# Occasional Paper Series

Budnik, Katarzyna, Dimitrov, Ivan, Groß, Johannes, Kusmierczyk, Piotr, Lampe, Max, Vagliano, Gianluca, Volk, Matjaz

## The economic impact of the NPL coverage expectations in the euro area

**No 297 / July 2022**

# Contents

# Abstract

This paper looks at the macroeconomic impact of the two policies proposed by ECB Banking Supervision to tackle the high share of non-performing loans (NPLs) on the balance sheets of euro area banks. The first is the coverage expectations for new NPLs set out in the Addendum to the ECB's NPL Guidance, which aim to prevent the build-up of new NPLs, and the second is the coverage expectations for legacy NPLs, which target the reduction of already existing stocks of NPLs. The impact assessment of the package is analysed via a semi-structural model, the Banking Euro Area Stress Test (BEAST). The coverage expectations for NPLs are found to be effective in reducing banks' NPLs. The phase-in of the policies can temporarily reduce bank profitability owing to increased loan loss provisioning targets. However, over a longer time horizon, lower NPL ratios reduce uncertainty and enable banks to access cheaper funding in the markets, ultimately benefiting lending and output growth. Furthermore, the coverage expectations can also moderately but persistently reduce procyclicality in the banking system.

# Executive summary

**The high stock of non-performing loans (NPLs) remains one of the key risks facing euro area banks.**[1] In recent years, regulators and supervisors have therefore put forward several policies to speed up the resolution of banks' NPLs. These policies involve hard requirements embedded in the Capital Requirements Regulation (CRR), the European Banking Authority (EBA) guidelines on management of non-performing exposures, and the ECB's Guidance to banks on non-performing loans (NPL Guidance). The NPL Guidance includes an array of solutions such as development of NPL strategies, instructions on NPL governance, or forbearance. The Addendum to the NPL Guidance of March 2018[2] and the later communication of August 2019[3], reinforce the solutions presented in the NPL Guidance by introducing coverage expectations for new and legacy NPLs.

**This paper considers the expected economic impact of the ECB's NPL coverage expectations through the lens of a large-scale model of banks and economies.** The Banking Euro Area Stress Test (BEAST) model features 19 countries and over 90 individual euro area banks and enables us to assess the largely heterogeneous impact of the NPL supervisory coverage expectations on bank profitability and balance sheets. In the model, the supervisory coverage expectations take the form of provisioning targets which banks meet by setting aside additional loan loss provisions. The main advantage of the model is its ability to assess the impact of supervisory coverage expectations on banks' lending behaviour and ultimately on real economy outcomes.

**In the short run, the NPL coverage expectations can weigh down bank profitability.** Following the original calendar of the coverage expectations, higher provisioning rates would reduce bank profitability most during the years 2020-26, with an impact of 0.2 percentage points on return on assets (ROA). This profitability is likely to be exaggerated because of very conservative model assumptions, excluding the recovery of collateral and the supporting impact of sell-offs, which allow banks to minimise their credit losses on their way to reducing NPLs.

**The positive effect of reduced NPLs on funding costs supports the medium-term growth of bank lending and reduces system procyclicality.** The clearance of the NPL burden from banks' balance sheets supports loan supply and fosters a decline in funding costs. As a result, the impact of the package on lending to the non-financial private sector and economic activity turns positive around 2025. The NPL coverage expectations appear to shift the full distribution of output growth, with the upward shift of lower tails of the euro area GDP distribution signifying lower costs

---

[1]   ECB (2017), Guidance to banks on non-performing loans, Frankfurt am Main, March.

[2]   ECB (2018), Addendum to the ECB Guidance to banks on non-performing loans: supervisory expectations for prudential provisioning of non-performing exposures, Frankfurt am Main, March.

[3]   ECB (2019), "Communication on supervisory coverage expectations for NPEs", Frankfurt am Main, August.

of recessions, and the downward shift of its upper tails substantiating that the euro area economy will be less prone to episodes of overheating.

**The impact of the coverage expectations on new and legacy NPLs is only weakly correlated across banks.** From the perspective of the overall banking system, the two parts of the policy package are complementary. Nevertheless, the overall impact of the package is also correlated with the initial stock of banks' NPLs, which emphasises the important role of coverage expectations in clearing legacy NPLs by 2026.

**The results also reveal that the overall impact on bank capitalisation differs across banks using different regulatory approaches.** Lending by banks that rely on the internal ratings-based (IRB) approach to credit risk is likely to be less affected by the phase-in of the NPL coverage policies than lending by banks following predominantly standardised approaches. The IRB shortfall would constitute a buffer with which to absorb the initial increase in provisioning rates. The IRB shortfall decreases when required provisioning rates increase and thus serves as a buffer for credit risk losses.

# 1 Introduction

**The financial crisis led to a substantial accumulation of non-performing loans (NPLs) on the balance sheets of euro area banks.**[4] A high level of NPLs can have a negative impact on the banking sector. NPLs tie up bank capital without return, increase banks' funding costs and erode their profitability. Although high NPL levels have clear disadvantages, and a variety of methods to resolve them are available, two-thirds of the countries that experienced high NPL levels had still not resolved them seven years after the crisis. This is largely due to several legal and administrative barriers, as well as large informational asymmetries between buyers and sellers that impede the functioning of the market for non-performing assets (Grodzicki et al., 2015; Fell et al., 2016 and 2017).

**NPL resolution is crucial for economic activity.** Banks with a large share of NPLs will be less able to provide lending to the real economy and support economic growth (Aiyar et al., 2015; Kalemli-Ozcan et al., 2015). They will be weaker, less resilient to shocks and more susceptible to systemic risks. A recent study by Ari et al. (2020) shows that countries with high levels of NPLs experience deeper recessions and slower recoveries.

**This paper assesses the system-wide impact of two supervisory initiatives aiming to reduce the NPL burden of euro area banks.** The supervisory coverage expectations for new NPLs target NPLs that went into default after 1 April 2018 and were introduced in the Addendum to the NPL Guidance in March 2018. The coverage expectations for legacy NPLs target the old stock of NPLs that existed on banks' books before 1 April 2018 and were introduced a few months later. The analysis looks at the effects of the NPL package over a longer time horizon, providing an estimate of its costs in terms of the reduction of banks' profitability and lending in the first years after the phase-in, and its benefits in terms of higher banking system resilience and a more stable flow of lending to the real economy in the longer run.

**The goal of the supervisory coverage expectations is the timely and adequate provisioning of NPLs.** The coverage expectations for new NPLs entered into force in 2019 and prescribe prudential provisioning rates that depend on the underlying collateral and time of default. The time frame for full provisioning of the default exposure varies from three years for unsecured exposures to nine years for exposure secured by immovable property. The coverage expectations for legacy NPLs become binding in 2020 and should remain effective until the end of 2026, when the entire stock of NPLs that defaulted before 1 April 2018 should already be fully provisioned. The progression of provisioning rates depends on the type of the underlying collateral, NPL vintage, and the initial NPL ratio of a bank.

**The impact assessment is done using the Banking Euro Area Stress Test (BEAST) model** (Budnik et al., 2020). The BEAST is a large-scale semi-structural

---

[4] ibid.

model with 19 euro area economies and over 90 banks. It combines bank reaction functions with detailed modelling of their balance sheets. A set of behavioural equations defines bank behaviour in terms of profit distribution, lending, interest rates and adjustments in the liability structure in response to regulatory requirements and economic conditions. In turn, bank lending and interest rate decisions affect the dynamics of the economies within which the banks operate.

**The rule-based elements of the supervisory coverage expectations are introduced directly in the model equations.** The defaulted exposures in the model are separated into new NPLs (defaulting after 1 April 2018) and legacy NPLs (defaulted before 1 April 2018), and further into unsecured exposures, exposures secured by immovable property and those secured by other collateral. The provisioning rates differ across sub-sectors in line with the supervisory coverage expectations.

**The model assesses both the costs and the benefits of the coverage expectations in an ex ante fashion.** The analysis takes account of the situation of banks as at the end of 2017, ahead of the introduction of the supervisory provisioning targets. In the short run, the NPL management strategies will result in higher loan loss provisioning. This, in turn, will reduce bank profitability and capital compared with the situation without the policies in place. The longer the horizon, the greater the importance of native mechanisms in shaping the results. As the stock of NPLs is successively provisioned and later cleared, the coverage expectations will start to have a favourable effect on bank funding costs and ultimately support bank lending.

**Both the costs and the benefits of the package may be influenced by economic conditions at the time of its phase-in and completion.** Many policies tacitly assume the continuation of normal economic conditions at least during their phase-in. The coronavirus (COVID-19) pandemic points to the risk of tail events, which are hard to anticipate but can have a substantial bearing on the costs and benefits of any policy. To assess the relevance of economic conditions during and following the phase-in of the coverage expectations, we adopt a growth-at-risk (GaR) approach which looks at the impact of the package over the whole distribution of plausible economic scenarios. This perspective allows us to assess the magnitude of costs amplification in early recession episodes and enriches our understanding of the long-term benefits of the coverage expectations in terms of affecting not only most likely but also "tail" economic outcomes.

**The model analysis provides an upper estimate of costs and a more balanced estimate of benefits.** The ex ante convention of the analysis and its focus on the coverage expectations mean that the effects of many parallel supervisory and regulatory actions are not factored into the analysis. Most of these will support banks in reducing their NPL burden, especially legacy NPLs, before the related coverage expectations become binding. EBA (2019)[5] documents that the NPL ratio of EU banks was down by over 1 percentage point in the second quarter of 2019 compared with the end of 2017, with a large share of the decrease attributable to NPL sales

---

[5]     EBA (2019), "EBA report on NPLs. Progress made and challenges ahead", report.

and securitisations. The model simulations do not factor in this reduction in NPLs, do not allow for sell-off of assets and assume that collateral for secured exposures is unrecoverable. These conservative assumptions likely exaggerate the profitability impact of the coverage expectations.

**Following the standard introduced in the ECB's NPL Guidance**[6]**, this paper uses "NPLs" as a shorthand term.** However, all policy actions described in the report refer to the EBA definition of non-performing exposures (NPEs). One of the aims of the EBA NPE definition is to make data more comparable by overcoming the differences in NPE classification across countries. It is broader than either the IFRS 9 accounting definition of default (Stage 3) or the CRR definition. Despite these differences, the three concepts are usually aligned for most exposures.

**The paper is structured as follows.** The next section discusses the new NPL-related polices introduced by regulators and supervisors. Section 4 summarises the modelling approach. Section 5 provides a broad overview of the impact of the NPL coverage expectations. Section 6 presents selected in-depth results on the impact of the package. Section 7 concludes with some final remarks and policy implications.

---

[6]   ibid.

# 2 Regulation and guidelines on management of NPLs

**The main ECB initiative targeting euro area NPLs is the NPL Guidance, which was introduced in 2017[7] and further adapted in 2018 and 2019.** The NPL Guidance includes a comprehensive set of measures and standards on NPL management strategies, NPL recognition and forbearance. In 2018, the ECB published the Addendum to the NPL Guidance[8], which stresses the need to enhance the timeliness of provisions for loans that became non-performing after 1 April 2018 (new NPLs). A year later, the ECB published supervisory coverage expectations for provisioning of NPLs that became non-performing before 1 April 2018[9] (legacy NPLs). In the same year, the ECB aligned the prudential provisioning rules for new NPLs with those specified in the amended CRR.[10]

**Chart 1**
Quantitative expectations for prudential provisioning of new NPLs
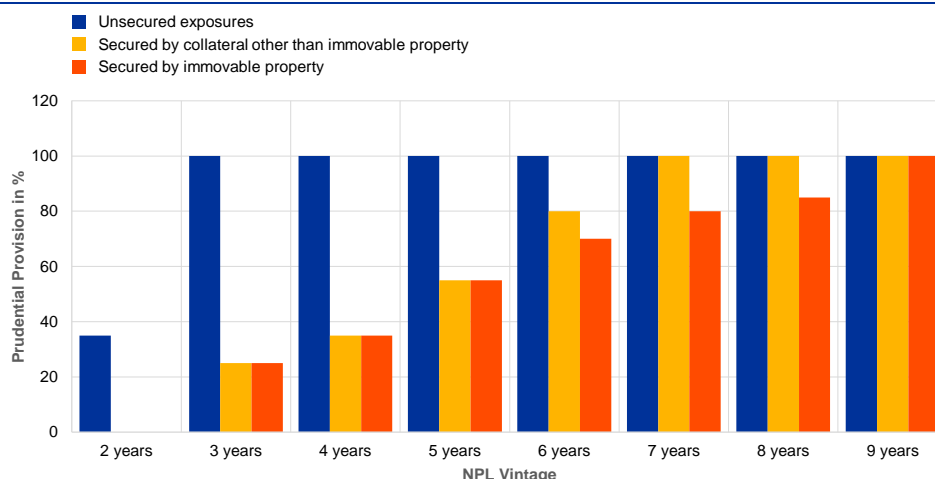


Source: ECB (2019)

**The coverage expectations for new NPLs ask banks to progressively increase loan loss provisions for new NPLs.** Banks are expected to fully provision the unsecured part of a new NPL after three years from its classification as non-performing (see **Chart 1**). For a secured exposure, the timeframe to arrive at full coverage is longer to allow banks to recover part of the collateral. However, if

---

[7]    ibid.

[8]    ECB (2018), "Addendum to the ECB Guidance to banks on non-performing loans: supervisory expectations for prudential provisioning of non-performing exposures", Frankfurt am Main, March.

[9]    ECB (2019), "Communication on supervisory coverage expectations for NPEs", Frankfurt am Main, August.

[10]   In order to make the two approaches more consistent and to simplify bank reporting, in 2019 the ECB adopted the same vintage count and provisioning rules for provisioning new NPLs. Initially, as defined in the Addendum to the NPL Guidance, the ECB's prudential provisioning expectations had followed slightly different steps, with full provisioning for unsecured and secured NPLs being expected after two and seven years respectively.

collateral has not been realised after several years, it would in principle be deemed ineffective and the exposure needs to be fully covered by provisions. Full coverage of exposures secured by immovable property is expected after nine years, whereas for exposures secured by other types of collateral it is expected after seven years.

**The supervisory coverage expectations on legacy NPLs aim to ensure full provisioning of legacy NPLs before the end of 2026.** Banks are classified in three groups based on their net NPL ratios as at the end of 2017. For each group, the expectations prescribe an initial coverage target in 2020 and a phase-in path to full coverage, with the aim of achieving adequate provisioning levels of legacy NPLs over the medium term. All existing legacy NPLs should be fully provisioned between 2023 and 2026. The exact timing depends on the bank's group classification, on the type of underlying collateral and on the NPL vintage.

**The NPL coverage expectations are non-binding in nature, but non-compliance can trigger a supervisory response.** The NPL Guidance and the supervisory coverage expectations apply to significant institutions within the Single Supervisory Mechanism (SSM), including their international subsidiaries. The supervisory coverage expectations are non-binding and fall under comply-or-explain procedures. Importantly, supervisory targets can potentially be revised for each individual bank after an impact assessment carried out by the ECB. Banks need to explain any deviation from the supervisory expectations, and compliance is taken into consideration in the SSM Supervisory Review and Evaluation Process (SREP).

**The ECB initiatives to define strategies for reducing NPLs came about jointly with at least two other proposals, which are only indirectly acknowledged in the present analysis.** The first is the amendment to the CRR regarding the minimum loss coverage for non-performing exposures,[11] and the second is the EBA guidelines on management of non-performing and forborne exposures.[12]

**The regulation amending the CRR introduced Pillar 1 backstop rules for new loans and applies to all banks.** The CRR amendment and the ECB coverage expectations on new NPLs share the common goal of managing the provisioning of new NPLs. The amendment requires a deduction from banks' own funds for NPLs which are not sufficiently covered by provisions or other credit risk adjustments. Sufficient coverage is defined in the same way as in the coverage expectations for new NPLs and in a progressive manner such that full coverage by provisions is achieved in three, seven and nine years for unsecured exposures, exposures secured by collateral other than immovable property and exposures secured by immovable property respectively.

**The Pillar 1 backstop rules apply only to loans originated from 26 April 2019 onwards.** The ECB communication of 19 August 2019[13] limits the scope of the ECB's supervisory expectations for new NPLs to exposures that are not subject to

---

[11] Regulation (EU) 2019/630 of the European Parliament and of the Council of 17 April 2019 amending Regulation (EU) No 575/2013 as regards minimum loss coverage for non-performing exposures (OJ L 111, 25.4.2019, p. 4).

[12] EBA (2018), Guidelines on management of non-performing and forborne exposures (EBA/GL/2018/06), October.

[13] See footnote 3.

the Pillar 1 treatment – i.e. to NPLs arising from loans originated before 26 April 2019. NPLs arising from loans originated from 26 April 2019 onwards are in principle subject to the Pillar 1 backstop. In order to make the two approaches more consistent and thereby simplify bank reporting, the relevant time frames for NPLs arising from loans originated before 26 April 2019 have been aligned with those in the Pillar 1 framework. This also means that, after several years, when all new NPLs will relate to loans originated after 26 April 2019, banks following the CRR and banks following the provisioning rules prescribed by the ECB's coverage expectations will effectively be subject to the same regime.

**The EBA guidelines mainly target banks with a larger share of NPLs (above 5%) and require them to establish a detailed strategy to reduce the stock of NPLs.** Where necessary, the supervisor can also request an NPL reduction from a bank with an NPL ratio below 5%. The EBA guidelines are as comprehensive as the NPL Guidance and include several measures and standards. However, unlike the NPL Guidance, they apply at consolidated, sub-consolidated and solo level.

# 3 Methodology

## 3.1 The model

**The impact assessment of the NPL coverage expectations employs a large scale semi-structural model linking macro and bank-level data (Budnik et al., 2020).** The model captures the heterogeneous behaviour of individual banks and includes interactions between the financial sector and the real economy. The model covers 91 of the largest euro area banks with their individual balance sheets and profit and loss accounts and 19 euro area economies. The sample of banks covers broadly 70% of the euro area banking sector in terms of total assets, allowing for a detailed analysis of the reform's impact on banks across euro area jurisdictions.

**The model looks at the joint dynamics of banks and economies** (see **Figure 1**). It encapsulates banks' adjustments of loan volumes and loan interest rates. It then aggregates the impact of these responses by individual banks on the credit supply and lending rates to the real economy, introducing a banking sector real economy feedback loop.

**Figure 1**
Schematic illustration of the BEAST
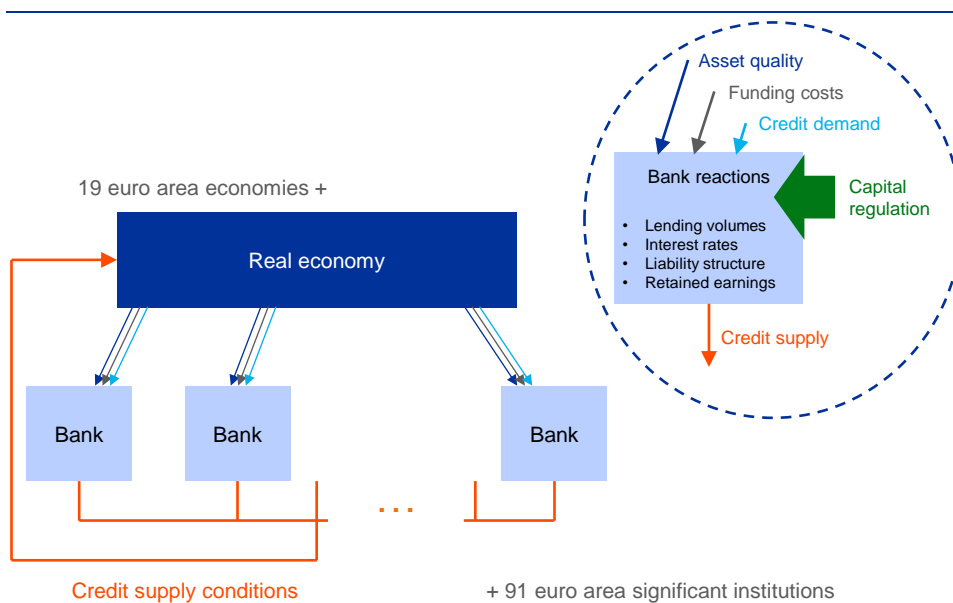


**Bank assets are broken down by sector and geography to reflect heterogeneous exposures to macroeconomic shocks.** The model accounts for individual banking book structures, distinguishing between bank exposures to sovereigns, the financial sector, the non-financial corporate sector, households backed by real estate, and household loans for consumption purposes. For lending to the non-financial private sector, the model separates exposures by country of exposure. For each of these portfolios, the model replicates the IFRS 9 impairment

stages with endogenous transition rates and the changes in risk weights conditional on macroeconomic developments. Credit risk weights are modelled separately for advanced and foundation IRB models and the standardised approach. Banks are also allowed to adjust their loan volumes within these sub-sectors in response to loan demand conditions and depending on their own capital position or profitability or the quality of the assets.

**In the model, banks write off a certain part of defaulted loans even in the absence of any supervisory guidance.** The share of loans that are written off (voluntary write-offs) is summarised in an empirical equation that links the write-off rate to the features of the defaulted portfolio and bank characteristics. The key drivers of the write-off rate are the NPL ratio, NPL vintage, provision coverage and bank profitability.[14] A share of NPLs is also cured in each period.

**The liability side distinguishes between equity, customer deposits and other debt funding.** The evolutions of term and sight deposits from households and corporations are shaped mainly by general economic conditions and influenced to a lesser degree by deposit margins offered by individual banks. Banks are assumed to fill the funding gap between equity and customer deposits with deposits from sovereigns and other financial institutions and, in the next stage, with wholesale funding. The cost of wholesale funding depends on endogenous maturity choices, the leverage ratio and the share of NPLs. This channel captures the effects of higher capitalisation and asset quality on bank funding costs and its counterbalancing capacity on profitability.

**Regarding profits and losses, the framework dynamically models net interest income, loan loss provisioning and net fee and commission income.** Bank-level interest rates on new lending and deposit rates depend on economic conditions, the bank's situation, and monetary policy rates. Other components of the profit and loss account, such as dividend income, follow simple dynamic rules linking them to, for instance, the evolution of total bank assets. The dynamics of trading book assets and market risk capital surcharge, banks' dividend holdings, and operational risk capital charge follow similar simplified dynamics. Finally, banks adjust their profit distribution policies to retain their management buffer over regulatory requirements, including Pillar 2 Requirements and Guidance.

**The macroeconomic module can be described as a reduced-form multi-country setup.** The dynamics of single euro area economies are represented by a structural vector autoregressive model, estimated in a panel setup. An additional block of cross-country trade spillovers links countries' import volumes to foreign demand variables, and their export prices to foreign price variables. Monetary policy is represented by the short-term interest rate (EURIBOR) and ECB assets, the former standing for a headline conventional monetary policy instrument, and the latter approximating the working of unconventional monetary policy measures.

---

[14]  See the Appendix for more details.

**Structural shocks in country-level value at risk are used to simulate potential outcomes under many plausible scenarios.**[15] These scenarios replicate interdependencies among variables in a way that is consistent with historical data. Via stochastic simulations, the BEAST allows us to observe the effects of a policy, including in very adverse (or positive) economic conditions.

## 3.2    Implementation of the NPL policies in the model[16]

**The model implementation of the coverage expectations relies on a split of defaulted exposures into new and legacy NPLs, and a split by the type of collateral.** On the basis of information from financial/supervisory reporting (FINREP) as at the end of 2017, each country-sector level exposure of a bank is divided into unsecured exposures, exposures secured by immovable property and exposures secured by other collateral. For defaulted exposures at the end of 2017, we assume a uniform distribution of time since default and track the average age of the new defaulted stock from then onwards.

**The coverage expectations on new NPLs are introduced as a set of provisioning floors.** The floors closely follow the Addendum to the NPL Guidance and depend on the type of collateral and the time since default.

**The coverage expectations for legacy NPLs assume that banks fall into one of three groups with differing initial NPL burdens.** Banks are classified into the three groups depending on their net NPL ratio as at the end of 2017[17] with high (Group 1), moderate (Group 2) and low (Group 3) NPL ratios. The provisioning floors for legacy NPLs are set separately for the secured and unsecured parts of an exposure and are specific to each group of banks. They became binding at the end of 2020, when banks had to meet the initial targets ranging from 40% for the secured part of the exposures of Group 3 to 70% for the unsecured part of the exposure of Group 1. Every year the coverage target increases by 10 percentage points until each target reaches 100%. Potential supervisory adjustments of NPL coverage expectations for individual banks are not considered in this assessment.

**The shortage of provisions resulting from the supervisory coverage expectations is booked as impairments.** The ECB also allows alternative treatments of the shortage, including deducting it directly from Common Equity Tier 1 (CET1) capital or using the IRB shortfall.

**The model introduces two alternative assumptions about the write-off of exposures falling under the scope of the ECB coverage expectations.** The assumption referred to as "immediate write-offs" is equivalent to the automatic write-

---

[15]  See Financial Stability Review, November 2020, Box 6 for more information about the underlying scenario generation process.

[16]  See the Appendix for a detailed exposition of modelling assumptions and model equations related to the implementation of the NPL coverage expectations.

[17]  The net NPL ratio is calculated after the deduction of provisions and better resembles the residual outstanding exposure that potentially still needs to be provisioned. Banks are classified into groups as follows: Group 1: net NPL ratio below 5%; Group 2: net NPL ratio between 5% and 12.5%; Group 3: net NPL ratio above 12.5%.

off of any exposure which reaches 100% provisioning under the coverage expectations. This assumption recognises that the write-off of a fully provisioned defaulted exposure should induce no additional loss, though it ignores the fact that banks may have incentives to keep such an exposure on their balance sheets, e.g. if it generates interest. The assumption referred to as "gradual write-offs" means that banks write off loans along with their historical propensity to write off defaulted assets. The impact of the supervisory coverage expectations on the write-off rates in the latter case will be less direct, via variables that enter the empirical equation on write-offs, and are generally slower. In both cases, the voluntary write-offs are calculated as a residual between the write-offs banks would undertake even in the absence of the NPL management strategies and the policy-related write-offs. If write-offs induced by the NPL coverage expectations exceed those that would be undertaken otherwise and result from the corresponding empirical equation, the voluntary write-offs will equal zero.

**These two assumptions pin down two extremes which allow us to deal with high uncertainty about banks' actual write-offs under the new regime.** The immediate write-off specification will lead to the highest estimates of write-offs. The gradual write-offs specification leads to excessively conservative estimates of write-offs.

**Importantly, the specification of the NPL coverage expectations should provide a very conservative estimate of their impact on banks' profitability.** First, the coverage expectations for legacy NPLs can be adjusted to the individual bank's situation, which is difficult to reflect in the model implementation. Second, missing historical data precludes the modelling of sell-offs, so the model assumes that no assets are sold. This is a very conservative assumption, which does not allow us to factor in the impact of parallel initiatives aimed at reducing NPLs, such as the successful development of NPL markets. Third, and again owing to missing data that would allow the corresponding model calibration, it is assumed that banks cannot recover any value from the underlying collateral of the NPL. In reality, banks would not necessarily provision every NPL up to 100% since part of it is likely to be covered by collateral.[18] All these assumptions will increase the estimated negative impact of the coverage expectations on bank profitability; they will have no discernible effect on the long-run benefits of reducing the NPL burden of banks.

**There are other assumptions which are not specific to the implementation of the coverage expectations but may nevertheless introduce an upward bias in the estimate of their costs.** Banks do not anticipate the NPL-related policies. The NPL coverage expectations will become binding only in the medium to longer run, which gives banks several years to prepare and adjust. It is also assumed that banks do not tap into equity markets and cannot raise capital by issuing new shares. In addition, capital requirements and buffers set by regulators are assumed to remain unchanged.

---

[18] The assumption of non-recovery of collateral was, however, tested in the model by assuming 10% recovery value on all written-off NPLs. The impact on banks' profitability during the phase-in of the package was moderated, but the modification did not have a material impact on the results and left them unaffected qualitatively.

## 3.3 Impact assessment

**We assess the impact of the ECB NPL coverage expectations by contrasting the simulation results with and without NPL-related policies.** In our assessment we thus compare the results with policy-driven loan loss provisioning and write-offs and losses to a regime where loan loss provisions and write-offs are unaffected by the NPL coverage expectations. In addition, we run exercises where the impact of the coverage expectations for new NPLs and legacy NPLs are assessed separately. This shows which part of the NPL policies has a larger effect on bank profitability, capitalisation and lending at any point in time.

**The time horizon for the assessment is 2018-30.** The NPL coverage expectations entered into force in 2018 but become binding only when new NPLs reach a certain vintage. For a defaulted exposure, depending on the underlying collateral, it can take up to nine years to reach full coverage by provisions. A more sizable effect of the NPL coverage expectations is therefore likely to materialize only at a longer horizon.

**The first impact assessment is carried out under the assumption of normal economic conditions.** It is represented by the ECB Autumn 2019 forecast, i.e. the last forecast unaffected by COVID-19 related developments, which could not have been anticipated when designing the package. The forecast represents moderately positive economic developments, with euro area GDP growing at the rate of around 1% to 1.5% in an environment of relatively low interest rates. The difference between the conditional forecast with and without the introduction of the NPL package will provide information on the likely effects of the package under normal economic conditions.

**The second assessment is conducted under various assumptions regarding future economic outlooks.** This part of the assessment follows the growth-at-risk perspective and looks at the full distribution of economic and bank-level variables, taking account of scenario uncertainty via the mean of multiple stochastic simulations of the model. It focuses on interpreting the changes in the left tail of the projected GDP distribution as a downside economic risk (Wang and Yao, 2001) or as an indicator of financial stability risks. Next, it considers two types of recessionary periods: during the phase-in of the package before 2026 and following its completion after 2026.

# 4 The system-wide impact of the supervisory NPL coverage expectations

**The phase-in of the NPL coverage expectations is expected to increase loan loss provisioning amounts at least temporarily.** The yellow bars (green dots) in Chart 2 report the impact of the coverage expectations on total credit losses, expressed in percentages of total assets, and the blue bars (red dots) show their impact on bank profitability measured by ROA, when banks immediately write off fully provisioned NPLs under the coverage expectations (or write them off only gradually). Credit losses are more than 0.25 percentage points higher in the years 2020-23 compared with the situation in the absence of the supervisory targets. This translates into a modest reduction in bank profitability by over 0.2 percentage points[19] in the same period. The profitability impact of the coverage expectations declines from 2024 onwards, stabilising around 2026 at below 0.1 percentage points. The cumulation of the impact in the early years and its fading thereafter mirrors the timing of the supervisory coverage expectations for legacy NPLs, with banks having to reach the corresponding loan loss provisioning targets by 2026. The assumption on the timing of write-offs does not appear to matter for the profitability outcomes. The difference in profitability introduced by alternative assumptions on the timing of write-offs is noticeable only in the medium run and even then, remains very small.[20]

---

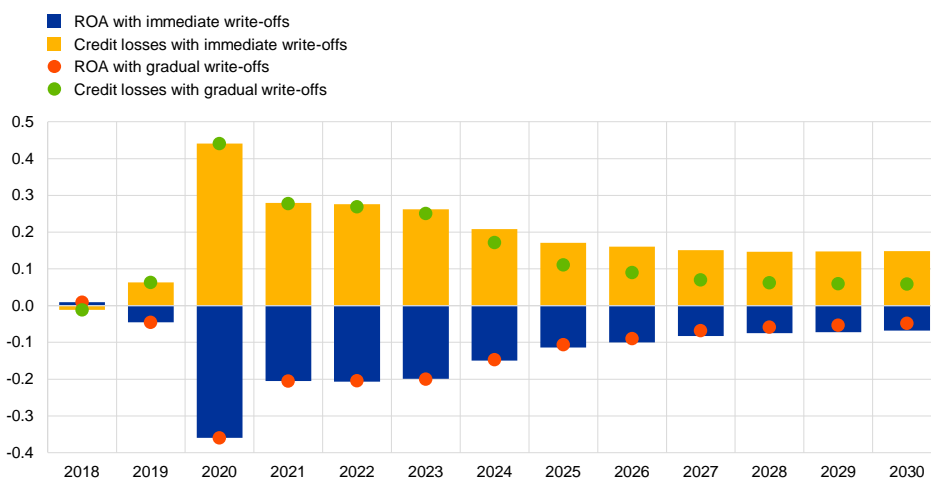[19] The size of the impact is significant as it represents 40-80% of the realised ROA in 2017.

[20] When fully provisioned NPLs under the supervisory coverage expectations are only gradually written off, some of them can be cured, triggering the release of corresponding provisions, and they can still yield some interest. This does not occur when the NPLs are written off immediately. These two channels are the main drivers of the gap in simulated profitability paths under the two alternative assumptions.

## Chart 2
### Quantitative expectations for prudential provisioning of new NPLs

**NPL policy package has a significant impact on credit losses, especially during the years 2020-23**

(Impact on ROA and credit losses in percentage points)

- ■ ROA with immediate write-offs
- ■ Credit losses with immediate write-offs
- ● ROA with gradual write-offs
- ● Credit losses with gradual write-offs



Note: Credit losses are calculated as a sum of loan loss provisions and write-offs and are measured in percentages of total assets.

## Chart 3
### Write-off rate of NPLs

**The supervisory coverage expectations induce an increase in the write-off rate from 2021-22 onwards**

(Write-off rate of NPLs in percentage points)

- ▬ No NPL policy
- ■ Cov. Exp + immediate write-offs
- ● Cov. Exp + gradual write-offs
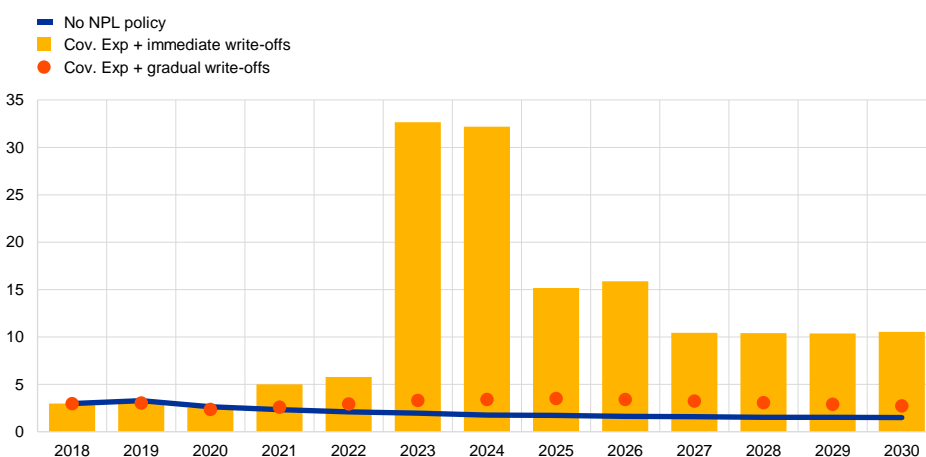


Note: Write-off rates are defined for all exposures including the non-financial private sector, sovereigns and financials.

**Regardless of the model assumption on the timing of NPL write-offs, the supervisory targets lead to an increase in write-offs by banks.** Chart 3 compares the write-off paths when banks either immediately (bars) or only gradually (dots) write off fully provisioned NPLs under the coverage expectations. In the latter case, banks write off fully provisioned NPLs along with their historical propensity to clean their balance sheet from non-performing assets. Under the benchmark assumption of immediate write-offs of NPLs under the coverage expectations, banks

would write-off massively[21] in the period 2023-26 when legacy NPLs reach full coverage by provisions. The increase is less pronounced when write-offs take place only gradually, but still amounts to 1 to 2 percentage points.

**Accordingly, the supervisory coverage expectations gradually reduce the NPL burden on bank balance sheets.** The impact of the coverage expectations on the euro area gross NPL ratio is distinctly negative, leading to a reduction of NPL ratios for total bank exposure by around 0.5 percentage points up to 2.5 percentage points by the end of 2030, depending on the assumption about the timing of write-offs (bars and dots in **Chart 4, panel a**). Under the benchmark assumption of immediate write-offs of NPLs under the coverage expectations, the gross NPL ratio already drops sharply in the years 2023-24, whereas under the alternative assumption of gradual write-offs, the impact phases in only gradually and is expected to increase further outside of the projection horizon. The supervisory provisioning targets also to substantially reduce the net NPL ratios.[22] The net NPL ratio is 2 percentage points lower relative to the outcome without the coverage expectations in 2030 (solid line and triangles in **Chart 4, panel a**) with their level stabilising around 1% at this horizon.

---

[21] In total, over 13 years, banks would write-off €875 billion of default exposure with immediate write-offs, €316 billion with gradual write-offs and €215 billion without coverage expectations in place.

[22] The net NPL ratio is calculated using net exposure values after deduction of provisions that have already been made.

**Chart 4**

Significant reduction in the share of defaulted exposures and the average risk weight

**a) Gross and net NPL ratios**

(Deviations of gross and net NPL ratios in percentage points)

- Gross NPL with immediate write offs
- Gross NPL with gradual write offs
- Net NPL with immediate write offs
- Net NPL with gradual write offs
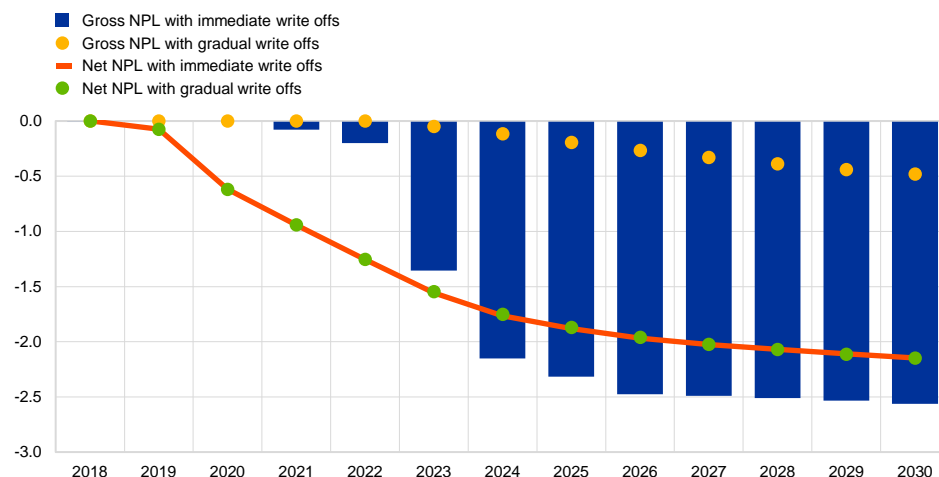


**b) Average effective risk weight**

(Average ratio of risk exposure amounts to total assets in percentage points)

- Cov. Expectations + immendiate write offs
- Cov. Expectations + gradual write offs
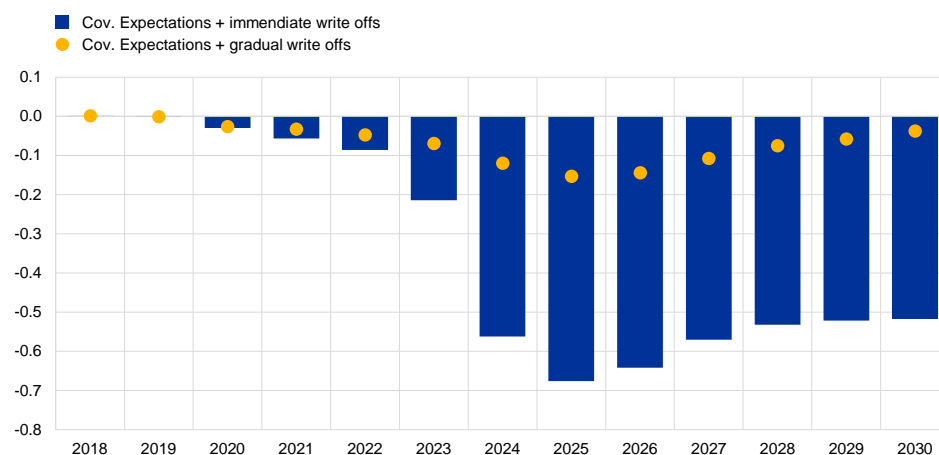


Note: The NPL ratio is calculated for total bank exposures including non-financial private sector, financial and sovereign exposures. The impact of the supervisory coverage expectations on the net NPL ratio is the same irrespective of the timing of write-offs since the contribution of a fully provisioned default exposure that remains on a balance sheet to the net NPL ratio amounts to zero. The average effective risk weight is calculated as the ratio of the risk exposure amount to total assets.
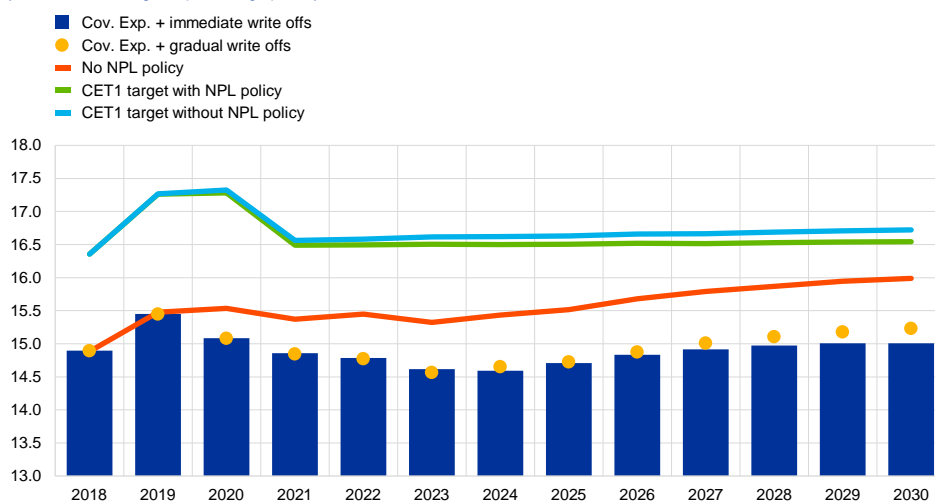
**The progressive reduction of the NPL burden is reflected in lower average credit risk capital charges.** The effective risk weight, calculated as a ratio of risk-weighted amounts to total assets, decreases in line with the decreasing share of defaulted exposures on bank balance sheets (**Chart 4, panel b**). The effective risk weights are reduced by 0.5 percentage points with the immediate write-offs and by about 0.1 percentage points with the gradual write-offs as compared to their levels in the absence of the supervisory coverage expectations.

**Chart 5**
CET1 ratio with and without policy

**The impact on CET1 ratio reaches close to 1 percentage point**

(CET1 ratio and target in percentage points)

- ■ Cov. Exp. + immediate write offs
- ● Cov. Exp. + gradual write offs
- — No NPL policy
- — CET1 target with NPL policy
- — CET1 target without NPL policy



Note: CET1 target is composed of Pillar 1 requirements, Pillar 2 requirements, combined buffer requirements, Pillar 2 Guidance and management buffer.

**Changes in bank profitability and management buffers are the main drivers explaining the evolution of the euro area CET1 ratio in the presence (as opposed to the absence) of the supervisory coverage expectations.** The CET1 ratio in 2030 is almost 1 percentage point (or 0.8 percentage points with gradual write-offs) lower than without the policy (**Chart 5**). This trend is partially attributable to a reduction in banks' management buffers permitted by the reduction of risk on their balance sheet, which in 2030 is 0.2 percentage points lower relative to a no-policy regime.[23] Furthermore, two factors counterbalance the negative impact of profitability on CET1 ratios under the supervisory coverage expectations. The first is a decrease in risk-weighted assets compared with a no-policy regime, which are 4% lower with immediate write-offs and 1.5% lower with gradual write-offs. The second is the reduction in the IRB shortfall induced by the supervisory coverage expectations, which contributes positively to the CET1 ratio by about 0.1 to 0.4 percentage points (this is discussed at more length in Section 6).

---

23    Bank management buffers in the model are empirically linked to the funding and revenue structure of banks, along with other structural indicators, such as bank size and the share of NPLs on their balance sheets. In line with this empirical dependency, a lower NPL burden on balance sheets will reduce their propensity to maintain an additional capital buffer above supervisory limits.

**a) Bank lending**

(NPL coverage expectations impact on loan growth, year on year in percentage points)

■ Cov. Exp. + immediate write offs
● Cov. Exp. + gradual write offs
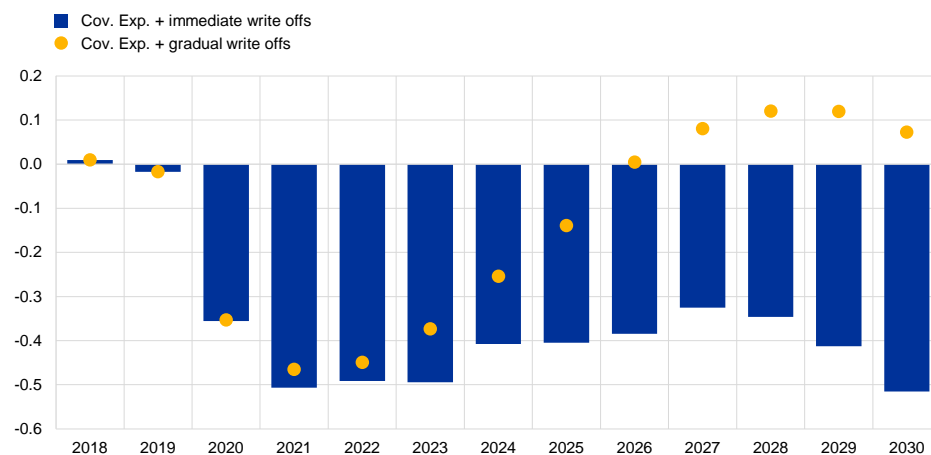


**b) Economic growth**

(Impact on GDP growth, year on year in percentage points)

■ Cov. Exp. + immediate write offs
● Cov. Exp. + gradual write offs
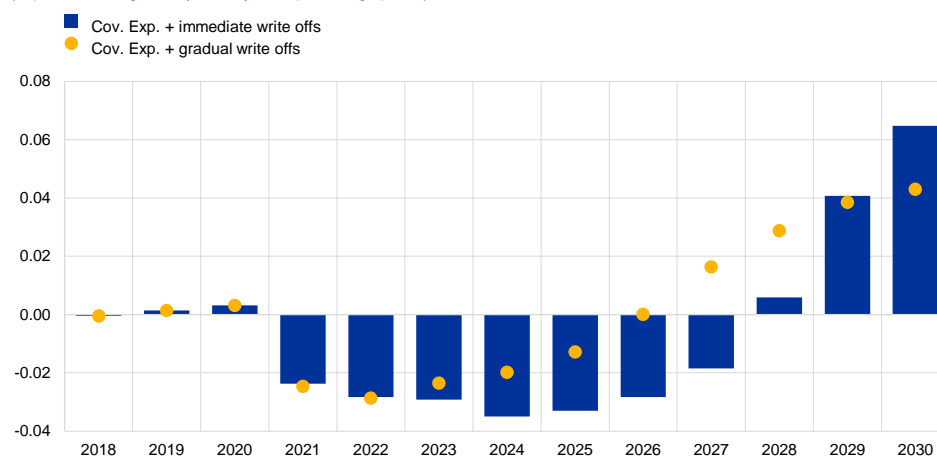


Note: The impact on loan growth is presented for the non-financial private sector.

**The NPL coverage expectations have a very small impact on real economic activity.** The initial impact of the supervisory provisioning targets on lending is negative, though very moderate. Annual loan growth is reduced by around 0.4 percentage points on average up to 2030 (**Chart 6, panel a**) under the assumption of immediate write-offs, and by around 0.3 percentage points on average up to 2025 and turning positive afterwards under the assumption of gradual write-offs. The low negative effect on lending relates to a negative impact of the coverage expectations on profitability, and to a lesser degree on bank solvency. The impact of the supervisory coverage expectations on GDP is already negligible, with the initial negative impact remaining below 0.05 percentage points in any period (**Chart 6, panel b**).

**The contained medium-term impact of the supervisory coverage expectations concerns the full distribution of euro area growth.** The panel a of Chart 7 plots the distribution of euro area GDP from 2018 to 2027, with full account of the

uncertainty of future economic outcomes represented by the fan spanning between the 10th and 90th percentiles of the distribution. GDP is expressed in 2017 values by discounting its level by the steady-state growth rate. The central moments (mean or median) of the GDP level expressed in this way will tend to remain close to 1 over a longer time horizon. The worst 10% of long-term outcomes in 2030, corresponding to recession events happening over the decade, correspond to at least a 17% reduction compared with the expected (mean) GDP in terms of 2017 GDP. The most positive 10% of outcomes in 2030 correspond to over 18% in output gains compared with the expected GDP in terms of 2017 GDP. The GDP distribution is generally positively skewed, meaning the mass of probability is concentrated on the left side (less optimistic GDP outcomes) but also that tails on the right side are longer (somewhat higher probability of extraordinary positive outcomes).

## Chart 7

### The impact of the NPL coverage expectation on the distribution and growth of euro are GDP

**Marginally positive impact of the NPL coverage expectations on GDP level**

- No coverage expectations (mean, 10th and 90th percentiles)
- Coverage expectations and immediate write-offs (mean, 10th and 90th percentile)
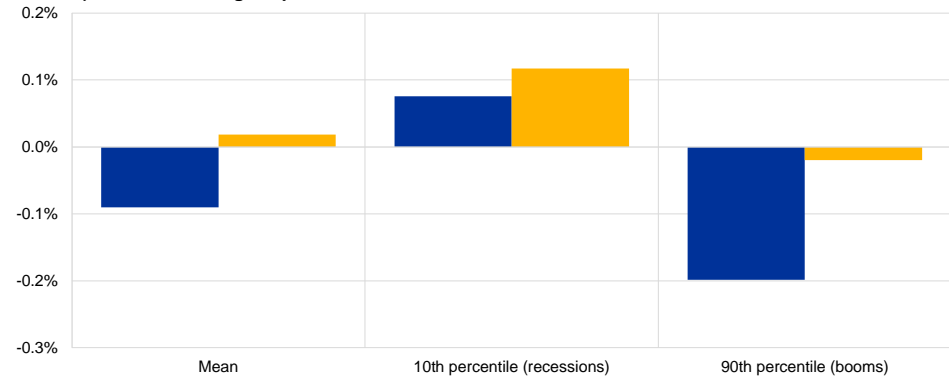- Coverage expectations and gradual write-offs (mean, 10th and 90th percentile)

**a) distribution of euro area GDP expressed in its 2017 values discounted by its steady-state growth rate**
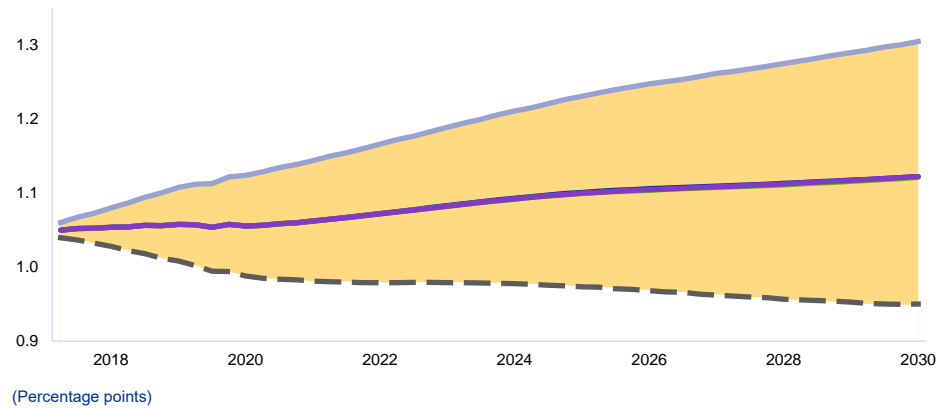
(Percentage points)

- With immediate write-offs
- With gradual write-offs

**b) Effect of coverage expectations on GDP level**

Note: (Panel a) The euro area GDP is expressed in its 2017 values by discounting by its steady-state growth rate. The yellow area represents 80% of the GDP distribution in the absence of the NPL coverage expectations, and the thick yellow line represents the mean of the corresponding distribution. Dashed green and blue lines represent the 10th and 90th percentiles of the two distributions with coverage expectations, and the corresponding solid lines represent their means.

**The NPL coverage expectations very moderately limit the procyclicality of the financial system and economic output.** The supervisory coverage expectations very modestly shift not only the mean GDP outcomes (as already illustrated in **Chart 7, panel a**) but also its full distribution. Panel b of Chart 7 maps the mean, 10th and 90th percentiles of the output distribution in the absence and presence of the NPL coverage expectations from the left-hand panel as at the end of 2030 in a bar chart. The impact on the mean of the distribution is low, remaining between -0.1% and slightly positive (even if at the cut-off point the GDP gap between outcomes with and without the coverage expectations is turning positive under both assumptions). At the same time, the GDP level for the worst 10% of scenarios is 0.1% higher, while that for the 10% of most excessive boom scenarios is lower by less than -0.2%. Regardless of the assumption about the timing of write-offs induced by the coverage expectations, the shift of the distributions shows that recessions become shallower and the economy is less prone to significant overheating.

# 5 Selected results

## 5.1 Disentangling the effect of supervisory coverage expectations on new NPLs and on legacy NPLs

**The impact of the two components of the coverage expectations is distributed differently over time.** The impact of coverage expectations on new or legacy NPLs, considered separately against the "no-policy change" benchmark, is reported in Chart 8. The main burden of the transitional adjustment under the coverage expectations for legacy NPLs falls between 2020 and 2025, when banks build provisions towards gradually increasing targets and credit losses remain elevated (top left panel). Afterwards, the coverage expectations for legacy NPLs have a positive impact on bank profitability owing to their advantageous effect on funding costs (top right panel) and the CET1 ratio (bottom left panel). The impact on the net NPL ratio is most pronounced around 2024, when coverage by provisions is highest, and gradually decreases thereafter when fully provisioned legacy NPLs start to be written off (bottom right panel).

**Chart 8**

## Impact on credit losses, ROA, CET1 ratio and net NPL ratio

**Dominating effect of policies for legacy NPLs in the medium run and of those for new NPLs in the long run**

(Impact of coverage expectations in percentage points)

- ■ Coverage expectations on legacy NPLs
- ── Coverage expectations on new NPLs

**Credit losses**

**ROA**

**CET1 ratio**
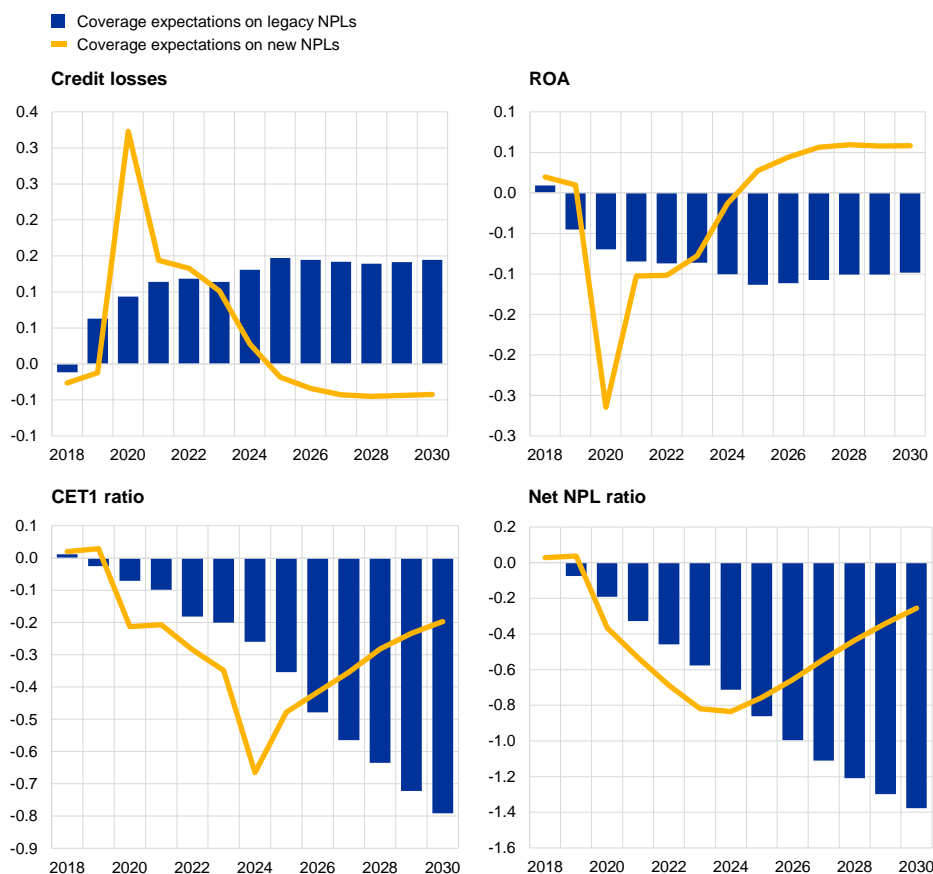
**Net NPL ratio**

Note: Credit losses are calculated as the sum of loan loss provisions and write-offs and are expressed in percentages of total assets. Impacts on the net NPL ratio are calculated for the total bank portfolio, including exposures to all sectors and countries. Results with immediate write-offs.

**The impact of the coverage expectations for new NPLs on banks' balance sheets and performance increases over time.** The coverage expectations for new NPLs have a low and relatively constant impact on bank profitability of about -0.1 percentage points of ROA (top right panel). The advantageous impact of the coverage expectations for new NPLs on net NPLs accumulates over time, with supervisory targets applying to an increasing share of non-performing assets. The reduction in the net NPL ratio relative to the no-policy change benchmark reaches 1.4 percentage points by 2030 (bottom right panel).
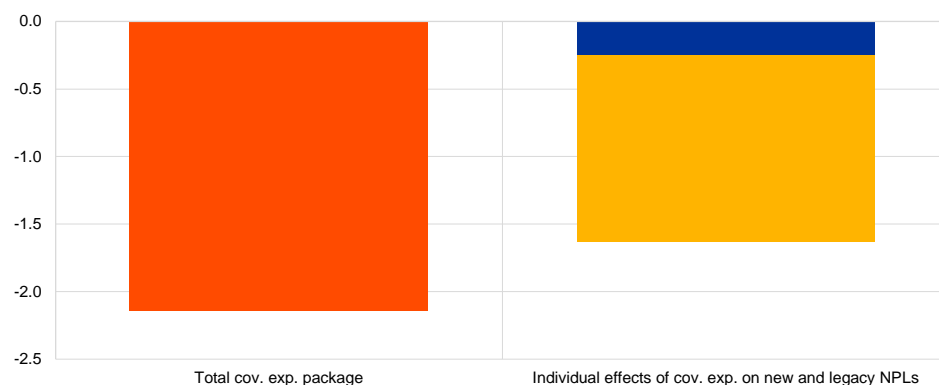
**Chart 9**

**Only the total coverage expectations package ensures a sizeable reduction in the net NPL ratio resulting in shorter right tails of the cross-bank distribution**
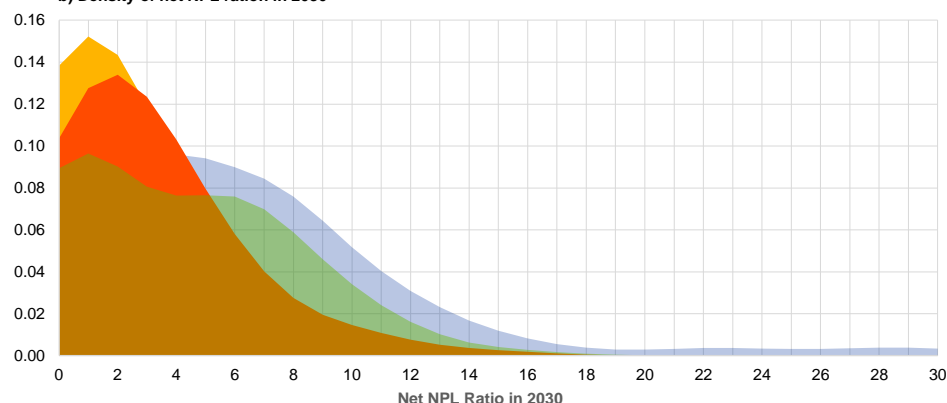
(Percentage points)

■ Cov.exp. on legacy NPLs
■ Cov.exp. on new NPLs
■ Total cov. exp. package

**a) Impact on net NPL ratio in 2030**



**b) Density of net NPL ration in 2030**

■ Without cov. exp.
■ Only cov. exp. on new NPLs
■ Only cov. exp. on legacy NPLs
■ Total cov. exp. package



Note: The impacts are shown for total net NPL ratio, including bank exposures to all sectors and countries. The right-hand side kernel density functions are estimated with gaussian kernels and bandwidth=2.

**Furthermore, the elements of the policy package are complementary in ensuring that banks across the system reach workable levels of NPLs.** Panel b of Chart 9 plots the distribution of NPL ratios of banks without the supervisory coverage expectations (blue area), with the coverage expectations for new and legacy NPLs (green area) and with the two elements of the coverage expectations separately (yellow and red area). The introduction of coverage expectations significantly shortens the right tail of the distribution, marking a significant reduction of net NPLs of banks which would otherwise hold the highest shares of NPLs on their balance sheets in 2030. Although coverage expectations for either new or legacy assets, introduced in isolation, would ensure such convergence of net NPL ratios within the system, the two policy proposals working in tandem lead to the strongest cutback in the dispersion of net NPL levels in the system.

**One source of the complementarity is that the coverage expectations for new and legacy NPLs substantially affect different banks.** Chart 10 compares the reduction in NPLs in 2030 measured relative to a regime without an NPL policy, assuming the working of the coverage expectations, for new NPLs (horizontal axis) and legacy NPLs only (vertical axis). A general conclusion from Chart 10 is that there is no clear relation between the impact of the two coverage expectations. With regard to the coverage expectations for legacy NPLs, banks with a low initial (2017) NPL ratio (blue dots) show little impact, and banks with the highest initial NPL ratio (in the top 75th percentile in 2017) show the largest reduction in NPL ratio (red dots). The remaining banks, with an initial NPL ratio between the 25th and 75th percentiles (yellow dots) show comparable benefits from both coverage expectations.

**Chart 10**

**Net NPL ratio impact – coverage expectations for new and legacy NPLs**

Low association between the impact of the two policies

(Impact on net NPL ratio in 2030 with Cov. Exp. for legacy NPL (y-axis) and for new NPL (x-axis) in percentage points)
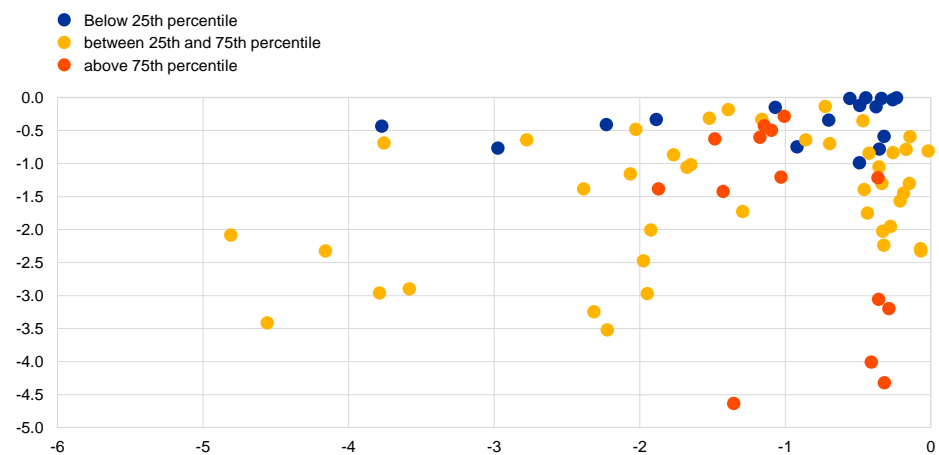


Note: Impacts on the net NPL ratio are calculated for the total bank portfolio, including exposures to all sectors and countries.

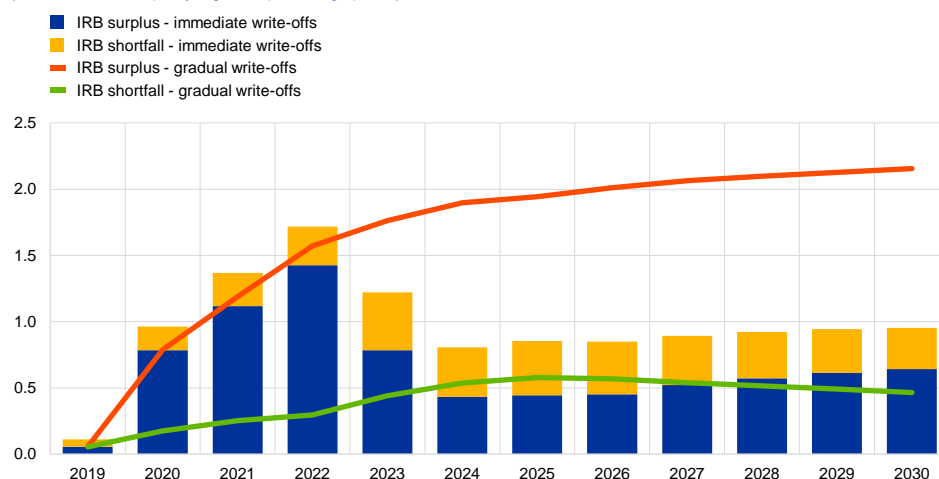## 5.2 Factors behind profitability and capital impact: IRB surplus/shortfall and funding costs

**The coverage expectations for NPLs will tend to increase a positive or reduce a negative impact of the IRB shortfall on banks' regulatory capital.** Banks using internal models to calculate credit risk are obliged to calculate the IRB surplus or shortfall for the affected assets. The latter is defined as the difference between the relevant loan loss provisions and the regulatory expected loss. If the accounting provisions exceed the regulatory expected loss amount (i.e. banks have a relatively sound loan loss provisioning policy) the difference may be added back to Tier 2 capital. But if the regulatory expected losses exceed the accounting provisions (i.e. banks' provisioning is relatively weak), the shortfall is deducted from regulatory CET1 capital. The coverage expectations will tend to increase the amount of provisions for IRB defaulted exposures and thus also the difference between loan loss provisions and the expected loss amount.

**Chart 11**

Contribution of IRB surplus to Tier 2 and IRB shortfall to CET1 capital ratios

IRB shortfall alleviates the impact of decreased profit on CET1

(Difference from no-policy regime in percentage points)

■ IRB surplus - immediate write-offs
■ IRB shortfall - immediate write-offs
— IRB surplus - gradual write-offs
— IRB shortfall - gradual write-offs



Notes: The IRB surplus and shortfall are measured in percentages of risk-weighted amounts and expressed in the chart as the difference (in percentage points) from a regime without an NPL policy in place. A positive contribution of the IRB shortfall means the shortfall is lower (less negative) and therefore positively contributes to the CET1 ratio

**Accordingly, IRB banks can at least partially compensate for a transitory reduction in capital ratios related to the phase-in of the coverage expectations.**
A reduction in the IRB shortfall for a share of banks will contribute positively to the system-wide CET1 ratio, with the maximum impact of 0.4 percentage points in 2023-26, as illustrated in Chart 11 with dark green bars (or dashed dark green lines for gradual write-offs). An increase in the IRB surplus for other IRB banks can add up to 1.4 percentage points (with immediate write-off of fully provisioned exposures, or 2 percentage points with their gradual write-off) to the system-wide Tier 2 capital ratio marked with light blue bars (and solid lines) in Chart 11. As a result, the Tier 2 capital ratio will tend to be higher than the no-policy change benchmark until 2023.

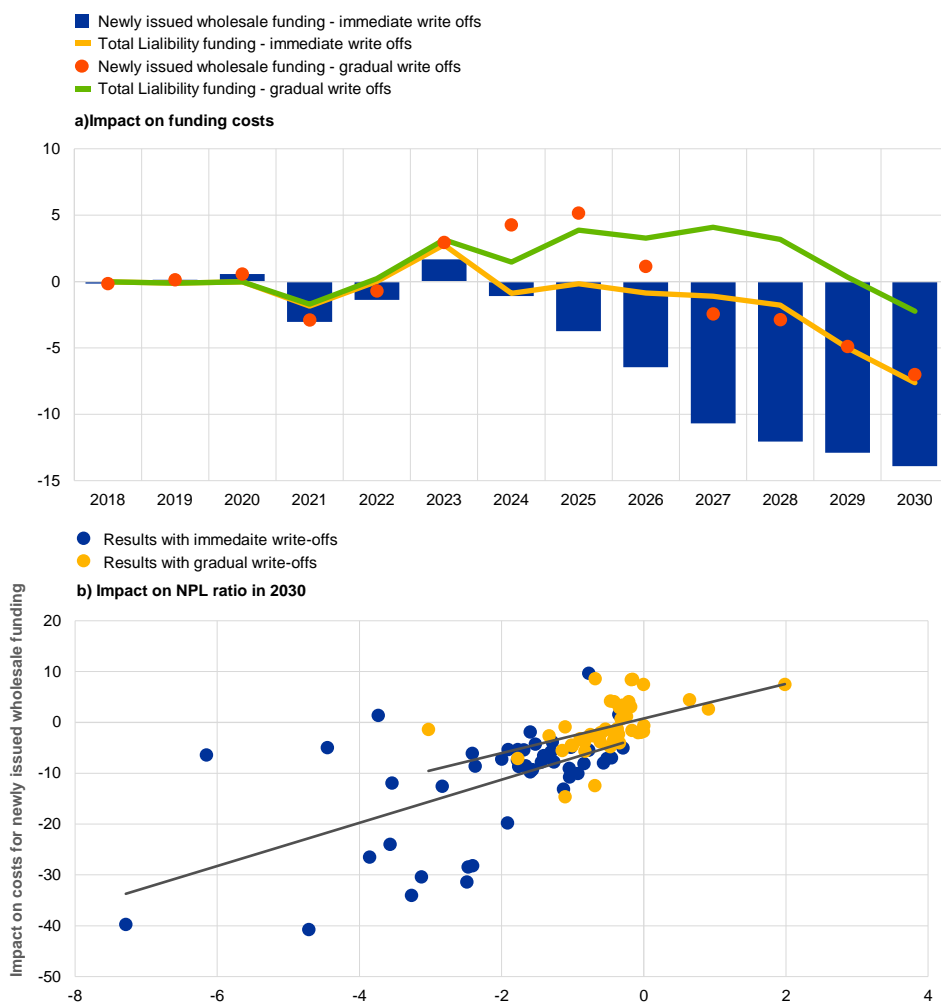**A decrease in the NPL burden on banks' balance sheets occasionally reduces bank funding costs.** Lower NPL ratios on banks' balance sheets reduce banks' perceived risk and depress the margins required by wholesale investors. As shown on panel a of Chart 12, the costs of newly issued wholesale funding[24] start decreasing in 2024, when we assume immediate write-offs of defaulted exposure (with gradual write-offs, the costs start decreasing later). For the total banking system, the costs of wholesale funding are reduced by about 15 basis points by 2030 (blue bars in **Chart 12, panel a**), resulting in 7 basis points lower overall funding costs (yellow line in **Chart 12, panel a**). Benefits with gradual write-offs are lower (up to 7 basis points lower costs of wholesale funding, and 3 basis points lower overall debt funding costs). The reduction in funding costs is positively associated with a decrease in the NPL ratio and is heterogeneous across banks, reaching up to 40 basis points when banks write off fully provisioned defaulted exposures immediately and up to 20 basis points with gradual write-offs (**Chart 12, panel b**).

---

[24]    Wholesale funding is composed of deposits by credit institutions, repos and debt securities.

**Chart 12**

Impact on funding costs

**Wholesale funding costs decrease up to 15 basis points increasing by banks NPL ratio reduction**

(Panel a: percentage points; panel b: percentage)

■ Newly issued wholesale funding - immediate write offs
▬ Total Lialibility funding - immediate write offs
● Newly issued wholesale funding - gradual write offs
▬ Total Lialibility funding - gradual write offs

**a)Impact on funding costs**



● Results with immedaite write-offs
● Results with gradual write-offs

**b) Impact on NPL ratio in 2030**



Note: Wholesale funding is composed of deposits by credit institutions, repos and debt securities. Total liability funding includes wholesale funding and deposits form households, non-financial corporates and government. Impacts on the NPL ratio are calculated for the total bank portfolio, including exposures to all sectors and countries. Wholesale funding is composed of deposits by credit institutions, repos and debt securities.

## 5.3    Factors behind the lending impact

**The adjustment costs are highest for banks with a high initial net NPL ratio and, accordingly, these banks will be the most likely to temporarily reduce their lending.** Panel b of Chart 13 documents a positive relationship between the initial net NPL ratio of individual banks and their yearly average credit losses in the years 2018-26. 2026 serves as a cut-off point since all the old stock of NPLs needs to be cleared by then and this could be an important trigger for a change in the dynamics of lending. Chart 13, panel a, demonstrates that banks that had a higher net NPL ratio in 2017 are likely to experience higher credit losses in the period 2018-26. Furthermore, it emphasises that banks with a relatively high net NPL ratio in
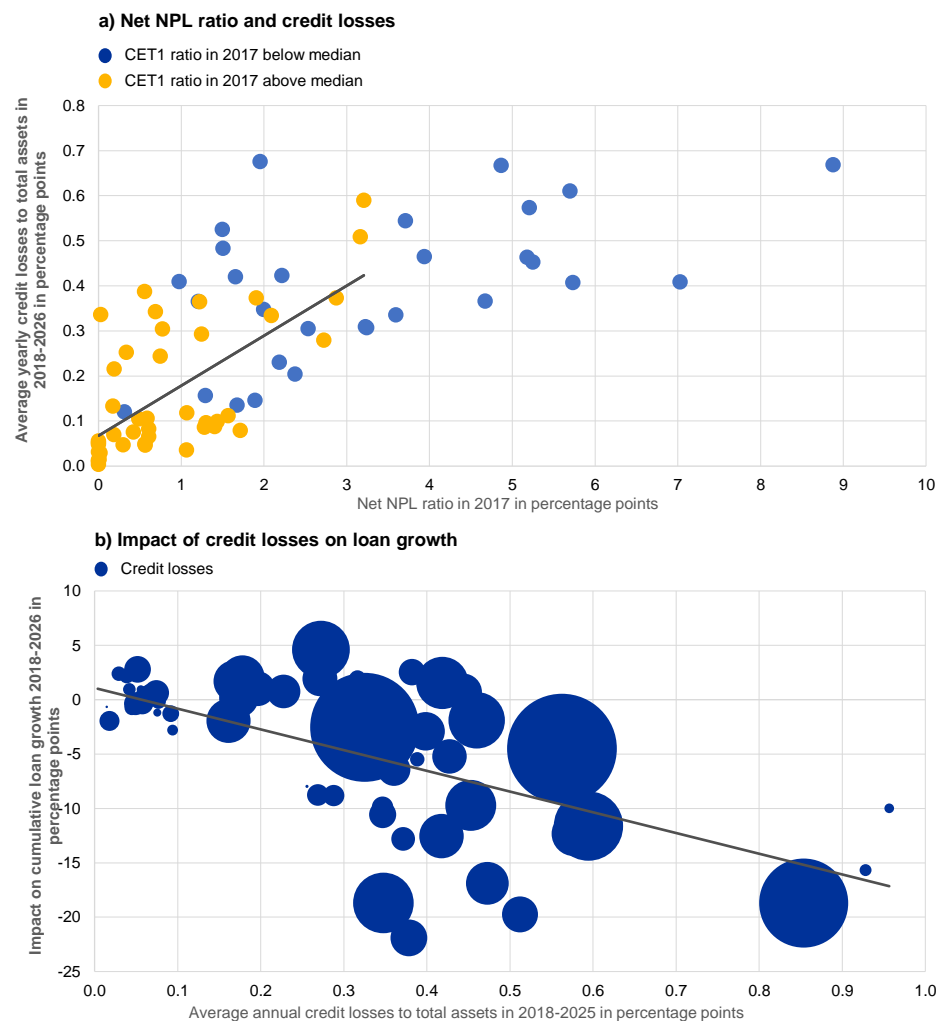
2017 frequently had a CET1 ratio below the median in 2017 (blue dots); this unfavourable association can amplify the costs of adjustment for high-NPL banks. Finally, panel b of Chart 13 depicts the relation between credit losses and cumulative credit growth in 2018-26, with outcomes measured as the difference from a regime without the NPL policies. It shows that banks strongly affected by the package in terms of profitability and capitalisation are the most reluctant to extend credit.

**Chart 13**

Credit losses versus initial level of NPLs and loan growth

**Banks with higher share of initial NPLs and larger credit losses are characterised by lower credit growth**

(Percentage points)

**a) Net NPL ratio and credit losses**

- CET1 ratio in 2017 below median
- CET1 ratio in 2017 above median



**b) Impact of credit losses on loan growth**

- Credit losses



Note: (Panel a) Average yearly credit losses are calculated as the average ratio of loan loss provisions and write-offs to total assets in 2018-26. The NPL ratio is measured in net terms in 2017 and includes banks' exposure to all sectors and countries. (Panel b) The size of the bubbles denotes the initial (2017) net NPL ratio. Average yearly credit losses are calculated as the average ratio of loan loss provisions and write-offs to total assets in 2018-26. Cumulative credit growth is measured in 2018-26 for the non-financial private sector.

**Lending drops more for banks that use the standardised approach to calculate the risk-weighted amount.** Banks that use only the standardised approach to credit risk experience lower lending dynamics, especially in the period 2021-24. Their annual loan growth rate is about 0.5 percentage points lower (assuming immediate
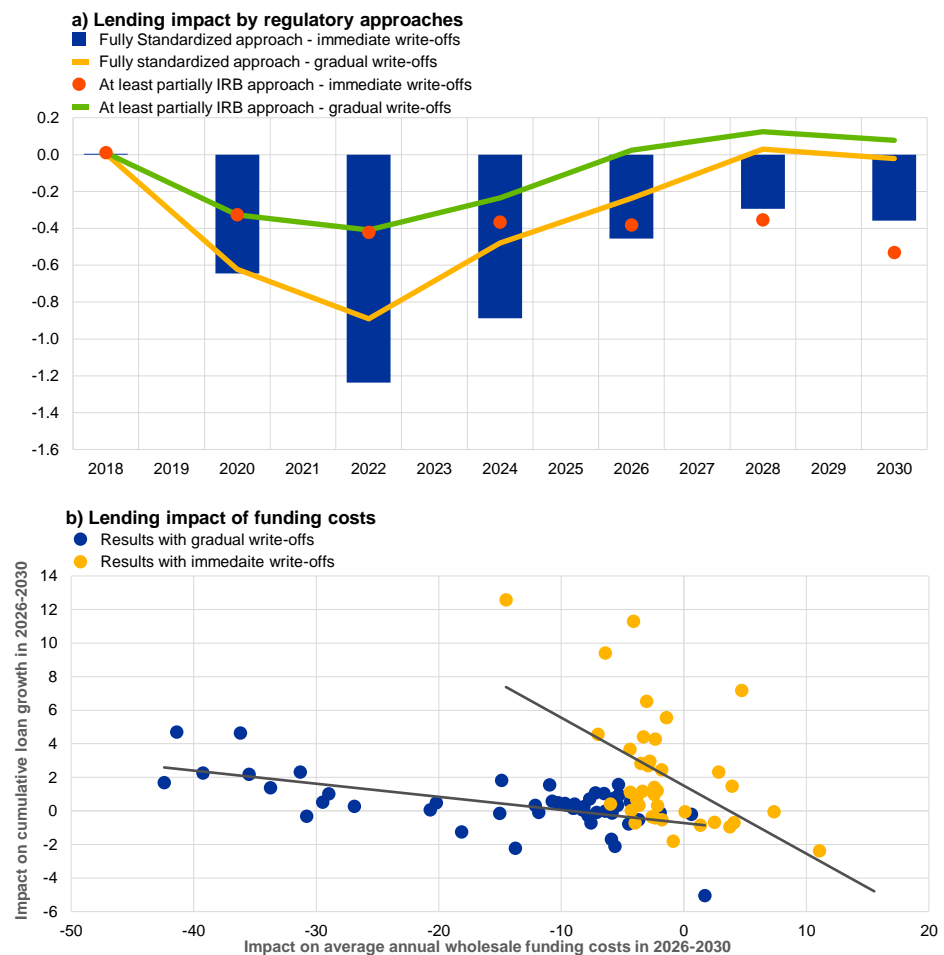
write-offs) compared with banks that use the IRB approach (**Chart 14, panel a**).The difference in cumulative terms over ten years amounts to 2.5 percentage points lower loan growth for banks using only a standardised approach and results, besides other possible structural differences between the two groups, from the alleviating impact of the IRB shortfall for the banks using the IRB approach. This difference in lending evolution between the two groups of banks is of a similar magnitude (2.5 percentage points over ten years) when gradual write-offs are assumed. However, in the latter case the impact on lending is more positive for both groups of banks, turning slightly positive for IRB banks from 2026 onwards.

**Chart 14**

Lending impact of funding costs and employed regulatory approaches

**Banks using IRB approach decrease loan supply by less**

(Percentage points)



**a) Lending impact by regulatory approaches**

- Fully Standardized approach - immediate write-offs
- Fully standardized approach - gradual write-offs
- At least partially IRB approach - immediate write-offs
- At least partially IRB approach - gradual write-offs



**b) Lending impact of funding costs**

- Results with gradual write-offs
- Results with immedaite write-offs

Note: (Panel-a) Loan growth is expressed in annual terms for the non-financial private sector. It is measured across two groups of banks: (1) banks that fully rely on the standardised approach to calculate the risk-weighted amount; and (2) banks that at least partially use the IRB approach. (Panel-b) The impact of loan growth is measured as the difference between loan growth to the non-financial private sector in the period 2026-30 with NPL policies in place and loan growth without the policies. The impact on average annual funding costs is expressed as the difference (in basis points) between average costs of wholesale funding in the period 2026-30 with policies in place and the outcomes without the policies.

**However, when the stock of NPLs is cleared banks start to lend more.** The vertical axis in Chart 15 shows the difference in cumulative loan growth between the two regimes. It is displayed separately for the periods 2018-26 (blue dots) and 2026-

30 (yellow dots). Note that blue dots on average lie higher and are more frequently above zero. On the other hand, the difference in loan growth in 2026-30 (yellow dots) lies more in the negative territory. This shows that there are some costs in terms of lower lending on the path to a low NPL regime, but once this NPL burden has been cleared banks start to increase loan supply. This is reflected in a new direction of the relation between loan growth and the NPL ratio after 2026. Banks whose NPL ratio decreased more until 2026 (more negative number on horizontal axis in Chart 15), lend slightly less in this period, but more afterwards. Unlike costs, that are only transitory, benefits are expected to persist in the long run. The persistence of benefits largely depends on when NPLs would be reduced to similar levels through banks' own policies.

**Chart 15**
**Difference in loan growth versus difference in NPL ratio, before and after 2026**

Negative effect of NPL policies on credit growth in the period 2018-26, but slightly positive afterwards when old NPLs are cleared

(Percentage points)
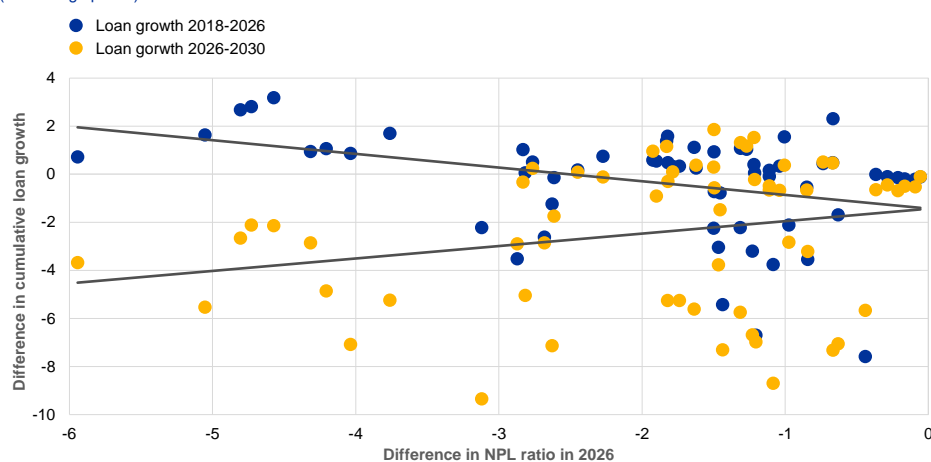


Notes: The results in the chart assume immediate write-offs of fully provisioned default exposure. The impact on loan growth is measured as the difference in loan growth to the non-financial private sector with NPL policies in place relative to the same outcomes without the policies. It is calculated separately for periods 2018-26 and 2026-30. The impact on the NPL ratio is measured in 2026 as the difference between the gross NPL ratio for the total bank portfolio with NPL policies in place relative to the outcome without the policies.

## 5.4 The heterogenous impact of the coverage expectations on lending sectors and jurisdictions

**The largest contribution to a lower net NPL ratio for the non-financial private sector comes from non-financial corporations (NFCs) and consumer credit (Chart 16).** Net defaulted exposure drops significantly by 2023 across all sectors, which results from the workings of the coverage expectations for legacy NPLs. In the long run, by 2030, both the net default exposure to NFCs and consumer credit are equal to 40% of their value in 2017. At the same time, both sectors also represent about 40% of the net default exposure in the absence of NPL policies in 2030, as the latter would remain fairly constant over time. On the other hand, the net default exposure on loans for house purchase decreases more slowly (30% by 2030), which results from the longer time span to fully provision new NPLs secured by real estate.

**Chart 16**

Net NPL ratio by sector

NPL ratio decreases most for NFCs and consumer credit

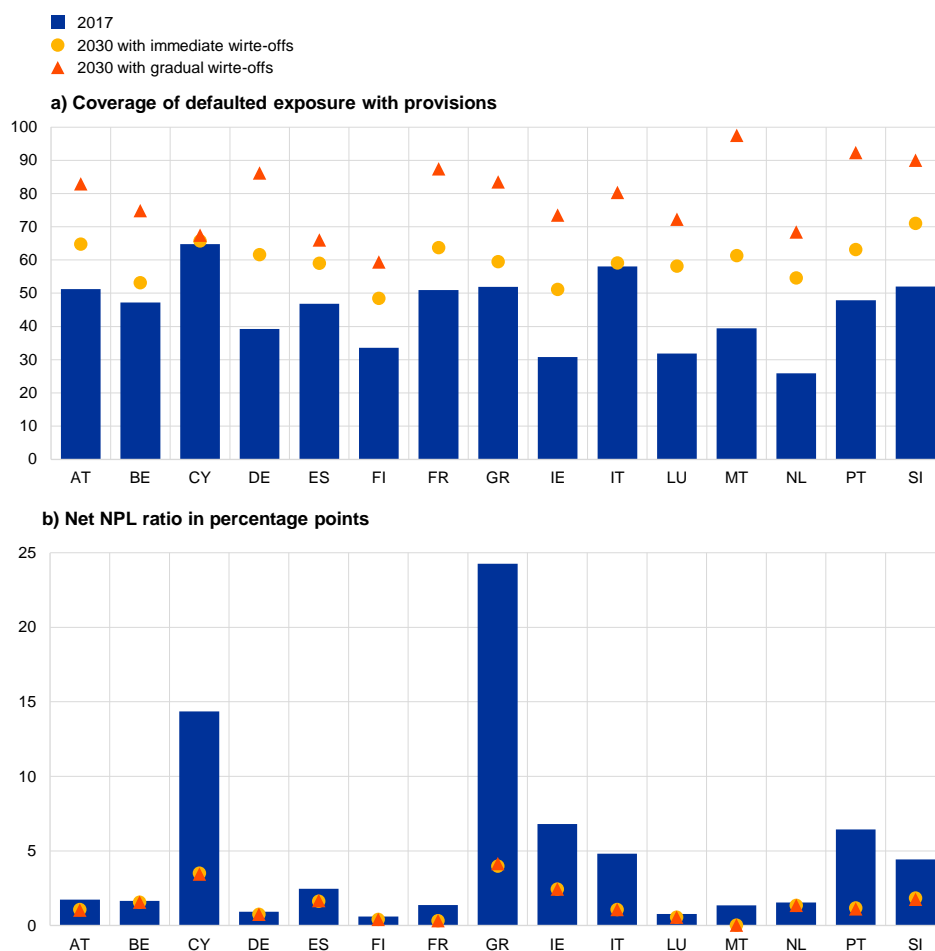(Net NPL ratio in percentage points)

■ NFC
■ HHCC
■ HHHP
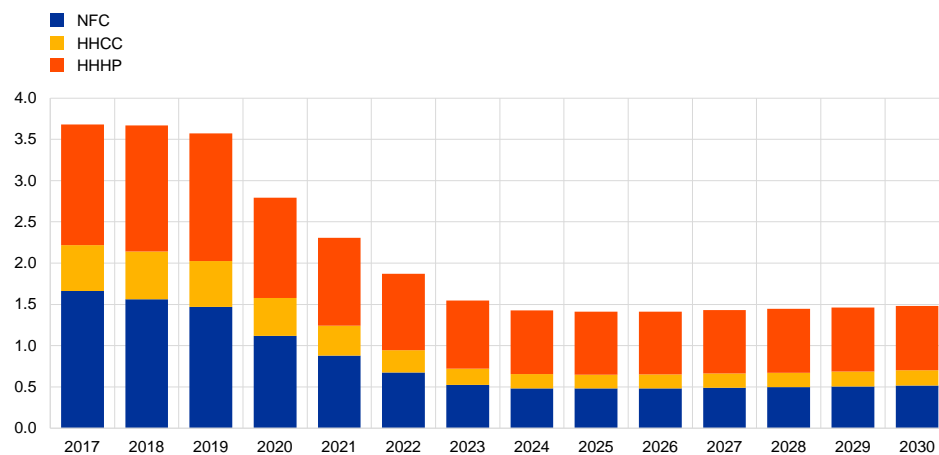


Notes: Sectoral decompositions show the contribution of each sector to the net NPL ratio for the non-financial private sector. The calculation includes banks' exposures to euro area countries. HH stands for households and NFC for non-financial corporations.

**The NPL coverage expectations ensure more comparable coverage by provisions across jurisdictions.** Panel a of Chart 17 shows coverage of defaulted exposure with loan loss provisions measured in 2017 and in 2030 under both assumptions about the timing of write-offs. The coverage ratio in 2017 was very dispersed, ranging from 25% in the Netherlands to 65% in Cyprus. NPL policies lead to higher coverage by provisions and at the same time ensure similar treatment of NPLs across different jurisdictions, resulting in close to 60% coverage of defaulted exposure by provisions for all the countries once the old defaulted exposure is cleared from bank balance sheets (assumption of immediate write-offs). With gradual write-offs, the coverage ratio in 2030 is higher because a large part of highly provisioned old default stock remains on bank balance sheets.

The NPL policy package ensures comparable coverage of defaulted exposure by provisions across countries while NPL ratios drop more in case of larger initial stock

■ 2017
● 2030 with immediate wirte-offs
▲ 2030 with gradual wirte-offs

**a) Coverage of defaulted exposure with provisions**



**b) Net NPL ratio in percentage points**



Note: (Panel-a) Coverage by provisions is shown for banks' total exposure including all sectors and countries. (Panel-b) The net NPL ratio is calculated for banks' total exposure including all sectors and countries.

**The coverage expectations result in a significant decrease in NPLs, especially in high-NPL euro area countries.** The NPL coverage expectations lead to a larger decrease in net defaulted exposures in initially high-NPL countries, mostly owing to the impact of the coverage expectations on legacy NPLs, which encourages the write-off of old defaulted exposures by the end of 2026. Hence, the net NPL ratio decreases the most for Greece, Cyprus, Ireland, Italy, Portugal and Slovenia, which are all countries that were heavily burdened with NPLs after the financial crisis (**Chart 17, panel b**). The conclusion is the same, irrespective of the timing of write-offs, as highly provisioned defaulted exposure that remains on banks' balance sheets contributes very little to the net NPL ratio.

## 5.5    Alternative scenarios

**The COVID-19 developments exemplify the uncertainties surrounding the phase-in of any policy package.** A reasonable assumption underlying the phase-in of most supervisory or regulatory measures is that the economy will follow its stable growth path throughout the transition. An early recession, such as the one triggered by the COVID-19 pandemic, has the potential to amplify the costs of a new policy. In fact, the coverage expectations for new and legacy NPLs permit enough discretion to allow a supervisor to alleviate the burden of the NPL coverage expectations in such a contingency, and such discretion was actively applied in 2020.

**The need to carve out enough conditionality can be justified ex ante by studying adverse but plausible economic developments during the phase-in of the coverage expectations.** In order to illustrate this point, we seek episodes of a possible recession in the early period of the implementation of the NPL policy package from the full distribution of all plausible economic scenarios, as given by the starting point and the estimated macroeconomic structural shock distribution in 2017.

**Alternative scenarios are selected from the full distribution of simulated macroeconomic and bank-level outcomes.** In line with the narrative of an early severe recession in 2020, individual simulated paths are sorted according to their contraction in economic activity, which is proxied by the decline in euro area GDP in 2020. The selected scenarios are all consistent with a severe recession narrative, although they differ with regard to the evolution of other macroeconomic variables and the exact timing or magnitude of shocks. By deriving a mean path combining the highest ranked subset of the sorted distribution, we average out the differences between alternative paths, while taking full account of parameter and scenario uncertainty.

**Chart 18**
GDP growth in the baseline scenario and in an early recession

A severe recession materializes in 2020 for the adverse scenario

(GDP growth year on year in percentage points)

- 25th-75th percentile range of adverse scenarios
- Mean adverse scenario
- Baseline scenario
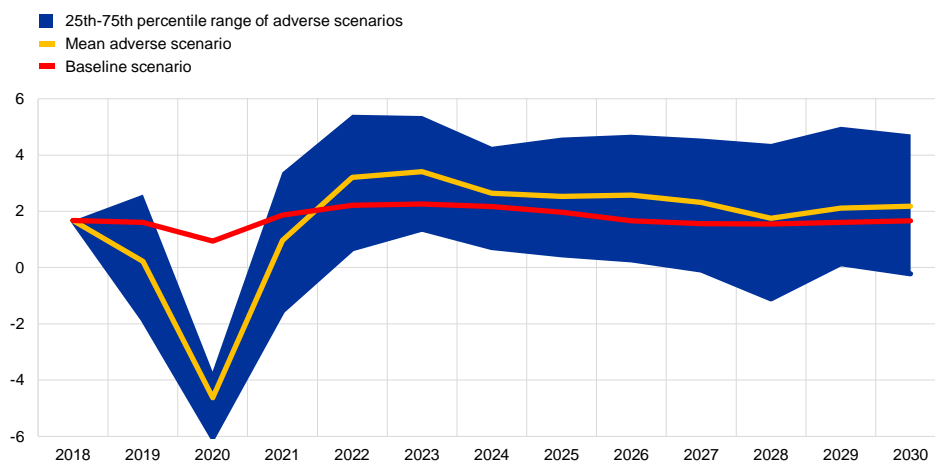


Notes: The shaded area shows the 25th–75th percentile range of GDP growth across all the selected individual adverse scenarios. GDP paths are displayed for simulations without NPL policies.

**The adverse scenarios resemble an early deep recession hitting the euro area economy in 2020.** Under the mean adverse scenario, euro area GDP is projected to contract by close to 5% in 2020 on an annual basis. Later, GDP growth recovers and fluctuates around 2-3% annually, which is slightly above the stable GDP growth of around 2% annually in the baseline scenario (**Chart 18**). Despite this fast recovery, GDP in 2030 is still 3% lower in the mean adverse scenario than in the baseline.

**Interestingly, the phase-in of the coverage expectations results in a faster recovery from the crisis compared with conditions in the absence of an NPL policy.** The impact on GDP is positive after 2027 for both scenarios and both write-off options (**Chart 19, panel a**). These positive impacts are higher for the simulations of being in an early recession than in baseline conditions, which shows that, despite higher transitory costs, the NPL coverage expectations also lead to a faster recovery, enabled by the timely provisioning and clearance of defaulted exposures.

**Chart 19**

Impact on GDP and lending in an early recession versus baseline economic conditions

Early recession can increase the costs of phase-in of the NPL coverage expectations, but also results in faster recovery of output growth afterwards

■ Cov. Expectations + gradual write offs
■ Cov. Expectations + immediate write offs
▬ Mean impact in an early recession
● Impact in baseline economic conditions

**a) Impact on GDP**
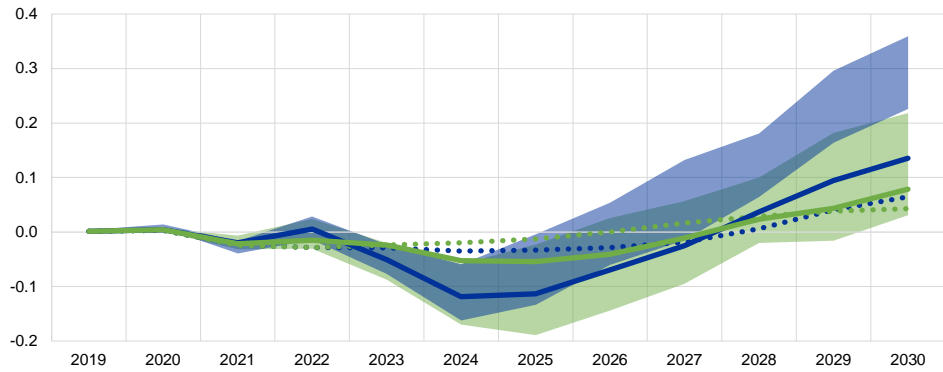


**b) ) Impact on loan growth in percentage points**
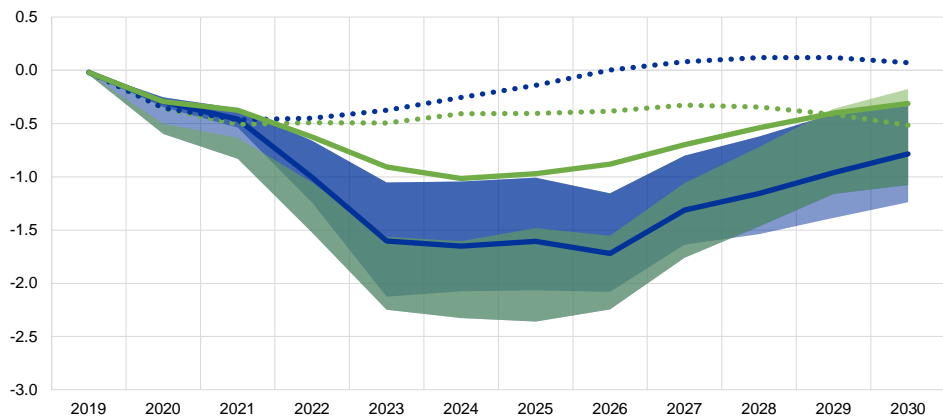


Note: The shaded areas show the 25th–75th percentile range of the impact under all the selected scenarios. Lines represent mean impact across all the "early recession" scenarios, whereas dots represent the impact under normal economic conditions, which is the same as the one presented in Section 4. The impact on loan growth is displayed for the non-financial private sector. The impacts on GDP and lending are measured relative to outcomes without NPL policies in place.

# 6 Conclusions and policy implications

**The analysis presented in this report focuses on the combined impact of the coverage expectations for new and legacy NPLs on euro area banks' stock of NPLs and on their profitability and lending.** The two policy measures are expected to bring down the share of NPLs in banks' portfolios of loans to the non-financial private sector from 4% in 2017 to a sustainable level of around 2% in 2030. The costs of the policies are highest in the phase-in period between 2020 and 2025. Bank profitability is estimated to be around 0.2 percentage points lower in this period, compared with a counterfactual scenario without the policies in place. The impact on bank lending is expected to be moderate. The estimated growth in lending volumes to the non-financial private sector is 0.4 percentage points lower compared to a regime without the NPL policies. The policies have limited impact on aggregate economic conditions, with GDP growth being only marginally lower between 2020 and 2024.

**From 2026 onwards the negative impact declines.** The impact of the policy package on bank profitability is estimated to be considerably lower after 2026, which can be primarily attributed to the coverage expectations for new NPLs. At the same time, the lower stock of NPLs would allow banks to increase loan supply, resulting in a less negative impact of the policy package on bank lending.

**The study exposes the mechanics of the two NPL policies, emphasises their differences, and reveals the synergies.** The coverage expectations for new NPLs target the flows of new NPLs and their impact on banks' NPL holdings, profitability and lending is relatively smoothly distributed across time: while sluggish in the initial phase, the impact grows in the long term. Ultimately, the effect of this policy will go beyond the 2020-30 time horizon. The analogous effects of the coverage expectations for legacy NPLs are highly concentrated in the medium-term time horizon.

**The use of a semi-structural model with individual bank behavioural responses enables us to capture some salient aspects of the policy package.** The approach reveals features of the policies that would be difficult to pin down in a constant balance sheet setup or at an aggregate sector level. First, the model puts the level of supervisory provisioning and write-offs into perspective, by comparing them with voluntary write-offs, estimated at the bank level. Second, the model provides insights into the response of the banking sector beyond the direct impact of the policy package on the sector's profits and regulatory capital ratios. It shows that as soon as the stock of NPL is substantially reduced, banks' funding costs decrease, while lending remains only moderately affected. This leads to the conclusion that the policies can be associated with long-term benefits, outweighing the short- to mid-term costs.

**Finally, the model emphasises the significance of the bank-level heterogeneity for the pass-through of the measures.** The ways in which this is manifested include the importance of the initial NPL ratio for the level of credit losses over the

studied horizon (the higher the ratio, the higher the losses) and the dependency of the magnitude of the decrease in regulatory capital on banks' use of internal models for regulatory compliance (banks using the standardised approach experience a larger drop in the CET1 ratio than IRB banks).

**Counterfactually and inflexibly phasing in the NPL package during an early recession would amplify the transitory costs of the policy.** An attractive feature of the model is that it enables us to test the policy impact under various economic conditions, including severe adverse economic developments resembling the effects of the recent pandemic. The NPL coverage expectations remain effective in reducing NPL stock amid an ongoing recession. However, they would pose a challenge for institutions struggling with the impact of adverse macroeconomic developments and intensifying lending contraction. This result justifies the exercise of reasonable discretion by the ECB in the application of the coverage expectations in 2020. In particular, in March 2020 the ECB announced it would provide banks with sufficient flexibility in the application of the coverage expectations to take into account the adverse conditions caused by the COVID-19 pandemic.[25]

**This notwithstanding, a reduction of the stock of NPLs on banks' balance sheets facilitates a quicker recovery.** Banks can more effectively increase their lending volumes with a lower level of non-performing legacy assets. One interpretation of the finding is the need for a careful balancing of supervisory judgement in a crisis. Another interpretation is a possible expansion of NPL policies beyond the coverage expectations to reduce the NPL burden on banks and support economic recovery.

**It should be borne in mind that a number of shortcomings will tend to inflate the short-term costs of the coverage expectations.** The analysis is designed as an ex ante exercise which focuses on a narrow subset of many policies taken to tackle the high NPL burden of European banks. The ex ante nature of the assessment is a good representation of the intentions of policymakers at the time of the policy announcement and illustrates the merits of model-based policy advice. However, it also means that information is not updated following the cut-off point (the end of 2017) and factors such as a pronounced reduction in the stock of NPLs between 2017 and 2019 − i.e. before the supervisory expectations on legacy NPLs − cannot be fully considered. The inability to include guidelines, including those in the NPL Guidance, which cannot be translated into quantifiable rules equivalent to model mechanisms, means that positive interactions between these actions are left outside the analysis. Accordingly, the analysis abstracts from sell-offs of NPLs and the establishment of an efficient secondary market for NPL assets in response to banks' willingness to sell these assets at highly discounted prices.

**A possibly less important caveat is that the study also relies on several assumptions that can affect the selected results.** The behavioural equations explaining the evolution of bank balance sheets, although aimed at achieving the closest possible representation of economic reality, are still subject to model

---

[25] See ECB press release of 12 March 2020, "ECB Banking Supervision provides temporary capital and operational relief in reaction to coronavirus".

uncertainty. The analysis covers only the largest banks in the euro area, with a relatively high share of NPLs staying on the balance sheets of smaller euro area banks. The costs of NPL policies may be overstated due to the assumption that banks do not receive the value of collateral on loans that have long defaulted.

# References

Adrian, T., Grinberg, F., Liang, N. and Malik, S. (2018), "The Term Structure of Growth-at-Risk", *IMF Working Paper*, No 18/180, July.

Aiyar, S., Bergthaler, W., Garrido, J.M., Ilyina, A., Jobst, A., Kang, K., Kovtun, D., Liu, Y., Monaghan, D. and Moretti, M. (2015), "A Strategy for Resolving Europe's Problem Loans", *IMF Staff Discussion Note*, No 15/19, Washington, September.

Ari, A., Chen, S. and Ratnovski, L. (2020), "The dynamics of non-performing loans during banking crises: a new database", *Working Paper Series*, No 2395, ECB, Frankfurt am Main, April.

Beck, T. (2017), "An asset management company for the Eurozone: Time to revive an old idea", VOXEU.

Budnik, K., Balatti, M., Dimitrov, I., Groß, J., Hansen, I., di Iasio, G., Kleemann, M., Sanna, F., Sarychev, A., Siņenko, N. and Volk, M. (2019), "Macroprudential stress test of the euro area banking system", *Occasional Paper Series*, No 226, ECB, Frankfurt am Main, July.

Budnik, K., Balatti, M., Dimitrov, I., Groß, J., Kleemann, M., Reichenbachas, T., Sanna, F., Sarychev, A., Sinenko, N. and Volk, M. (2020), "Banking euro area stress test model", *Working Paper Series*, No 2469, ECB, Frankfurt am Main, September.

Budnik, K., Dimitrov, I., Giglio, C., Groß, J., Lampe, M., Sarychev, A., Tarbe, M., Vagliani, G. and Volk, M. (2021), "The growth-at-risk perspective on the system-wide impact of Basel III finalisation in the euro area", *Occasional Paper Series*, No 258, ECB, Frankfurt am Main, July.

Duffie, D. (1999), "Credit Swap Valuation", *Financial Analysts Journal*.

EBA (2019), "EBA report on NPLs. Progress made and challenges ahead", report.

EBA (2018), Guidelines on management of non-performing and forborne exposures (EBA/GL/2018/06), October.

Fell, J., Grodzicki, M., Martin, R. and O'Brien, E. (2016), "Addressing market failures in the resolution of non-performing loans in the euro area", *Financial Stability Review*, ECB, November.

Fell, J., Moldovan, C. and O'Brien, E. (2017), "Resolving non-performing loans: a role for securitisation and other financial structures?", *Financial Stability Review*, ECB, May.

Grodzicki, M., Laliotis, D., Leber, M., Martin, R., O'Brien, E. and Zboromirski, P. (2015), "Resolving the legacy of non-performing exposures in euro area banks", *Financial Stability Review*, ECB, May.

IMF (2017), "Global Financial Stability Report", Chapter 3, October.

Kalemli-Ozcan, S., Laeven, L. and Moreno, D. (2015), "Debt overhang, rollover risk and investment in Europe", mimeo.

Prasad, A., Elekdag, S., Jeasakul, P., Lafarguette, R., Alter, A., Xiaochen Feng, A. and Wang, C. (2019), "Growth at Risk: Concept and Application in IMF Country Surveillance", *IMF Working Paper*, No 19/36, February.

Wang, Y. and Yao, Y. (2001), "Measuring Economic Downside Risk and Severity: Growth at Risk", *World Bank Policy Research Working Paper*, No 2674.

# Appendix: Model description

**This appendix discusses the modelling of the supervisory coverage expectations within the Banking Sector Euro Area Stress Test Model (BEAST).** The model is described in detail in Budnik et al. (2020) and some of the extensions of the model including the approach taken for stochastic simulations are summarised in Budnik et al. (2021).

## A1 Write-offs

**Banks write off a certain fraction of their NPLs even in the absence of the supervisory coverage expectations.** This propensity of banks to write off certain loans is estimated on the basis of quarterly data from supervisory statistics (FINREP) starting in 2018. The write-off rate ($WRITEOFFS_r$) is modelled following a tobit specification using data for non-financial corporations, households, financial and sovereign exposures and the following dependent variables:

- share of non-performing loans (+);

- share of default exposure older than one year (+);

- coverage of default exposure with loan loss provisions (+);

- return-on-assets (+);

- and several interaction terms between the variables above.

**Write-offs take place each quarter after the realisation of new defaults but before the building up of loan loss provisions.** In the absence of the supervisory coverage expectations, loans which are written off are assumed to be provisioned on the average level of the defaulted portfolio. Total $WRITEOFFS_{it}$, understood as the nominal value of loans written off, are deducted from the profit of a bank. Then we can write (cf. equation (38) in Appendix B, Budnik et al., 2020):

$$
\begin{aligned}
PROVSTOCKDEF_{i,t} = & \left( 1 \ - \ TR_{31_{i,t}} \ - \ TR_{32_{i,t}} \ - \right. \\
& \left. WRITEOFFS_{r_{it}} \right) DEFEXP_{i,t-1} \ LR_{33_{i,t}} \ + \ TR_{13_{i,t}} \ NONDEFEXP_{S1_{i,t-1}} \ LGD_{13_{i,t}} \ + \\
& TR_{23_{i,t}} \ NONDEFEXP_{S2_{i,t-1}} \ LGD_{23 \ i,t}
\end{aligned} \quad (1)
$$

And further (cf. equation (21) in Appendix B, Budnik et al., 2020):

$$
\begin{aligned}
DEFEXP_{i,t} = & \left( 1 \ - \ TR_{31_{i,t}} \ - \ TR_{32_{i,t}} \ - \ WRITEOFFS_{r_{it}} \right) DEFEXP_{i,t-1} \\
& + \ TR_{13_{i,t} \, NONDEFEXP_{S1_{i,t}}} \ + \ TR_{23_{i,t}} \ NONDEFEXP_{S2_{i,t}}
\end{aligned} \quad (2)
$$

$$WRITEOFFS_{it} = WRITEOFFS_{\text{r}_{it}} \; DEFEXP_{\text{i,t}-1} \qquad (3)$$

- **The timing of the model, including the write-offs, is described in Figure A.1**:

**Figure A.1**
Timing of changes in the banking book



The equation of $OUTFLOWS$ (see equation (24) in Appendix B, Budnik et al. 2020) is modified accordingly:

$$OUTFLOWS_{i,t} = \left(0.25 - AVGDURATION_{i,t}\right)\left(\left(\left(1 - TR_{13_{i,t}}\right)NONDEFEXP_{S1_{i,t-1}} + \left(1 - TR_{23_{i,t}}\right)NONDEFEXP_{S2_{i,t-1}} + \left(TR_{31_{i,t}} + TR_{32_{i,t}}\right)DEFEXP_{i,t-1}\right) + WRITEOFFS_{i,t}\right) \qquad (4)$$

## A2. Introducing the supervisory coverage expectations

**The NPL coverage expectations require a granular split of defaulted exposures.** Defaulted exposures in the model are split into new NPLs (NEW) and legacy NPLs (OLD). The new default stock is further split into unsecured (UNSEC), secured by real estate (SECRES) and secured by other collateral (SECOTH), whereas legacy default stock is split into unsecured (UNSEC) and secured (SEC) part of exposure. This results in the creation of the following variables:

- $DEFEXP_{UNSEC_{OLD_{i,t}}}$ – unsecured exposures that defaulted before Q2 2018

- $DEFEXP_{SEC_{OLD_{i,t}}}$ – secured exposures that defaulted before Q2 2018

- $DEFEXP_{UNSEC_{NEW_{i,t}}}$ – unsecured exposures that defaulted in Q2 2018 or afterwards

- $DEFEXP_{SECOTH_{NEW_{i,t}}}$ – exposures that defaulted in Q2 2018 or afterwards, secured with collateral other than residential property

- $DEFEXP_{SECRES_{NEW_{i,t}}}$ – exposures that defaulted in Q2 2018 or afterwards Q2 2018, secured with residential property

where it holds that:

$$DEFEXP_{it} = DEFEXP_{UNSEC_{NEW_{i,t}}} + DEFEXP_{SECRES_{NEW_{i,t}}} + DEFEXP_{SECOTH_{NEW_{i,t}}} \\ + DEFEXP_{UNSEC_{OLD_{i,t}}} + DEFEXP_{SEC_{OLD_{i,t}}} \quad (5)$$

Analogous equations will hold for the stocks of provisions:

$$PROVSTOCKDEF_{i,t} \\ = PROVSTOCK_{UNSEC_{NEW_{i,t}}} + PROVSTOCK_{SECOTH_{NEW_{i,t}}} \\ + PROVSTOCK_{SECRES_{NEW_{i,t}}} + PROVSTOCK_{SEC_{OLD_{i,t}}} \\ + PROVSTOCK_{UNSEC_{OLD_{i,t}}} \quad (6)$$

**The write-off rates can differ for new and legacy NPLs.** $WRITEOFFS_{NEW_r}$ will be applied to all new defaulted exposures (irrespective of their collateralisation) and $WRITEOFFS_{OLD_r}$ to legacy defaulted assets (Section A.4 explains their calculation in more detail).

**The variables are initiated on the basis of the information from supervisory reporting (FINREP).** FINREP information from the end of 2017 serves to calibrate the initial share of secured versus unsecured exposures in the stock of individual banks' NPLs. The new defaulted exposures and the corresponding loan loss provisions are initiated as zeros.

## A21 Coverage expectations for new NPLs

**The implementation of the coverage expectations for new NPLs assumes a gradual build-up of provisions from the moment of their default until the deadline set by the Addendum to the NPL Guidance.** At the moment of its default, the loan is first provisioned at the level derived from the empirical loss given default (LGD) or loss rate (LR) equations (depending on the IFRS 9 stage in which the loan was previously classified) and the corresponding loan loss provisions enter $PROVSTOCKDEF_{TYPE_{NEW}}$. The difference between the value of the loan and these initial provisions, which describes provisions which will still have to be built for this exposure (in the absence of its recovery), is added to the shadow fund $PROVSTOCKDEFDUE_{TYPE_{NEW}}$. In the next quarters, the provisions on the loan are increased linearly until, for example, the end of the third year for unsecured exposures, which will be mapped by increasing $PROVSTOCKDEF_{TYPE_{NEW}}$ and reducing $PROVSTOCKDEFDUE_{TYPE_{NEW}}$. The moment the loan reaches 100% provisioning, it is either written off immediately (immediate write-offs) or moved to another shadow fund $WRIOFFNEWDUEEXP_{TYPE}$ and queued for a write-off.

**The new defaulted exposures start to build up from Q2 2018 onwards.** With $TYPE = \{UNSEC, SECRES, SECOTH\}$ the equation for the new defaulted exposures

will include the elements of the transition matrix and the share of relevant exposures $SHARE_{TYPE}$, which is assumed to be constant over time.

$$
\begin{aligned}
DEFEXP_{TYPE_{NEW_{i,t}}} &= \left( 1 \ - \ TR_{31_{i,t}} \ - \ TR_{32_{i,t}} \right. \\
&\quad - \ WRITEOFFS_{NEW_{r_{i,t}}} \left. \right) DEFEXP_{TYPE_{NEW_{i,t-1}}} \\
&\quad + \ TR_{13_{i,t}} \ SHARE_{TYPE} \ NONDEFEXP_{S1_{i,t-1}} \\
&\quad + \ TR_{23_{i,t}} \ SHARE_{TYPE} \ NONDEFEXP_{S2_{i,t-1}} \\
&\quad - \ WRITEOFFS_{TYPE_{NEW_{i,t}}} \qquad\qquad (7)
\end{aligned}
$$

There are two types of write-off variables in equation (7). Loans which are written off as a result of the application of $WRITEOFFS_{NEW_r}$ are, at the moment of write-off, provisioned at the average defaulted portfolio level. $WRITEOFFS_{TYPE_{NEW}}$ corresponds with loans which are already fully provisioned at the moment of write-off and their write-off will reduce the special shadow fund $PROVSTOCKDEFDUE_{TYPE_{NEW}}$.

**New defaults trigger changes in the actual and shadow loan loss provisioning funds**:

$$
\begin{aligned}
PROVSTOCKDEF_{TYPE_{NEW_{i,t}}} &= \left( 1 - TR_{31_{i,t}} - TR_{32\ _{i,t}} - \right. \\
WRITEOFFS_{NEW_{r_{i,t}}} &\left. \right) PROVSTOCKDEF_{TYPE_{NEW_{i,t-1}}} + \\
TR_{13_{i,t}} \ SHARE_{TYPE} NONDEFEXP_{S1_{i,t-1}} \ & LGD_{13_{i,t}} + \\
TR_{23_{i,t}} \ SHARE_{TYPE} \ NONDEFEXP_{S2_{i,t-1}} \ & LGD_{23_{i,t}} \ + \\
PROVTRANCHEDEF_{TYPE_{NEW_{i,t}}} \ & - \ WRITEOFFS_{TYPE_{NEW_{i,t}}} \qquad (8)
\end{aligned}
$$

where the first part of the expression, i.e. $\left( 1 - TR_{31_{i,t}} - TR_{32\ _{i,t}} - \right.$ $WRITEOFFS_{NEW_{r_{i,t}}} \left. \right) PROVSTOCKDEF_{TYPE_{NEW_{i,t-1}}}$, describes a carry-over of provisions from the previous period (for the defaulted exposures that have been neither cured nor written off in the reference period), and $TR_{13_{i,t}} \ SHARE_{TYPE} \ LGD_{13_{i,t}}$ and $TR_{23_{i,t}} \ SHARE_{TYPE} \ NONDEFEXP_{S2_{i,t-1}} \ LGD_{23_{i,t}}$ describe an inflow of provision for newly defaulted loans.

$$
\begin{aligned}
PROVSTOCKDEFDUE_{TYPE_{NEW_{i,t}}} &= \left( 1 \ - \ TR_{31_{i,t}} \ + \right. \\
TR_{32_{i,t}} &\left. \right) PROVSTOCKDEFDUE_{TYPE_{NEW_{i,t-1}}} + \\
TR_{13_{i,t}} \ NONDEFEXP_{S1_{i,t-1}} \ & SHARE_{TYPE} \left( 1 \ - \ LGD_{13_{i,t}} \right) + \\
TR_{23_{i,t}} \ NONDEFEXP_{S2\ _{i,t-1}} \ & SHARE_{TYPE} \left( 1 \ - \ LGD_{23\ _{i,t}} \right) \quad - \\
PROVTRANCHEDEF_{TYPE_{NEW_{i,t}}} & \qquad\qquad (9)
\end{aligned}
$$

Here, new defaults trigger an increase in the shadow fund by $\left( 1 - LGD_{13_{i,t}} \right)$ or $\left( 1 - LGD_{23\ _{i,t}} \right)$ of the value of defaulted exposures. $PROVTRANCHEDEF_{TYPE_{NEW}}$, which is added to (8) but deducted from (9), captures the quarterly build-up of provisions flows on loans that defaulted a time ago and are already under the supervisory expectations calendar.

**The build-up of provisions under the supervisory expectations within the supervisory deadlines for new NPLs is linear.** This calendar parameter will be denoted by Ω_TYPE and describes the number of quarters given by the supervisor to ensure full provisioning of a loan: 12 for unsecured loans, 28 for secured exposures backed by other collateral, and 36 for secured exposures backed by residential property. Then:

$$
\begin{aligned}
&PROVTRANCHEDEF_{TYPE_{NEW_{i,t}}} \\
&= \frac{\left(1 - TR_{31_{i,t}} - TR_{32_{i,t}}\right)PROVSTOCKDEFDUE_{TYPE_{NEW_{i,t-1}}}}{\left(\Omega_{TYPE} - 0.5\right.} \\
&\left.- DEFMATURITY_{TYPE_{NEW_{i,t-1}}}\right) \qquad (10)
\end{aligned}
$$

With the average time since default of loans $DEFMATURITY_{TYPE_{NEW}}$ being updated each quarter as follows:

$$
\begin{aligned}
&DEFMATURITY_{TYPE_{NEW_{i,t}}} = \\
&\frac{\begin{array}{c}\left(DEFMATURITY_{TYPE_{NEW_{i,t-1}}}+1\right)\left(1-TR_{31_{i,t}}-TR_{32_{i,t}}-WRITEOFFS_{NEW_{r_{i,t}}}\right) \\ \left(DEFEXP_{TYPE_{NEW_{i,t-1}}}-WRIOFFNEWDUEEXP_{TYPE_{i,t-1}}\right) \\ +0.5\,SHARE_{TYPE}\left(TR_{13_{i,t}}NONDEFEXP_{S1_{i,t-1}}+TR_{23_{i,t}}NONDEFEXP_{S2_{i,t-1}}\right) \\ -(\Omega_{TYPE}+0.5)WRITEOFFS_{TYPE_{NEW_{i,t}}}\end{array}}{\begin{array}{c}\left(1-TR_{31_{i,t}}-TR_{32_{i,t}}-WRITEOFFS_{NEW_{r_{i,t}}}\right) \\ \left(DEFEXP_{UNSEC_{NEW_{i,t-1}}}-WRIOFFNEWDUEEXP_{TYPE_{i,t-1}}\right) \\ +SHARE_{TYPE}\left(TR_{13_{i,t}}NONDEFEXP_{S1_{i,t-1}}+TR_{23_{i,t}}NONDEFEXP_{S2_{i,t-1}}\right) \\ -WRITEOFFS_{TYPE_{NEW_{i,t}}}\end{array}} \qquad (11)
\end{aligned}
$$

**The model introduces special shadow variables to allow different assumptions about the immediate or gradual write-off of fully provisioned loans.** $WRITEOFFNEWEXP\_TYPE$ stands for the maximum amount of loans that are fully provisioned and can be written off in a period:

$$
\begin{aligned}
WRITEOFFNEWEX⟦P\_TYPE⟧\_(i.t) = &(DEFEX⟦P\_TYPE\_NEW⟧\_(i,t-1) \\
&> 0.5\,\Omega\_TYPE - 1)\,(1 - TR\_31\_(i,t) \\
&- TR\_32\_(i,t)\,)\,(DEFEXP\_TYPE\_⟦NEW⟧\_(i,t-1) \\
&- WRIOFFNEWDUEEXP\_TYPE\_(i,t-1)) \\
&\cdot (DEFMATURIT\_TYPE\_NEW\_(i,t-1) - 0.5\,\Omega\_TYPE \\
&+ 1))/(0.5\,\Omega\_TYPE) \qquad (12)
\end{aligned}
$$

These defaulted exposures are added to the shadow fund $WRIOFFNEWDUEEXP\_TYPE$:

$$
\begin{aligned}
WRIOFFNEWDUEEXP\_⟦TYPE⟧\_(i,t) = &(1 - TR\_31\_(i,t) - \\
TR\_32\_(i,t)\,)\,WRIOFFNEWDUEEXP\_⟦TYPE⟧\_(i,t-1) + & \\
WRITEOFFNEWEXP\_TYPE\_(i,t) - WRITEOFF\_TYPE\_NEW\_(i,t) & \qquad (13)
\end{aligned}
$$

## A22 Coverage expectations for legacy NPLs

**The stock of legacy defaulted exposures will tend to decrease over time.** The equation for legacy defaulted exposures for $TYPE = \{UNSEC, SEC\}$ is described by:

$$
\begin{aligned}
DEFEXP\_TYPE\_OLD \\
&= (1 - TR\_31\_(i,t) - TR\_32\_(i,t) \\
&\quad - WRITEOFFS\_OLD\_r\_(i,t)) \ DEFEXP\_TYPE\_OLD\_(i,t) \\
&\quad - WRITEOFFS\_TYPE\_OLD\_(i,t) \qquad (14)
\end{aligned}
$$

And the formulas for provisioning should be modified as follows:

$$
\begin{aligned}
PROVSTOCKDEF\_TYPE\_OLD\_(i,t) \\
&= (1 - T[\![R\_31]\!]\_(i,t) - T[\![R\_32]\!]\_(i.t) \\
&\quad - WRITEOFF[\![S\_OLD\_r]\!]\_(i,t))(DEFEXP\_TYPE\_OLD\_(i,t \\
&\quad - 1)) [\![LR\_33\_TYPE\_TARGET]\!]\_(i,t) \\
&\quad - WRITEOFF\_TYPE\_OLD\_(i,t) \qquad (15)
\end{aligned}
$$

Compared to the original model formula, the empirically described $LR\_33$ is replaced by $LR\_33\_TYPE\_TARGET$, which will combine the original outcome of the empirical equation with targets prescribed by the supervisory coverage expectations.

**The core variable which steers the working of the coverage of expectations for legacy NPLs is the target coverage ratio.** It starts with the initial coverage target set to bind banks from 2020 onwards for three groups of banks and the two collateral types. Initial coverage targets are presented in the table below:

**Table A.1**

Initial coverage target in %

|  | Group 1 | Group 2 | Group 3 |
|---|---|---|---|
| **Secured loans** | 60% | 50% | 40% |
| **Unsecured loans** | 70% | 60% | 50% |

Group 1 includes bank with a net NPL ratio below 5%; Group 2 includes banks with a net NPL ratio between 5% and 12.5%; and Group 3 those with a net NPL ratio above 12.5%. $TYPE\_INIT\_TARGET$ is set at 40%, 50%, 60% or 70%, depending on the initial net ratio of NPLs of a bank in 2017, and starting from the end of 2020 the target coverage ratio evolves as follows:

$$
COVRATIO\_TYPE\_TARGET\_(i,t) = \min(1, TYPE\_INIT\_TARGET\_EXP\_i + time \cdot 0.025) \qquad (16)
$$

The variable $time$ stands for the quarterly increase in the target coverage ratio (with quarterly steps of 2.5 percentage points), so that before Q4 2026 $COVRATIO\_TYPE\_TARGET$ for any types of legacy NPLs reaches 100%. The effective loss rate takes account of the target coverage ratio from equation (16) and the share of already fully provisioned legacy defaulted exposures $LR\_33\_FULL\_TYPE$:

$$LR\_33\_TYPE\_TARGET\_(i,t)$$
$$= LR\_33\_(i,t) + max(0, COVRATIO\_TYPE\_TARGET\_(i,t)$$
$$- LR\_33\_(i,t))(LR\_⟦33\_FULL\_TYPE⟧\_(i,t) + (1$$
$$- LR\_⟦33\_FULL\_TYPE⟧\_(i,t))(0.5 DEFMATURITYOL⟦D\_TYPE⟧\_(i,t)$$
$$+ 0.5)) \quad (17)$$

**The model introduces shadow variable for the tracking the maximum amount of loans that are fully provisioned and can be written-off in a period:**

$$WRITEOFFOLDEX⟦P\_TYPE⟧\_(i,t)$$
$$= ((COVRATIO\_TYPE\_TARGET\_(i,t-1) =$$
$$= 1)DEFMATURITYOL⟦D\_TYPE⟧\_(i,t-1)$$
$$- (COVRATIO\_TYPE\_TARGET\_(i,t-1) =$$
$$= 1) DEFMATURITYOLD\_TYPE\_(i,t-1))(1$$
$$- TR\_31\_(i,t) - TR\_32\_(i,t))(DEFEXP\_TYPE\_OLD\_(i,t$$
$$- 1) - WRIOFFOLDDUEEXP\_TYPE\_(i,t-1)) \quad (18)$$

And the shadow fund for loans which are already fully provisioned but not yet written off:

$$WRIOFFOLDDUEEX⟦P\_TYPE⟧\_(i,t)$$
$$= (1 - T⟦R\_31⟧\_(i,t)$$
$$- T⟦R\_32⟧\_(i,t)) WRIOFFOLDDUEEX⟦P\_TYPE⟧\_(i,t-1)$$
$$+ ⟦WRITEOFFOLDEXP\_TYPE⟧\_(i,t)$$
$$- ⟦WRITEOFF\_TYPE\_OLD⟧\_(i,t) \quad (19)$$

# A3 Realigning the timing of write-offs and the supervisory coverage expectations

**The additional level of complexity relates to modelling actual bank write-offs in the presence of the supervisory coverage expectations.** In the most general case, banks will first establish their desired level of write-off ratio $WRITEOFFS\_r\_(i,t)$, just as in the absence of the supervisory coverage expectations, then compare it with the stock of defaulted loans which are already fully provisioned under the supervisory coverage expectations, and finally decide on the ultimate write-off policy in the period. The resulting write-offs will be the sum of:

$$WRITEOFFS\_(i,t) = WRITEOFFS\_UNSEC\_OLD\_(i,t) +$$
$$WRITEOFFS\_SEC\_OLD\_(i,t) + WRITEOFFS\_UNSEC\_NEW\_(i,t) +$$
$$WRITEOFFS\_SECOTH\_NEW\_(i,t) + WRITEOFFS\_SECRE⟦S\_NEW⟧\_(i,t) +$$
$$WRITEOFFS\_VO⟦LOUNTARY⟧\_(i,t) \quad (20)$$

with $WRITEOFFS\_VOLUNTARY$ standing for any loans which are written off before being fully provisioned.

## A31 Immediate write-offs under the coverage expectations

**The assumption of the immediate write-offs under the supervisory coverage expectations leads to a significant simplification of model formulas.** It always holds that $WRITEOFF\_TYPE\_NEW = WRITEOFFNEWEXP\_TYPE$ and $WRITEOFF\_TYPE\_OLD = WRITEOFFOLDEXP\_TYPE$. Accordingly, the shadow funds $WRIOFFNEWDUEEXP\_TYPE$ and $WRIOFFOLDDUEEXP\_TYPE$ are always empty. The only realignment which must ensue is that between the calendar write-offs under the supervisory coverage expectations and "voluntary" write offs predicted by the related banks' behavioural equations.

**Figure A.2**

Actual write-offs under the immediate write-off policy with an overhang of loans banks would write off even in the absence of the coverage expectations
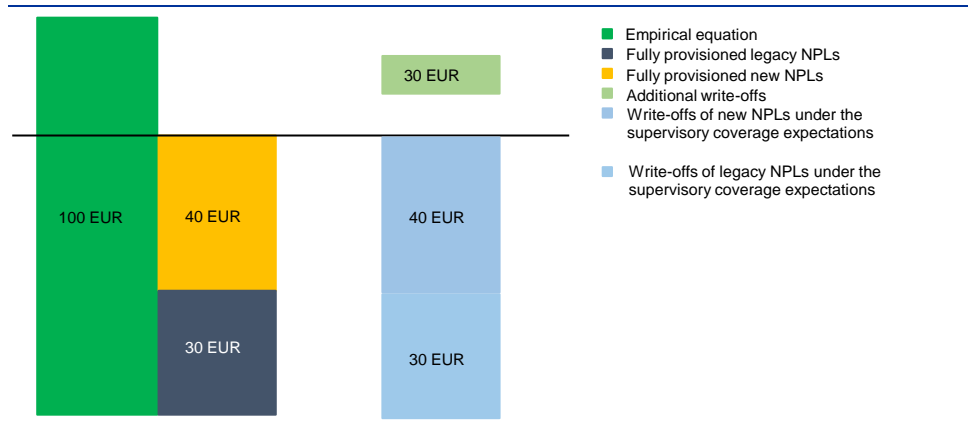


**Figures A.2 and A.3 illustrate the working of the model using numerical examples.** When the amount of write-offs predicted from the behavioural equation surpasses the defaulted loans which are already fully provisioned under the coverage expectations, there is an additional surplus amount of write-offs which will enter $WRITEOFFS\_VOLUNTARY$. If the write-offs derived from the behavioural equation are lower than the amount of the fully provisioned loans, the latter are still to be written off but $WRITEOFFS\_VOLUNTARY$ is set to zero.

## A32 Gradual write-offs under the coverage expectations

**With gradual write-offs, the actual write-offs in each period will depend on banks' propensity to write off embedded in the estimated write-off equation.** Accordingly, banks will compare the write-offs from the behavioural equations with the shadow funds $WRIOFFNEWDUEEXP\_TYPE$ and $WRIOFFOLDDUEEXP\_TYPE$. In this case the empirical equation sets the maximum amount of write-offs in the period as illustrated. Though the situation as in Figure A.2 is still feasible, the more likely situation is illustrated in Figure A.4. Figure A.4 also illustrates that the model introduces the pecking order between fully written-off legacy and new NPLs, with the former always being prioritised over the latter.

**Figure A.4**

Actual write-offs under the gradual write-off policy with large versus smaller stock of already fully provisioned legacy NPLs
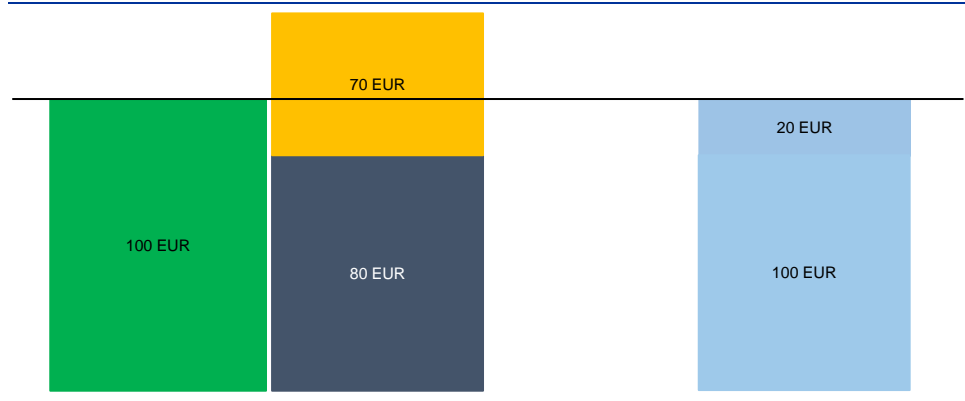
## A33 Re-establishing additional "voluntary" write-offs

**In cases where the empirical equation predicts higher voluntary write-offs, these are used to calculate the "voluntary" write-off rates for new and legacy NPLs.** In the presence of the supervisory coverage expectations $WRITEOFFS\_VOLUNTARY$ becomes a residual outcome after the application of the mechanistic rules in A31 and A32. If $WRITEOFFS\_VOLUNTARY = 0$, both $WRITEOFFS\_NEW\_r$ and $WRITEOFFS\_OLD\_r$, which appeared in earlier equations, are also zero.

**Legacy assets will be written off ahead of new NPLs if "voluntary" write-offs are non-zero.** Banks will first compare the $WRITEOFFS\_VOLUNTARY$ with the amount of outstanding legacy assets which are not yet fully provisioned under the coverage expectations. The effective $WRITEOFFS\_OLD\_r$ will be set so that banks can write off the maximum amount permitted by the value of $WRITEOFFS\_VOLUNTARY$. Only when $WRITEOFFS\_VOLUNTARY$ is above the value of all outstanding, not fully provisioned legacy assets, will it be applied to calculate the effective $WRITEOFFS\_NEW\_r$.

**Katarzyna Budnik**
European Central Bank, Frankfurt am Main, Germany; email: katarzyna.budnik@ecb.europa.eu

**Ivan Dimitrov**
European Central Bank, Frankfurt am Main, Germany; email: ivan.dimitrov@ecb.europa.eu

**Johannes Groß**
European Central Bank, Frankfurt am Main, Germany; email: johannes.gross@ecb.europa.eu

**Piotr Kornel Kusmierczyk**
European Central Bank, Frankfurt am Main, Germany; email: piotr_kornel.kusmerczyk@ecb.europa.eu

**Max Lampe**
European Central Bank, Frankfurt am Main, Germany; email: max.lampe@ecb.europa.eu

**Gianluca Vagliano**
European Central Bank, Frankfurt am Main, Germany; email: gianluca.vagliano@ecb.europa.eu

**Matjaz Volk**
European Central Bank, Frankfurt am Main, Germany; email: matjaz.volk@ecb.europa.eu