changes in the economic environment and policy measures.

The new macroeconomic block features a more flexible specification of the error structure that allows for heavy tails and a strengthened identification strategy. Specifically, the error term is assumed to follow a Student-t distribution. This assumption makes the model's estimation more robust when extreme observations such as those related to the coronavirus (COVID-19) pandemic or the great financial crisis are included.[8] The error terms during these periods clearly deviate from the typical normality assumption (Chart 3)[9], and not taking this fact into account would severely affect parameter estimates and the resulting model dynamics. Under the new specification, estimated parameters and the distribution of errors proved to be stable over the sample period. This development improves the model's forecasting performance over one estimated only on the pre-pandemic

8 See Chan (2020), Hartwig (2022), and Bobeica and Hartwig (2023).

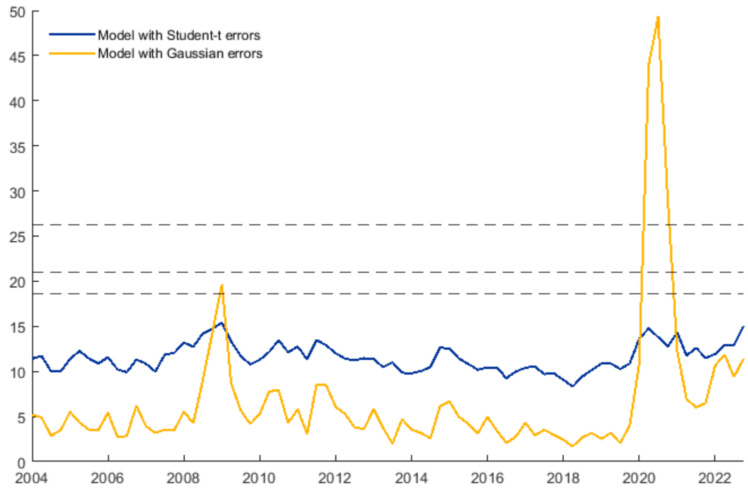
9 The chart shows the Mahalanobis distance of the model errors from zero, which intuitively measures by how many standard deviations an observation differs from the mean, extended to multiple dimensions.

sample, with the latter featuring root mean squared forecast errors about twice as large.

The revised macro-block now produces results consistent with the changes in monetary policy stance observed over the last year. When analysing the effects of monetary policy shocks in a macroeconomic environment characterised by an abrupt surge in inflation and the consequent change in financing conditions, the previous identification strategy did not generate coherent dynamic reactions to the drastic changes in the monetary policy shocks. Strengthening the restrictions on the interest rate policy coefficients in the structural form of the model implies that the effects of such shocks are now in line with the consensus view in the literature.[10]

Chart 3

Test for normality of vector autoregression estimation error terms



Source: Authors' calculations.
Notes: Period-by-period posterior medians of the Mahalanobis distance of vector autoregression (VAR) residuals, averaged across countries. This distance measure is a generalisation of the concept of how many standard deviations an observation is away from its mean to multi-dimensional observations. The solid blue line depicts the model with heavy tails. The solid yellow line shows the same statistic for the model without heavy tails. The dashed black lines depict the 10% (lowest), 5% (middle) and 1% (highest) critical values from a chi-squared distribution with 12 degrees of freedom.

The equations governing banks' behaviour in the banking block were recalibrated in the context of a high inflation environment. Previously, loan demand equations (broken down by sector) were estimated over a period characterised by low and stable inflation, spanning data from the fourth quarter of 2007 to the fourth quarter of 2020. Projecting values based on the previously estimated equation coefficients in the current high inflation regime would result in sustained and prolonged credit growth, significantly exceeding macroeconomic projections and observed values for the initial quarters of 2023. To address this issue, inflation (as a control variable) was interacted with a dummy variable for the periods after the first quarter of 2022[11] to better incorporate the impact of recent macroeconomic developments. Additionally, the house price index was introduced as an explanatory variable for household loan demand, allowing for a more

[10] See Arias, Caldara, and Rubio-Ramírez (2019).

[11] This dummy variable has a value of 1 from the first quarter of 2022 onwards, and 0 otherwise. It is also set to 1 during the forecasting period.

comprehensive understanding of the relationship between housing market dynamics and mortgage loan demand. This refined specification yields projections which align themselves closely with the actual development of credit growth, as evidenced by observed values for the first and second quarters of 2023. These adjustments enhance the model's capacity to accurately capture and predict credit dynamics within the current economic landscape.

The lending rate equations were substantially updated to reflect a more realistic pass-through of changes in short-term rates. The swift increase in short-term interest rates since the start of the monetary policy tightening cycle and the slow adjustment of rates on overnight deposits imply that banks' average funding costs are lower than the short-term interest rate. In the previous version of the model, banks were assumed to fully pass on the implied decline in the difference between their average funding costs and the short-term market rate to lending rates, not fully taking advantage of the market conditions.[12] To address this issue, the average funding costs in the lending rate equation were floored by the short-term market rate, ensuring that only positive funding cost shocks are passed through to asset rates. This adjustment raises lending rates by 1 to 2 percentage points and brings the model's output in line with observed market dynamics, especially since the start of interest rate increases by the ECB.

The equations modelling sight and term deposit rates were revised to allow for an effective transmission of changes in monetary policy. Previously, the pass-through of short-term rates was interacted with a non-linear function to reflect the limited possibility of banks to lower deposit rates below the zero lower bound.[13] This specification implied that recent short-term interest rate increases would not be passed through and deposit rates would remain close to zero indefinitely. In line with recent findings (see Altavilla et al., 2022), the interaction term in the empirical specification was dropped and a direct link between changes in short-term interest rates and changes in sight deposit rates was introduced. For rates on term deposits, changes in the short-term interest rate are now assumed to be fully passed through within one year instead of two years, more in line with the speed of adjustment observed in the past year.

The assumption of dynamic homogeneity in banks' liability structure was also relaxed in the latest model specification. In the model specification used in 2021, the growth of sight deposits would rapidly converge to nominal GDP growth. As a result, with elevated inflation as assumed under both scenarios, the model would have projected sight deposits to grow at a higher rate than term deposits. This projection contradicts the fact that sight deposits decrease as households and corporates substitute them for term deposits or other higher-yielding assets (as discussed in Drechsler et al., 2017). Therefore, deposit supply equations were re-estimated without the dynamic homogeneity constraint on sight deposit growth. The projections resulting from this updated specification accurately capture the shift from

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12 See Budnik et al. (2023), page 33, equations 55 and 175.

13 See Budnik et al. (2023), page 61, equation 174, and page 183 for a more detailed explanation of the non-linear specification. See also Demiralp et al. (2019).

sight to term deposits observed since the beginning of the current monetary tightening cycle.

5 Main findings on banking system resilience

Under the baseline scenario, the CET1 ratio of the banking system slightly declines by 42 basis points. At the end of 2022, the average CET1 ratio[14] of euro area banks stood slightly above 15%, decreasing by almost half a percentage point by the end of the three-year period. This subtle downward trend is primarily attributed to credit losses and operational expenses, which are partially offset by the positive contribution of NII and net fee and commission income (NFCI). The evolution of banking system assets, as indicated by changes in RWAs, exerts a marginal impact on this trajectory (Section 6.2).

Under the adverse scenario, the average CET1 ratio experiences a substantial decline, dropping by more than 2 percentage points. The decline in the banking system's solvency is primarily driven by the reduction in positive contributions from NII, although rising interest rates benefit income from floating rate loans. Operating expenses remain quite stable across scenarios.[15] The unfavourable CET1 trend is further accentuated by a substantial increase in credit risk, making these factors the primary contributors to the downturn in the system's solvency.

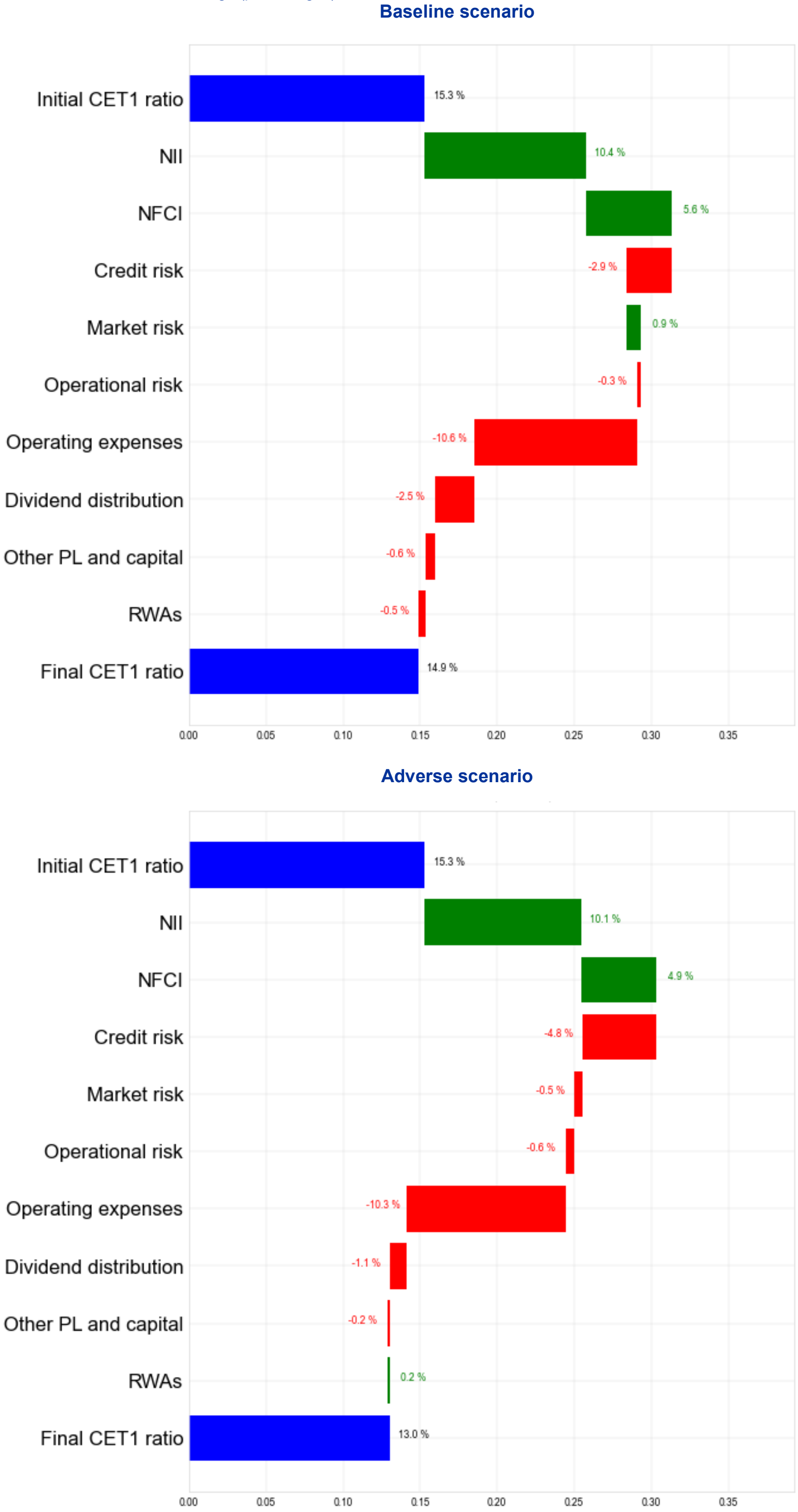
[14] We weight each bank capital ratio by its RWAs.

[15] Operating expenses include administrative expenses and depreciation. They are modelled with an autoregressive AR(1) model controlling for lagged values of total assets, nominal GDP, the share of total operating expense over total assets and the fixed effect by bank (see Budnik et al., 2023, Section D.5).

Chart 4

Euro area banking system solvency under the baseline and adverse scenarios

Contribution to CET1 ratio change (percentages)



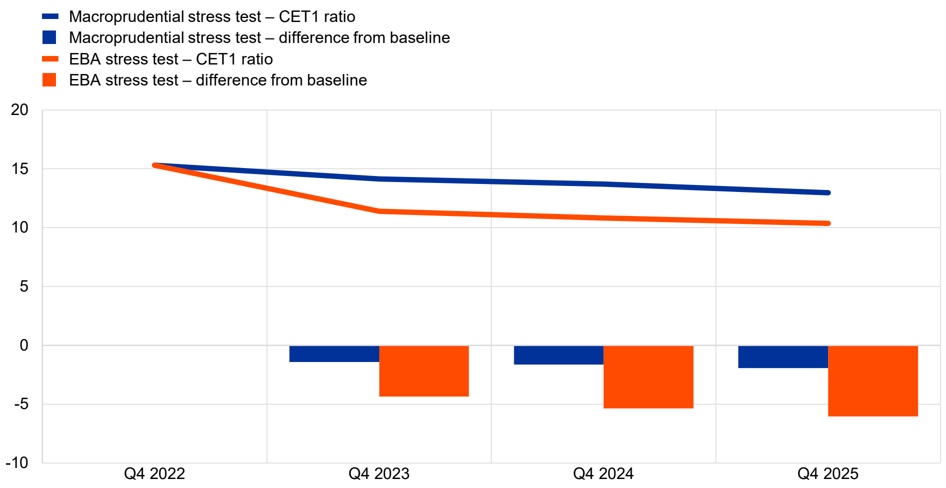
Notes: Average CET1 ratio change from the fourth quarter of 2023 to the fourth quarter of 2025, weighted by total RWAs of each bank. All components explaining the change in the ratio are based on initial RWAs, except for the impact related to "RWAs", which accounts for the change caused by the denominator.

Compared with the EBA exercise, the macroprudential stress test results under the adverse scenario show a milder depletion of the CET1 ratio due to bank deleveraging and de-risking, which more than compensate for the increase in funding costs (Chart 5a). The key differences compared with the 2023 EBA stress test relate to the reaction of banks to macroeconomic developments, leading to deleveraging and de-risking (Section 6.1) and to the relaxation of methodological constraints assumed in the microprudential exercise (Section 6.2). Banks' de-risking and deleveraging behaviour lowers RWAs. The decrease in (profitable) assets also diminishes NII. Under the adverse scenario, the macroprudential stress test results exhibit stickier funding costs, resulting in more favourable NII and therefore better capital positions than the EBA results.

Chart 5a

Comparison of EBA stress test results and dynamic balance sheet effects under the adverse scenario

(y-axis: percentages of RWAs)



Notes: Lines represent average CET1 ratios under the adverse scenario from the fourth quarter of 2022 to the fourth quarter of 2025, weighted by the total risk exposure amount of each bank. Bars represent the difference from the average CET1 ratio under the baseline scenario.

Under the adverse scenario, banks accounting for 27.6% of RWAs breach the combined buffer requirement. All banks retain sufficient capital under the baseline scenario to cover their capital requirements. Under the adverse scenario, 12 banks breach the MDA trigger in 2025 and only four of them (accounting for 5.1% of banking system RWAs) have a capital depletion sufficient to push them below minimum capital requirements (Chart 5, panel a). For comparison, in the 2021 macroprudential stress test (Budnik et al., 2021), 24 banks breached their MDA threshold under the adverse scenario.

The variability of bank-level results in terms of CET1 ratios increases under the adverse scenario. Interquartile ranges under the baseline and adverse scenarios stand at 3.2 and 4.3 percentage points, respectively. The increase in variability can be attributed to the non-linearities in the macroprudential stress test model, which become more relevant under the adverse scenario. The scenarios affect banks differently based on their business model (Chart 5, panel b).

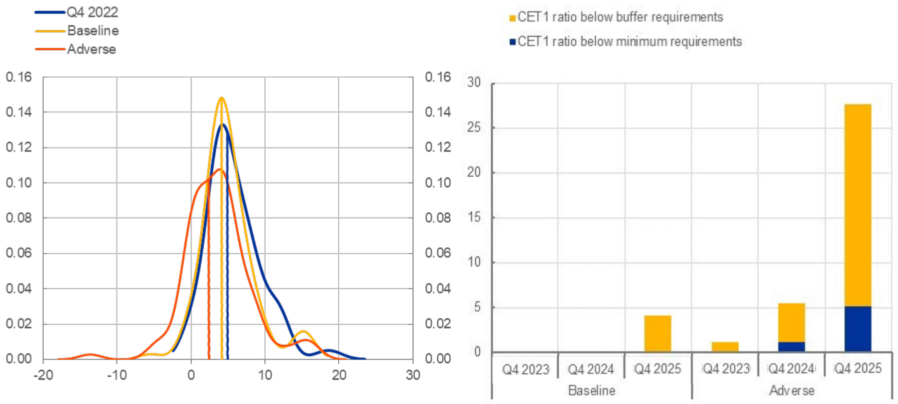
Chart 5

Resilience of the banking sector. CET1 shortfall/surplus distribution in 2025 (left-hand panel) and the share of banks below regulatory thresholds (right-hand panel)

(x-axis: CET1 capital shortfall/surplus in percentage points (left-hand panel); y-axis: percentages of RWA (right-hand panel))

a) Distribution of CET1shortfall/surplus (end-2025)

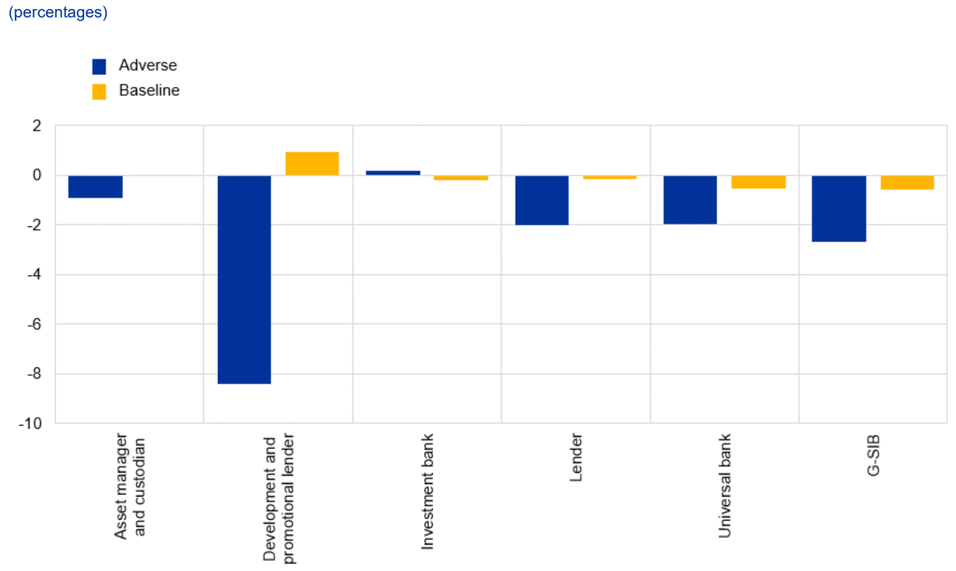
b) Share of banks below regulatory thresholds



Notes: Transitional CET1 ratios. Kernel density functions with bandwidth equal to 1.5 percentage points. Vertical dashed lines represent weighted means (left-hand panel). CET1 buffer requirements are defined as the sum of Pillar 1, Pillar 2 minimum requirements and combined buffer requirements. CET1 minimum requirements are defined as the sum of Pillar 1 and Pillar 2 minimum requirements (right-hand panel).

Chart 6

CET1 depletion by bank business model



Notes: CET1 depletion calculated as the difference between risk-weighted values of CET1 capital at starting point (fourth quarter of 2022) and end of period (fourth quarter of 2025). Depicted are business model averages weighted by total risk exposure amount. The "lender" category includes small market, consumer credit, retail, corporate and diversified lenders.

Under the baseline scenario, a large share of banks experience a decrease in profits from the high level reached in 2022, remaining well in positive territory. The (weighted) average trailing return on equity (ROE) is positive in the initial year of the scenario, mainly on account of the further rate hikes until September and the relatively low contribution of provisions. In the subsequent two years there is a noticeable deceleration. Despite this slowdown, the cross-sectional distribution of banks' returns consistently remains above the zero line, indicating that, on average, banks maintain positive profitability. However, there is a considerable dispersion across banks, reflecting varying levels of performance within the sector.

Under the adverse scenario, bank profitability faces significant headwinds and turns negative on aggregate. Euro area banks remain slightly profitable in 2023, primarily supported by higher NII resulting from a continued widening of margins. However, by 2024 and 2025, the rise in banks' funding costs and the deceleration of the economy begin to pose headwinds to profitability. The profitability of global systemically important banks (G-SIBs) is more resilient than that of smaller banks, as the former can rely on a more diversified funding structure and cheaper funding costs.

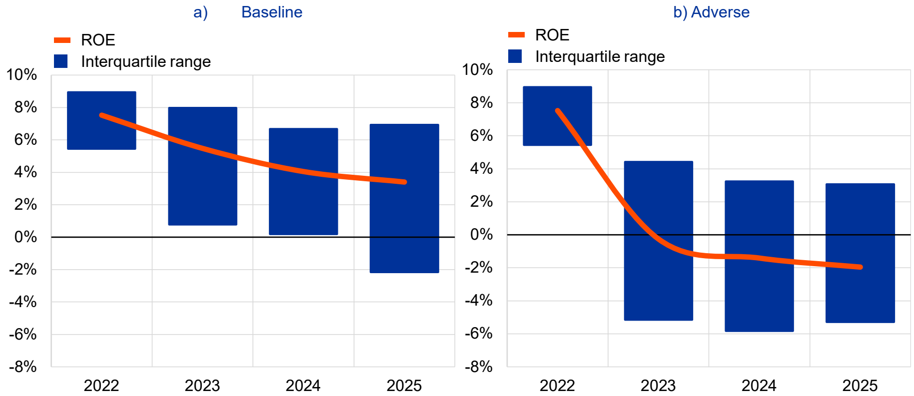
Under the adverse scenario, credit provision weakens as macroeconomic developments affect credit demand and supply. Once we depart from the static balance sheet assumptions, the average change in credit volumes over the three years attributable to macroeconomic developments is around 3 percentage points.

Limited breaches of regulatory requirements contain the space for negative feedback loops. Feedback loops assume that banks breaching regulatory requirements restructure their balance sheet and shed assets, which generates negative effects on credit volumes, interest rates and thereby macroeconomic developments. Given the resilience of the banking system with only a relatively small number of banks not being able to meet solvency and liquidity requirements, negative feedback loops remain limited.

Chart 7

Evolution and distribution of ROE under the baseline and adverse scenarios

(percentages))

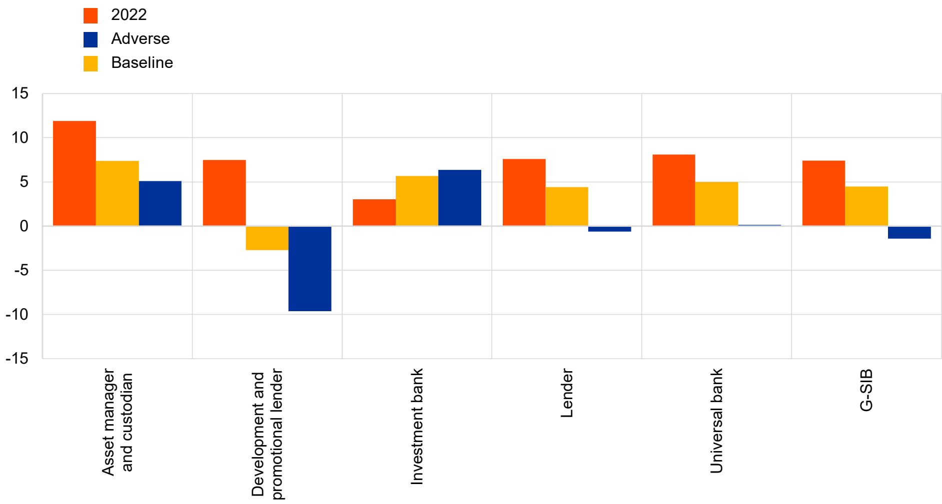


Notes: Weighted average of ROE. The sample includes EU banks participating in the 2023 EBA stress test.

Chart 8

Average ROE under the baseline and adverse scenarios by business model

(percentages)



Notes: 2023-25 average ROE weighted by total assets by bank business model under the baseline and adverse scenarios. 2022 refers to the mean value of ROE weighted by total assets at the end of the year. The "lender" category includes small market, consumer credit, retail, corporate and diversified lenders.

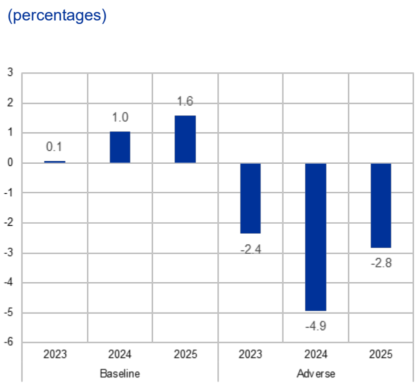
6 Discussion of selected results

Credit and market risk are the main drivers of banks' capital depletion in the 2023 EBA stress test, followed by administrative expenses. The macroprudential stress test model maintains the same granular approach of the EBA stress test but models the behavioural reactions of banks in a consistent and economically sound manner, thereby departing from the ad hoc methodological prescriptions of the microprudential exercise. We will illustrate in more detail those risk areas where results from the macroprudential stress test differ most from the EBA approach, which is bound by static balance sheet and other methodological assumptions (e.g. banks' pass-through of policy rates to deposit and lending rates).

6.1 Bank lending

Credit growth for the non-financial private sector is positive under the baseline scenario but turns negative under the adverse scenario. The initial low credit growth under the baseline scenario is attributable to a weakening of loan demand due to the economic slowdown and the rise in inflation and associated increase in interest rates (Chart 9). The adverse scenario instead features negative real GDP growth in 2023 and 2024, which translates into lower loan growth over the entire projection period. The forecast average annualised credit growth rate for the non-financial private sector is 0.9% under the baseline scenario and -3.4% under the adverse scenario.[16]

Chart 9
Credit growth for the non-financial private sector



Note: Bars show the evolution of loan growth in the euro area non-financial private sector.

Banks with higher capitalisation and profitability show stronger lending capacity. Credit growth for the non-financial private sector tends to be higher for

[16] The forecast average annualised growth rate for total assets is -2.5% under the baseline scenario and -5.4% under the adverse scenario. Total assets decrease by more than credit essentially due to the repayment of TLTRO III, which is mainly financed by a decrease in banks' deposits at the central bank.

banks with a higher CET1 ratio and a higher return on assets (ROA) (Chart 10, panel a and b). This relationship underscores the importance of robust capital positions and profitability in fostering lending to the real economy under both scenarios. Looking at the trend lines, there is a parallel shift from the baseline to the adverse scenario. Importantly, we do not observe a steeper slope under the adverse scenario. If there was such a pattern, it would imply that less capitalised banks and those with a lower ROA would react more strongly to adverse developments, potentially suggesting non-linear credit supply shocks. Although our model considers the possibility of such behaviour, the resilient capital and profitability positions of banks mute this effect under the adverse scenario.

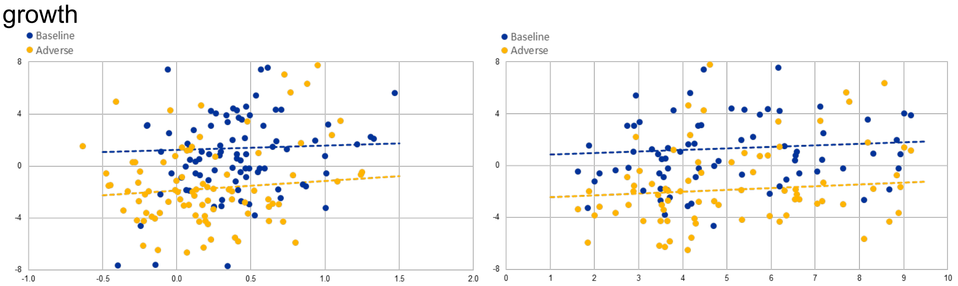
Chart 10

Lending evolution across banks versus initial capitalisation and profitability

(percentages)

Profitability and loan growth growth

b) Initial CET1 ratio and loan



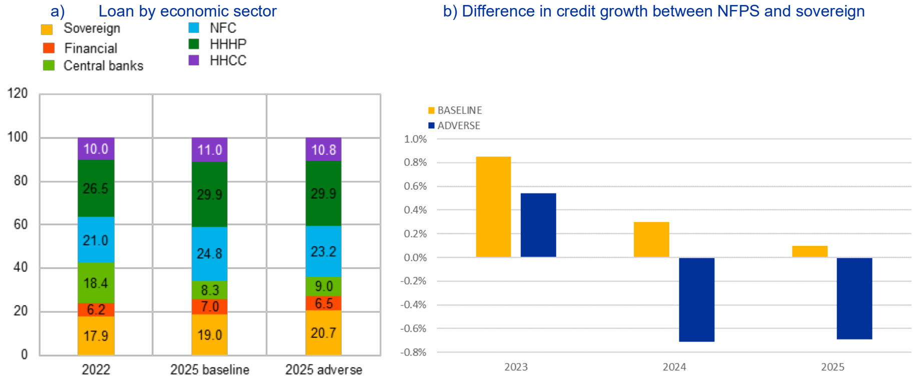
Notes: The left-hand panel shows the relationship between average bank profitability, represented by ROA (x-axis), and annualised loan growth to the euro area non-financial private sector over the three-year horizon (y-axis). The right-hand panel shows the relationship between the initial CET1 ratio in 2022 (x-axis) and annualised loan growth to the euro area non-financial private sector over the three-year horizon (y-axis). Trend lines are weighted by loan volumes. The trend lines indicate that a bank with a 1 percentage point higher CET1 ratio in 2022 has, on average, 0.12 percentage point higher loan growth under the baseline scenario and 0.14 percentage point higher loan growth under the adverse scenario. Moreover, a bank with a 1 percentage point higher ROA shows, on average, 0.33 percentage point higher loan growth under the baseline scenario and 0.74 percentage point higher loan growth under the adverse scenario.

Under the adverse scenario, banks increase their lending exposure to the sovereign sector relative to the non-financial private sector. Even though, under both scenarios, credit growth for the non-financial private sector is higher than for the sovereign sector in the first year of the projection, in 2024 and 2025 this gap narrows under the baseline scenario and turns negative under the adverse scenario (Chart 11). Therefore, under the adverse scenario, banks shift from non-financial private sector credit towards sovereign lending, decreasing their lending exposure to the non-financial private sector compared with the baseline scenario (to 19% and 20.7%, respectively).

Chart 11

Decomposition of loans in the banking book (panel a) and credit growth of the non-financial private sector compared with credit growth of the sovereign sector (panel b)

(percentages)



Notes: The left-hand panel shows the shares of the main loan segments for the starting point and the decomposition in 2025 for the adverse and baseline scenarios in percentage points. The right-hand panel shows the difference between the credit growth of the non-financial private sector (NFPS) and the credit growth of the sovereign sector for each year and each scenario.

Under the adverse scenario, deleveraging and de-risking significantly reduce banks' RWAs. In the EBA stress test, these potential bank reactions are excluded due to the static balance sheet assumption. As a result, under the adverse scenario, the contribution of the change in RWAs to average CET1 depletion is slightly positive (Chart 4), while in the EBA stress test it is more than 1 percentage point. In terms of credit risk losses, the impact of deleveraging and de-risking is limited given that both factors are relevant only for performing loans. In other words, the bulk of credit risk losses stem from non-performing borrowers, whereas deleveraging and de-risking effects arise from less lending to (risky) performing borrowers.

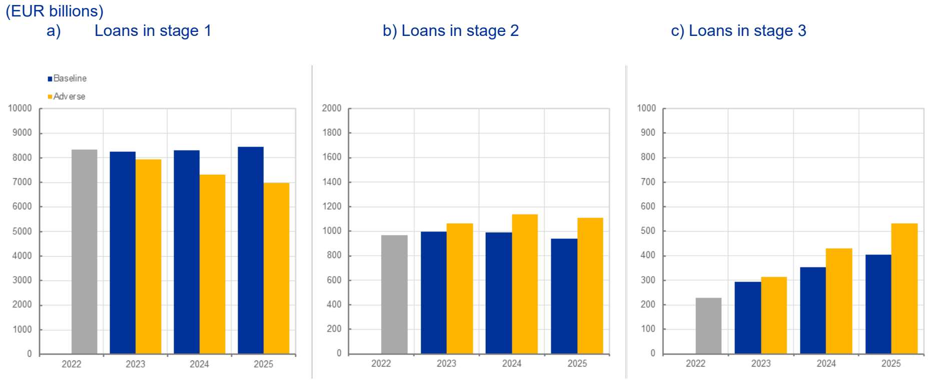
6.2 Asset quality and credit losses

The riskiness of the non-financial private sector loan portfolio deteriorates significantly under the adverse scenario and to a lesser extent under the baseline scenario. Under both scenarios, the volume of NPLs increases. At the end of the projection horizon, NPLs increase by 75% under the baseline scenario, while they more than double under the adverse scenario (Chart 12). Loan growth under the baseline scenario leads to an increase in Stage 1 loans. Under the adverse scenario, deleveraging and the transition of performing loans to Stage 2 and Stage 3 decrease the total amount of loans in Stage 1.

Chart 11

Evolution of loan portfolios to the non-financial private sector by stage

(EUR billions)



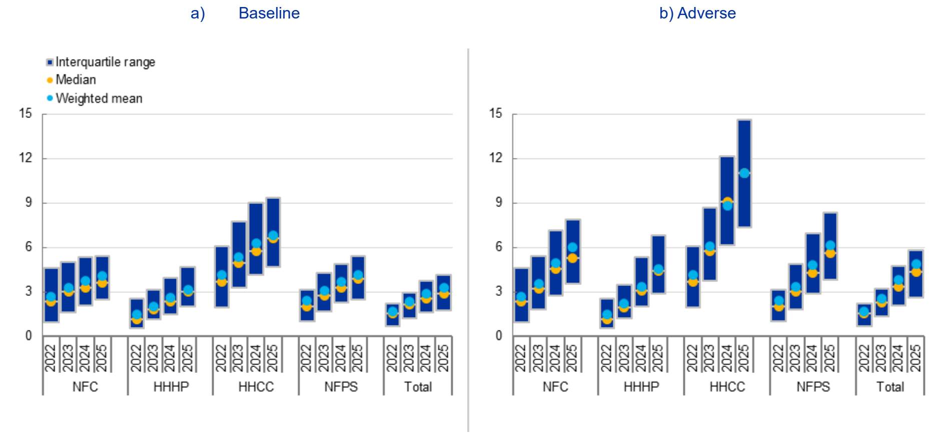
Notes: The panel a shows the amount of Stage 1 loans to the non-financial private sector. The middle panel (panel b) shows the amount of Stage 2 loans to the non-financial private sector. The panel c shows the amount of NPLs to the non-financial private sector.

Unfavourable economic conditions under the adverse scenario lead to a substantial increase in the share of non-financial private sector non-performing assets. Under the adverse scenario, the NPL ratio for non-financial private sector loans rises from 2.4% in 2022 to 6.2% in 2025. Under the baseline scenario, the NPL ratio increases to 4.1% in 2025. The rise in the NPL ratio is highest for consumer loans, which are usually considered riskier. Heterogeneity across banks is greater under the adverse scenario, when credit risk is exacerbated and increases over the projection horizon. The interquartile range for the non-financial private sector NPL ratio widens from 2.2 percentage points in 2022 to 4.6 percentage points in 2025 (Chart 13).

Chart 12

NPL ratio under the baseline and adverse scenarios

(percentages)



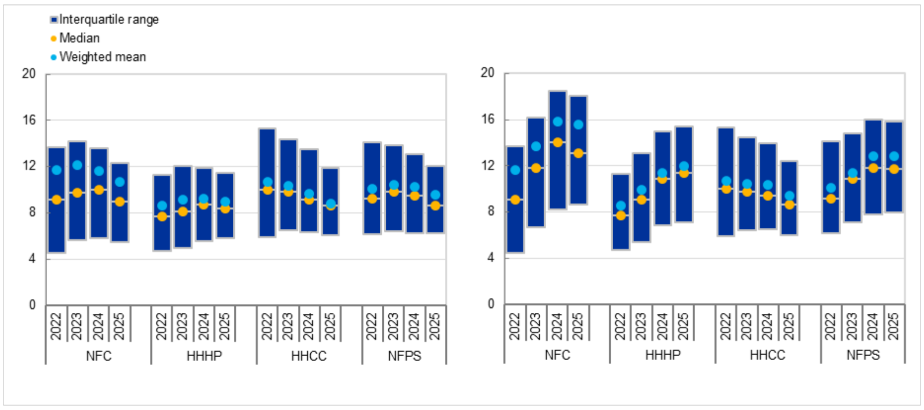
Notes: NPL ratios for exposures to the euro area non-financial private sector. Panel a shows the NPL ratio under the baseline scenario. Panel b shows the NPL ratio under the adverse scenario.

The share of Stage 2 assets exposed to the non-financial private sector remains broadly stable under the baseline scenario but increases under the adverse scenario. The euro area Stage 2 ratio for banks' exposures to the non-financial private sector remains stable at around 10% under the baseline scenario (Chart 14). Under the adverse scenario, it increases slightly to almost 13%. The overall development masks heterogeneity at the sector and bank level. While the Stage 2 ratio for NFC and household mortgage loans remains stable under the baseline scenario and increases under the adverse scenario, the Stage 2 ratio for household consumer loans decrease in both cases. This is mainly due to the higher transition rates from Stage 2 to Stage 3, which results in household credit for consumption purposes becoming NPLs more quickly.

Chart 13
Development of share of Stage 2 assets

(percentages)

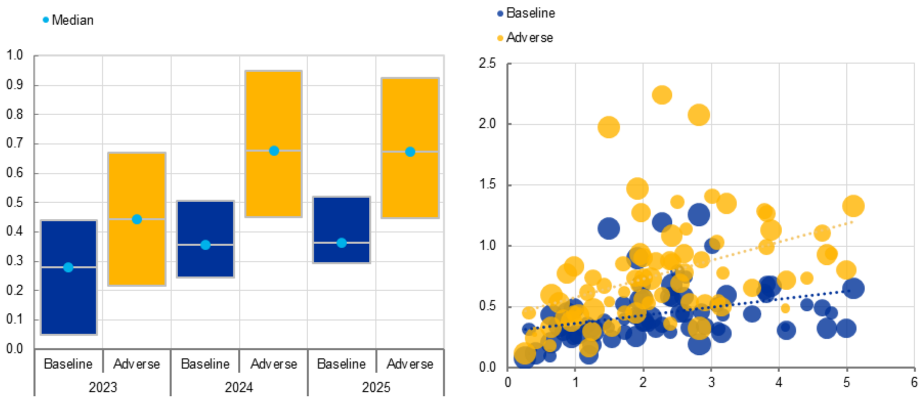
a) Baseline   b) Adverse



Notes: Stage 2 ratios for exposures to the euro area non-financial private sector. Panel a shows the Stage 2 ratio under the baseline scenario. Panel a shows the Stage 2 ratio under the adverse scenario.

Chart 14
Evolution of credit losses

(y-axis: credit losses as a share of total assets in percent; x-axis (right-hand panel): NPL ratio in 2022)



Notes: The left-hand panel displays the median and interquartile range of credit losses incurred as a result of provisions and write-offs as a share of total assets. The right-hand panel shows credit losses incurred as a result of provisions and write-offs at the end of 2025 (y-axis) and the NPL ratio at the end of 2022 (x-axis). The size of the bubbles denotes unsecured NPLs as a share of total NPLs.

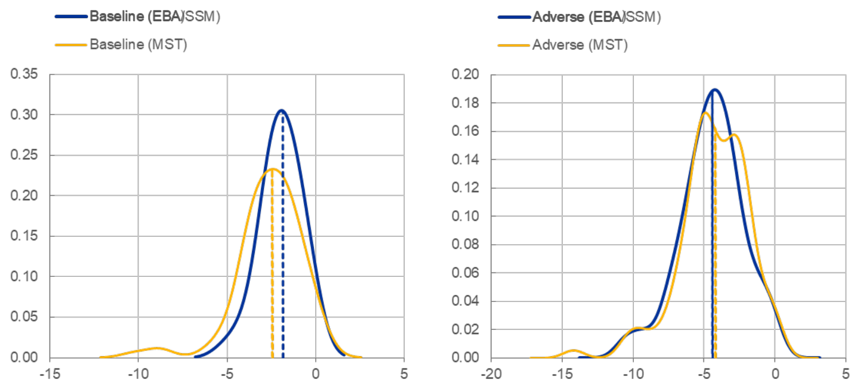
Credit risk losses remain one of the main factors contributing to the depletion of banks' capital under the adverse scenario (Chart 15). The positive association between banks' credit losses and their share of NPLs at the beginning of the projection horizon persists for both the baseline and the adverse scenario but is slightly steeper under the latter. The median of the bank distribution accounts for 4.2 percentage points of the CET1 ratio impact under the adverse scenario and 2.5 percentage points under the baseline scenario.

Compared with the EBA exercise, the macroprudential stress test results in a stronger contribution of credit risk to capital depletion under the baseline scenario and a similar impact under the adverse scenario (Chart 16). The macroprudential stress test model's baseline scenario estimates of credit risk parameters are more conservative than the risk parameters submitted by EU banks in the EBA stress test. The main difference from the EBA stress-testing methodology is that the macroprudential stress test allows for curing.[17] Setting cure rates to zero would increase the impact on the CET1 ratio from credit risk by approximately 0.8 percentage points in the macroprudential stress test across both the adverse and baseline scenarios.

Chart 16

CET1 depletion due to credit risk

(kernel density)



Notes: Transitional CET1 ratio depletion due to credit risk. Kernel density functions with bandwidth equal to 0.75 percentage points. Vertical dashed lines represents medians. The left-hand panel represents the baseline scenario, and the right-hand panel the adverse scenario.

17 The transition rates (i.e. cure rates) are estimated using separate seemingly unrelated (SUR) equation systems for each country and sector, taking into account a set of macro-variables (see Budnik et al., 2023, Section D.1.1, for more details).

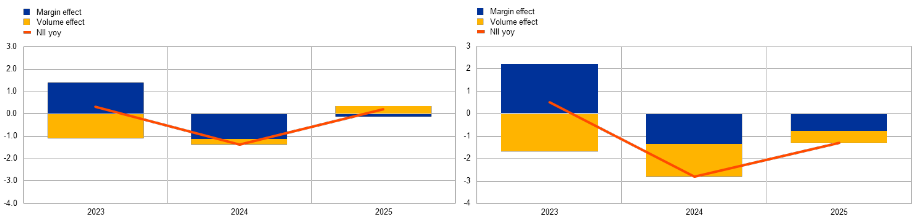
6.3 Funding costs and net interest income

Under both scenarios, the initial favourable effects of rising rates on NII are followed by a noteworthy contraction owing to growing funding costs and a contraction in lending volumes (Chart 17). The NII increase in 2023 is fuelled by a growing net interest rate margin due to an asymmetric pass-through of short-term interest rates. While increases in short-term interest rates are directly passed through to lending rates[18], rates on sight deposits, which are the main source of funding for banks, are relatively stickier. As the scenarios unfold, rates on liabilities, such as term deposits, continue to rise until changes in short-term rates are fully passed through, resulting in an overall contraction of the intermediation margin. Furthermore, the weak loan dynamic at the onset of the baseline and throughout the entire adverse scenario contributes to a deceleration in NII. Under the adverse scenario, the contributions of banks' balance sheet size and liability composition to NII are negative over the projection horizon. By contrast, under the baseline scenario, the volume effect is much smaller and even contributes positively to NII in 2025.

Chart 17
Changes in NII (margin and volume effects)

(percentages)

a) Baseline b) Adverse



Notes: Margin effect is defined as the change in the net interest margin multiplied by the volume of interest-bearing assets in the previous period, divided by the NII of the previous period. Volume effect is defined as the change in interest-bearing assets multiplied by the net interest margin of the previous period, divided by the NII of the previous period. The sample includes 98 banks in the 2023 EBA stress test.

The macroprudential stress test model shows a more positive contribution of NII to capital compared with the EBA stress test under the adverse scenario (Chart 4).[19] The significant profits in the first year of the projection period more than compensate for the decline in NII over the remaining two years. The initial increase in NII under both scenarios is driven by the rise in the net interest rate margin coinciding with rising short-term and long-term interest rates (Chart 2). As interest rates stabilise, the net interest rate margin eventually falls slightly below its starting point level (Chart 18). This contrasts with the EBA results, which show a strong initial decrease in NII under the adverse scenario before NII moves slightly above its initial level. The decrease is driven primarily by the methodological assumption on the pass-through and the static balance sheet in the microprudential exercise.[20] The

18 The model specification for bank lending interest rates can be found in Appendix C.4 of Budnik et al., 2023.

19 The EBA stress test results are presented in Chapter 2.1. of ECB (2023).

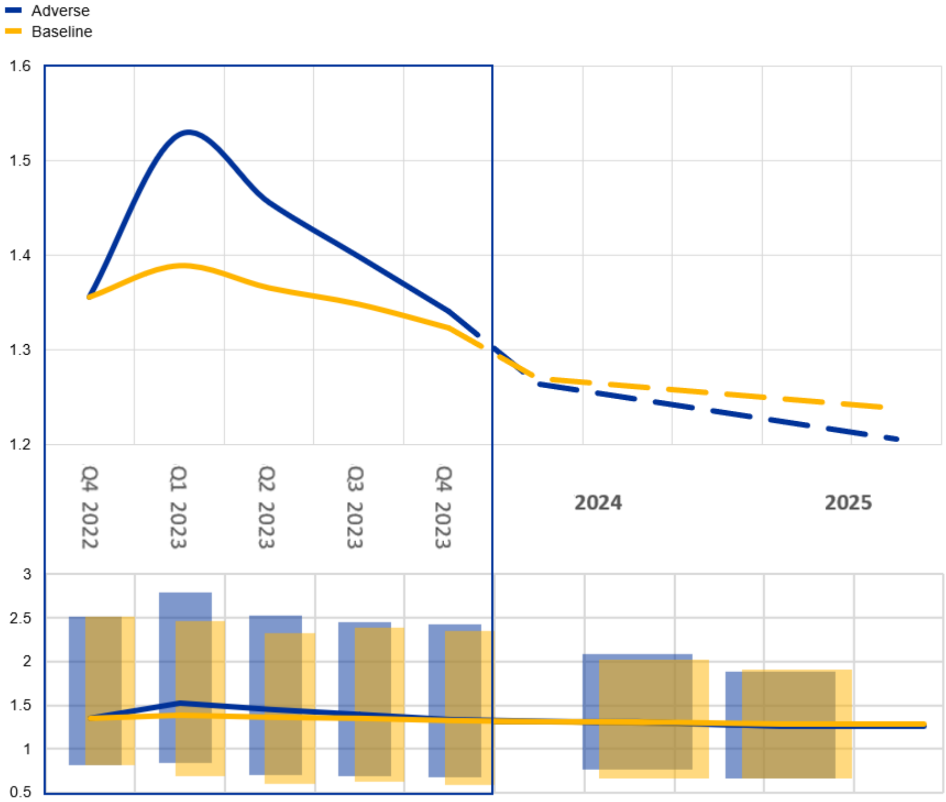
20 According to Chapter 2.4 of ECB (2023.

EBA methodology assumes that a significant part of the change in the short-term rate is rapidly passed through to sight deposits.[21] In the macroprudential model, the pass-through to deposits is estimated to be limited, but the composition of assets and liabilities changes, reflecting the development in financial markets. In particular, banks' funding gradually shifts from cheaper sight deposits to term deposits with higher remuneration and to the issuance of bonds.

Chart 18

Decrease in net interest margin below starting point after initial increase

(percentages; mean net interest rate margin (top), mean net interest rate margin with interquartile range(bottom))



Notes: Mean and interquartile range of banks' net interest margins (annualised). All statistics are weighted by total assets. A bank's net interest margin is defined as the difference in the average interest earned on assets to the average interest paid on liabilities. The sample includes 98 EU banks included in the EBA 2023 stress test.

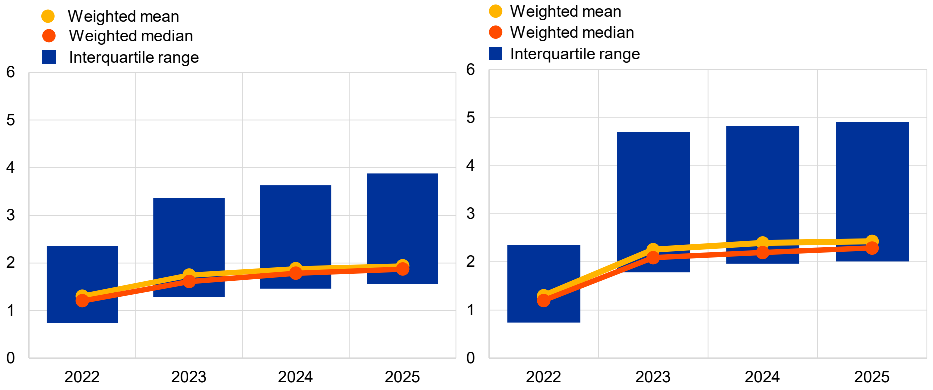
Under both scenarios, banks' funding costs increase owing to a shift in their funding structure towards costlier sources of funds and rate increases. Under the baseline scenario, banks' average funding costs rise by approximately 100 basis points, while under the adverse scenario, the increase is even more pronounced at around 150 basis points (Chart 19). The surge in the cost of funding is driven by two factors: a rising short-term interest rate and a reduction in available cheap funding sources (e.g. sight deposits from the non-financial private sector and liquidity from the Eurosystem).

[21] The EBA methodology assumes a significant pass-through of the short-term interest rate to the reference rate for sight deposits. In particular, the pass-through is assumed to be 50% for households and 75% for non-financial corporations, and 100% otherwise. Given the static balance sheet assumption, funding costs in the EBA stress test solely reflect rising rates for liabilities.

Chart 19

Average cost of funding

(percentages; baseline (left-hand panel) and adverse (right-hand panel))



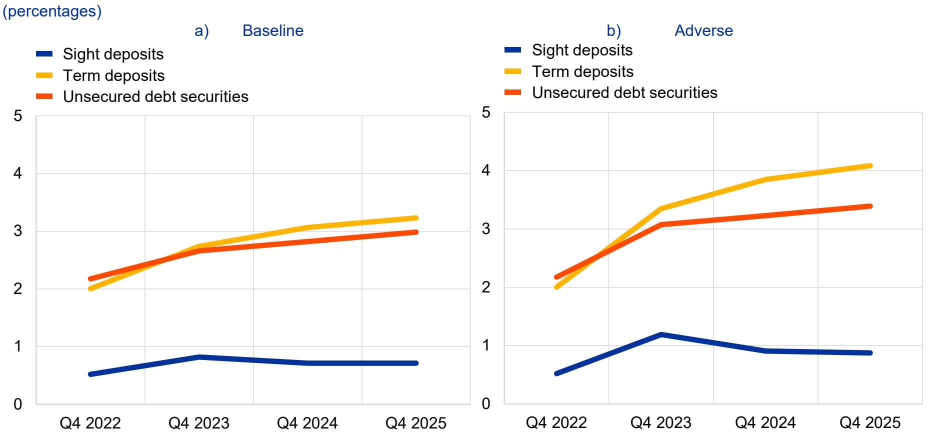
Notes: Average, median and interquartile range of banks' cost of funding. All statistics are weighted by total liabilities. A bank's funding costs are defined as the sum of the total cost per funding source multiplied by the share of that funding source in total liabilities. The sample includes 98 EU banks included in the EBA 2023 stress test.

Rates on term deposits from the non-financial private sector witness a sizeable increase, while rates on new sight deposits remain almost unchanged. Interest rates on sight deposits initially react to rising short-term interest rates under both scenarios. However, the effect diminishes after the first quarter of 2023, and over the three years the pass-through remains muted. Under the baseline scenario, the interest rate on sight deposits reaches a maximum of 0.6%, while the higher rise in short-term interest rates under the adverse scenario pushes sight deposit rates just above 1%. By contrast, the cost of term deposits rises more steeply and steadily, exceeding 3% and 4%, respectively, under the baseline and adverse scenarios by the end of the projection period (Chart 20).

Chart 20

Effective interest rate by funding source

(percentages)

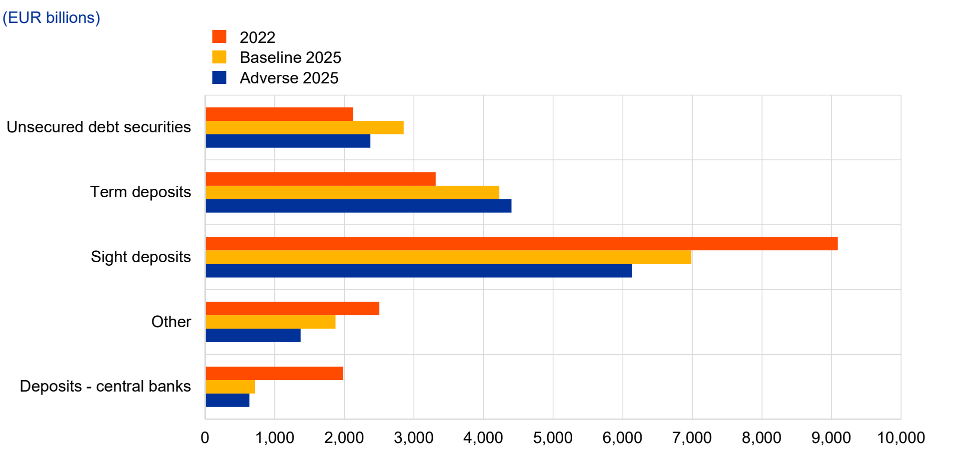


Notes: Average effective interest rate by source of funding (annualised). The statistics are calculated as an average of the bank-specific interest rates for each sector, weighted according to the banks' share of total liabilities in that sector. The sample includes 98 EU banks in the EBA 2023 stress test. Central bank deposit rates follow scenario short-term rates.

With the shift from sight to term deposits, banks' funding structure tilts towards more expensive sources of funds. As rates on term deposits increase significantly and sight deposit rates increase only modestly, the non-financial private sector systematically moves funds from sight to term deposits. Withdrawals from sight deposits, the most substantial and cheapest funding source for banks, prompt a transformation in banks' funding composition towards pricier term deposits. Additionally, banks need to compensate for the reduction in the overall deposit supply by issuing more bonds.

The increase in the volume of unsecured debt is higher under the baseline scenario than under the adverse scenario. This is in part because of the higher increase in term deposits, given the bigger difference between sight and term deposit rates. More importantly, the shrinking of banks' balance sheets under the adverse scenario reduces the need for the issuance of more costly debt securities (Chart 21).

Chart 21
Liabilities by counterparty type



Notes: Sum of liability volumes by sector at starting point and end of projection period. The sample includes 98 EU banks in the EBA 2023 stress test.

Borrowing from central banks accounts for around 6% of all bank liabilities in 2023. Under both scenarios this share is projected to fall to 3.7%, driven by targeted longer-term refinancing operation (TLTRO) III repayments by 2025. TLTRO III early repayments from before 2023 are already captured in the starting points, and projected repayments are calibrated based on the maturity schedule of the remaining TLTRO III funds.[22] Bank borrowing through TLTROs amounted to €2.2 trillion in September 2022. It subsequently dropped significantly to €1.3 trillion by the end of 2022 due to voluntary early repayments. Sizeable early repayments continued in the first half of 2023 and brought the total outstanding amount below €600 billion by the end of June 2023. Afterwards, the gradual decrease was mainly driven by mandatory repayments. As of November 2023, the total outstanding

[22] TLTRO III repayments are calibrated and implemented based on aggregated banking system repayment dynamics (data source: https://www.ecb.europa.eu/mopo/implement/omo/html/index.en.html) and are not based on the TLTRO III template submitted by banks as part of the EBA exercise.

TLTRO III amount stood at €491 billion. Remaining amounts are scheduled to be fully repaid by the end of 2024. In the model, repayments of TLTRO III are accompanied by a decrease in banks' central bank reserves and an increase in bond issuance.

7 Conclusions

The macroprudential stress test is based on the same starting points and macroeconomic scenarios as the EBA stress test but relaxes some of its key assumptions. The macroprudential stress-testing exercise considers the development of 98 significant banks and 19 euro area economies, covering more than 80% of the euro area banking sector. The model allows for dynamic balance sheet adjustments, considering amplification mechanisms such as the interplay between solvency and funding costs and the potential disruptive effects of stress in the banking system on the real economy. The BEAST model also allows for the curing and writing-off of NPLs as well as bank-specific profit distribution policies, among other bank behavioural equations.

The macroprudential stress test results show a stable CET1 ratio under the baseline scenario and a drop of more than 2 percentage points under the adverse scenario over the three-year period. Under the baseline scenario, the system-level CET1 ratio declines slightly by 42 basis points, standing at 14.9% at the end of 2025. Under the adverse scenario, the aggregate CET1 ratio decreases from 15.3% to 13%, a depletion of 2.3 percentage points in three years. This solvency deterioration is primarily driven by a reduction in NII and a substantial increase in credit risk.

Compared with the EBA stress test, the macroprudential stress test estimates a lower depletion of the CET1 ratio in 2025 for the adverse scenario. The EBA stress test results indicate an aggregate fully loaded CET1 ratio of 10.4% at the end of the projection horizon, significantly lower than the macroprudential stress test's aggregate CET1 ratio of 13%. The difference can be mostly attributed to the following deviations from the EBA's methodological assumptions: (i) the EBA exercise assumes a sizeable pass-through of short-term rates to deposits, thus dragging down NII, whereas the macroprudential stress-testing exercise estimates a limited pass-through to deposits; and (ii) the EBA exercise assumes a static balance sheet, whereas in our model banks are allowed to partially offset the impact of the adverse scenario on their CET1 ratio by lowering credit volumes (deleveraging), also taking into consideration the reduction in credit demand related to the development in economic activity and shifting their lending towards the sovereign sector. This leads to a reduction in RWAs but also exacerbates the sovereign-bank nexus.

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