Box 3.2

DEVELOPMENT OF THE LIQUIDITY RISK ANALYSIS FRAMEWORK FOR MACROPRUDENTIAL PURPOSES

The crisis that affected several medium-sized US banks and Credit Suisse in March 2023 stemmed from structural and governance factors that led to significant liquidity outflows, compelling the banks to rapidly monetise assets to cover these outflows. This situation ultimately affected their solvency and caused turbulence in the global financial system.[1] The euro area banking sector and, in particular, the Spanish banking sector faced this turmoil with high capital and liquidity positions, significantly limiting its impact.[2]

Despite this favourable precedent, the lessons from the 2023 crisis highlight the need for a more thorough analysis of banks' liquidity risk and how it relates to various aspects of their financial position. Consequently, the Banco de España has supplemented the regular monitoring for financial stability purposes of the liquidity coverage ratio (LCR)[3] and the net stable funding ratio (NSFR)[4] with new macroprudential tools to: (i) analyse liquidity flows more granularly by maturity and currency and (ii) assess the impact of a potential liquidity crisis on banks' solvency.

Liquidity analysis by maturity and currency

Regulatory reporting information[5] provides a detailed overview of each financial institution's liquidity flows – breaking them down into liquidity inflows and outflows at different maturities (of both less and more than the 30 days covered by the LCR) and in different currencies – and their counter-balancing capacity (CBC).[6] Chart 1 shows Spanish significant institutions' overall asset and liability items that could generate liquidity inflows and outflows[7] at different maturities, as a percentage of total assets. These maturities range from one week, one week to one month, one month to three months, and so on, to more than five years. The chart also shows the CBC at the same maturities.

Given the maturity mismatch prevalent in the banking business, potential liquidity inflows are concentrated in maturities of five years or more, both in euro and in other currencies. Meanwhile, potential outflows are concentrated in items with very short-term maturities, generally of up to one week (including sight deposits), with this maturity accounting for 47.5% of total assets in the case of euro-denominated items and 29% for items denominated in other currencies.[7] The CBC remains at around 20% of total assets for maturities of up to one year in euro and at around 10% for those same maturities in non-euro currencies. The CBC decreases for longer maturities, in tandem with potential outflows. For maturities above five years, a CBC of around 10% (combining euro and non-euro-denominated funds) would still be available.

In the case of inflows (Chart 2), the largest flows correspond to loans and advances. However, at one week, which is a relevant maturity for short-term liquidity management, the main items subject to inflows are secured loans and capital market flows. The liquidity from maturing currency swaps is also noteworthy at short maturities.

Meanwhile, among items subject to outflows (Chart 3), retail deposits stand out at the one-week horizon. With the caveats noted in footnote 7 (which affect various categories including retail sight deposits, which are highly stable under normal circumstances), prudent liquidity management and stress testing requires considering adverse scenarios and ensuring that short-term assets

1 For a detailed analysis of the causes of this crisis, see, for example, José Alonso, Rebeca Anguren, Mª Cruz Manzano and Joaquín Mochón. (2023). "The 2023 banking crises: the causes and the role played by bank management, supervisors and regulators". *Financial Stability Review - Banco de España,* 45, Autumn.

2 It should also be noted that the worst liquidity crises in Spain in the last decade (for example, the resolution of Banco Popular in June 2017 and the political crisis in Catalonia in October 2017) have not been systemic but only affected specific institutions.

3 The LCR is a regulatory measure that assesses a credit institution's ability to cover its short-term liquidity needs, ensuring that it has sufficient high-quality liquid assets to meet net cash outflows over a stress period of 30 days. Prudential regulations require banks to have an LCR of 100% or more.

4 The NSFR considers institutions' available funds to finance their activity over a one-year time horizon. It is defined as the ratio of a bank's available stable funding to the stable funding it needs over one year. Prudential regulations require banks to have an NSFR of 100% or more.

5 Template C 66 - Maturity ladder. This template is available on the Banco de España website and the instructions for completing it can be found in Annex XXIII to Regulation (EU) 2021/451.

6 The CBC represents the stock of unencumbered assets or other funding sources which are available to the banks at the reporting date to cover potential liquidity gaps.

7 The maturity of items subject to inflows or outflows does not imply their full realisation. For example, sight deposits are included under the first maturity horizon (up to one week), but under normal circumstances only a small percentage will actually be withdrawn by customers.

are able to cope with behavioural changes and unexpected outflows. At longer maturities, potential liquidity outflows due to maturing currency swaps, outflows of liabilities resulting from securities issued, guaranteed loans and capital market flows become more relevant.

An illustrative liquidity stress test has been developed on the basis of this information for Spanish banks. These types of exercises can include different volume channels (for example, an acceleration of outflows) and price channels (for example, changes in interest or exchange rates, which affect the value of liquid assets), as summarised in Figure 1.

As an initial approach to explore the application of stress scenarios to this type of data, an exercise focused on the volume channel was carried out, considering an increase in the percentages of liquidity outflows. To this end, the exercise uses two scenarios: one using the LCR regulatory outflow coefficients (which already assume a somewhat stressed level of outflows) and an alternative scenario in which certain items are subject to additional outflows based on those observed in recent liquidity episodes in Spain.[8] The outflow coefficients assumed for each source of funding are applied homogeneously across all maturities and currencies.

Given the prevalence of short-term funding in the banking sector, the results presented focus on maturities from one week to three months. Despite the outflows applied in both adverse scenarios, the CBC at the end of the exercise is positive for all the maturities analysed (Chart 4). Therefore, Spain's significant institutions would have sufficient overall liquidity to cover net funding outflows in the stressed scenarios envisaged.

Chart 5 details the cascade of cash flows with a one-month maturity under the alternative stressed outflow scenario, as these are the scenario and maturity with the lowest residual CBC. Under these assumptions, the liquidity outflows obtained represent 25.3% of significant institutions' overall assets, with wholesale funding seeing the largest outflows (9.5% of assets).[9] Outflows linked to derivatives to manage the exchange rate are also notable (5.2%), exceeding those linked to retail products. Liquidity inflows (10.3% of assets) and the initial CBC after the haircut (27.4% of assets) would absorb the impact, leading to a final CBC of 12.3%.

Future exercises will be extended to consider the effects of additional risk factors (Figure 1) and explore asymmetric shocks by maturity and currency.

Interaction between liquidity and solvency

As already mentioned, the March 2023 crisis involving various US banks and Credit Suisse showed that a liquidity crisis can force institutions to rapidly monetise assets, and that this can affect their financial position and, therefore, their solvency.

The existence of unrealised losses[10] on investments in debt securities held at amortised cost is one of the most significant channels through which this impact can occur in scenarios of rising interest rates and heightened liquidity stress. Unrealised losses typically stem from interest rate rises, which result in asset impairment. Under a scenario of severe liquidity stress, the unrealised losses may be realised, if the bank chooses to sell the associated asset, or may limit access to funding, if these assets are used as collateral.

8 Namely, the resolution of Banco Popular in June 2017 (the "resolution crisis") and the political crisis in Catalonia in October 2017. The outflow percentages are calculated as the difference between the liabilities positions reported to calculate the LCR in the month of the crisis and those of the previous month. In the case of the resolution crisis, the last full month with a reported LCR is used, meaning that the exercise does not consider the total outflows up to the resolution date. For each source of funding, the outflow coefficient applied is the higher of the percentage used to calculate the LCR and the outflow percentage observed during the crisis episodes. Specifically, the outflow coefficient assumed in the LCR is not relaxed for those items for which a lower outflow rate was observed during the crises. The haircuts on the liquid assets comprising the CBC and the inflows are consistent with the LCR regulatory parameters under both scenarios.

9 This includes deposits, secured lending and capital market flows, liabilities resulting from securities issued and derivatives.

10 Unrealised losses are impairments in the market value of an asset that the bank does not record as losses because the asset is classified in the amortised cost portfolio. Assets in this portfolio are recorded at acquisition cost, adjusted over time for the interest accrued, coupons paid and principal repaid, as well as for potential changes in their credit quality, but not for changes in their market value. It should be noted that an asset classified at amortised cost could also accumulate unrealised gains in the event of an increase in its market value. Conversely, the book value of an asset classified at fair value will be updated to reflect changes in its market value.

Chart 1
Items subject to inflows or outflows, by currency (a) and term, and CBC - Significant institutions

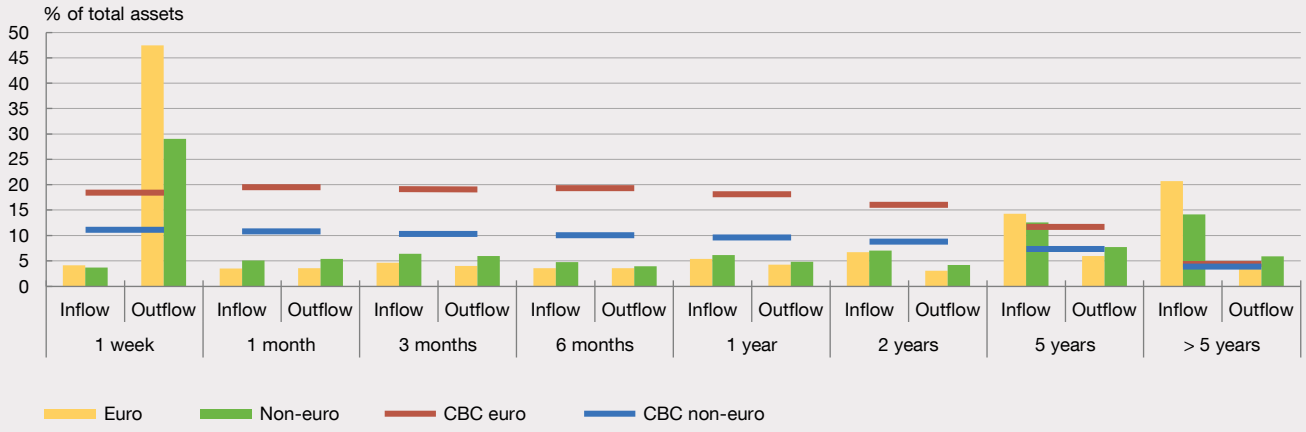


Chart 2
Items subject to inflows at various maturities (a)

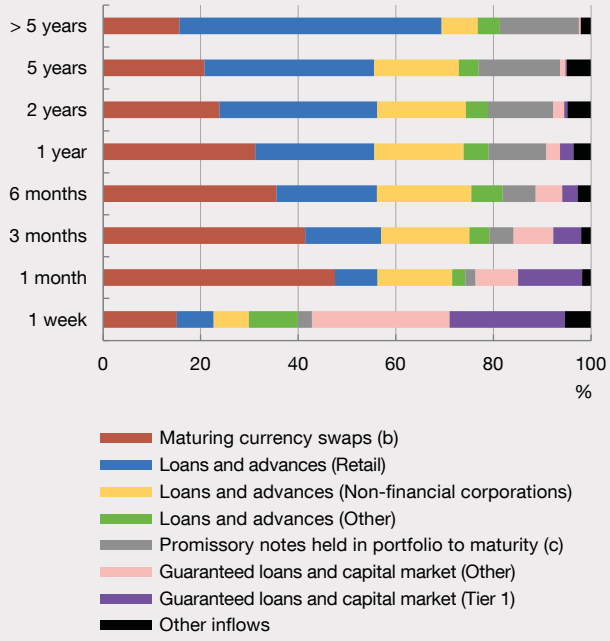
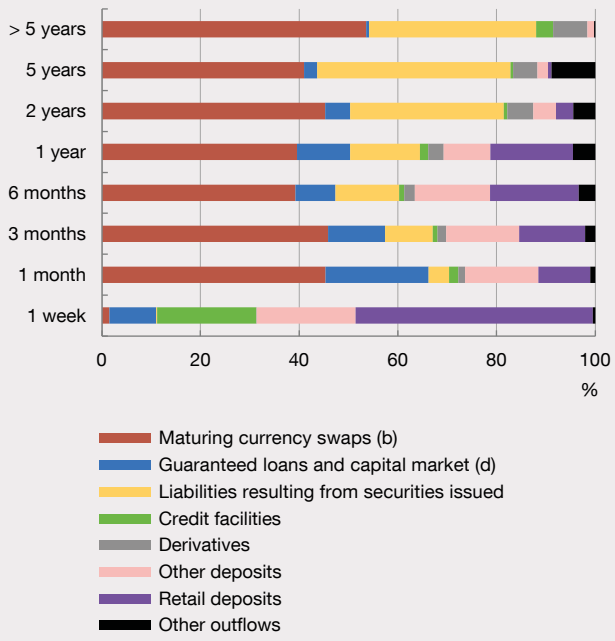


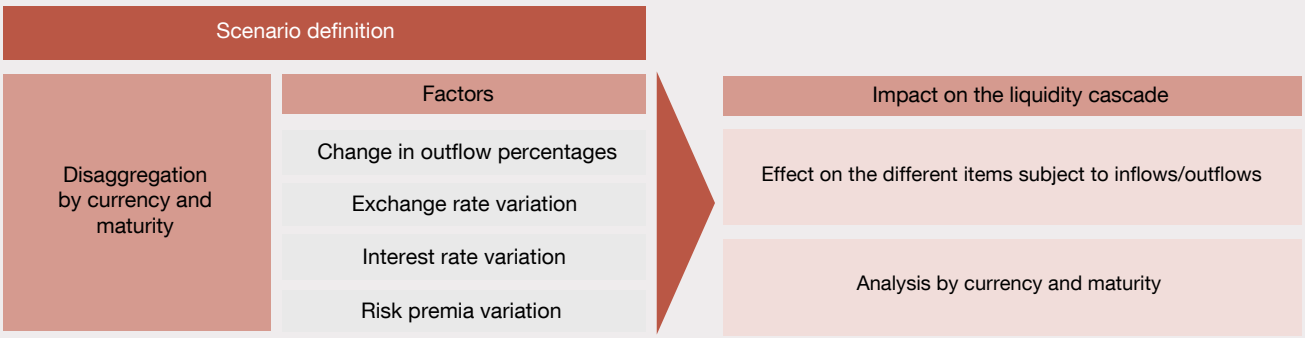
Chart 3
Items subject to outflows at various maturities (a)



SOURCE: Banco de España. Latest observation: December 2024.

a Template C66 includes the significant currencies, meaning that non-euro items are representative, but do not fully represent the balance sheet.
b Maturing currency swaps are a subgroup of derivatives, but are shown separately given their share of the total. These currency swaps allow banks to hedge against exchange rate fluctuations.
c This item includes cash inflows from the maturity of own investments in bonds. This same amount is also accounted for as a debt security outflow in the CBC.
d Includes, among other assets, shares, various types of bonds (guaranteed, corporate, asset-backed) and central bank and government sector marketable assets.

Figure 1
Potential elements of a liquidity stress framework



SOURCE: Banco de España.

Chart 4
Impact of the scenarios (a). Significant institutions.
All currencies. LCR and adverse scenarios. Horizons up to 3 months

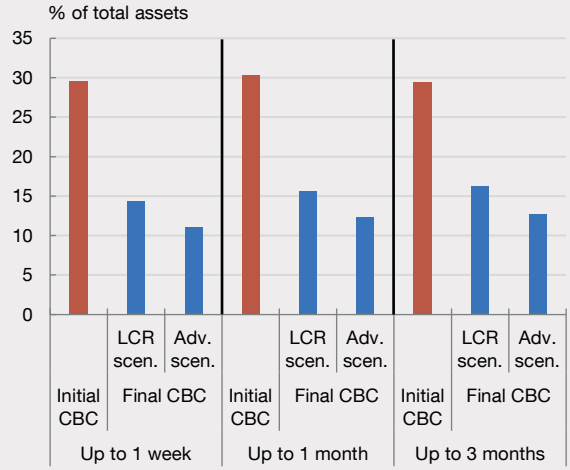
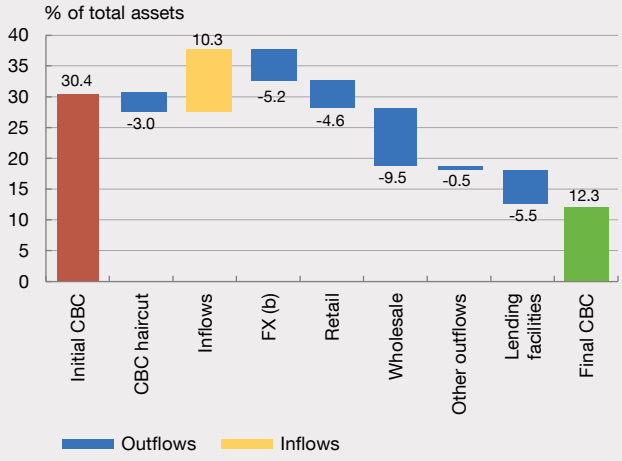


Chart 5
Impact of the scenarios (a). Significant institutions.
All currencies. Adverse scenario and 1-month horizon



SOURCE: Banco de España. Latest observation: December 2024.

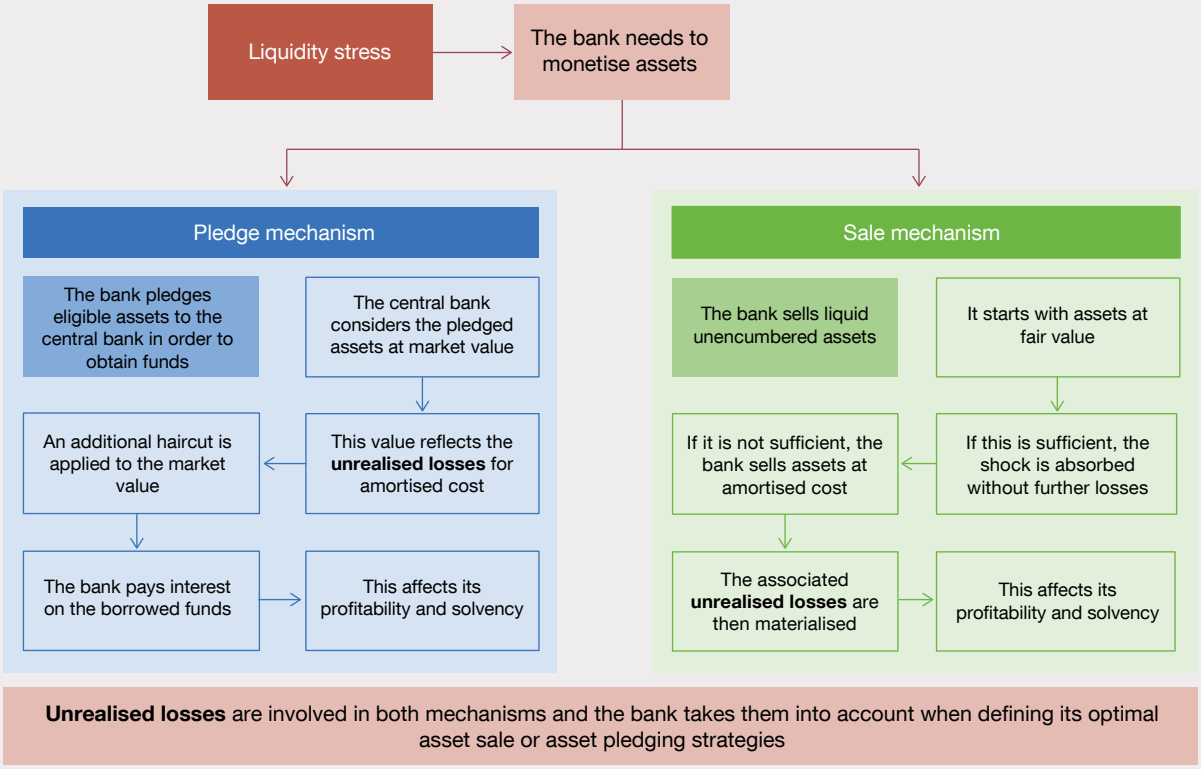
a The LCR scenario applies inflow and outflow coefficients in line with the regulatory assumptions for the calculation of the LCR ratio. Compared with the LCR scenario, the adverse scenario increases the outflow coefficients applied to some liabilities in line with the experience of recent idiosyncratic liquidity crises in the Spanish banking system. The final CBC for each scenario is the result of subtracting from the initial CBC the net outflows calculated according to each scenario's assumptions.
b Corresponding to outflows associated with currency swap contracts.

In this setting,[11] an analytical tool has been developed to assess the financial stability implications of this urgent asset monetisation under two liquidity-raising mechanisms: sale of assets on the secondary market and pledge of assets in loan transactions with the Eurosystem.[12] Figure 2 illustrates both mechanisms.

11 For more in-depth analysis of the link between liquidity and solvency through urgent asset monetisation, see A. Ferrer and A. Molina. (2025). "The interaction of liquidity risk and bank solvency via asset monetisation mechanisms". Documentos Ocasionales, 2509, Banco de España.

12 Although the option of pledging assets with a private counterparty through a repurchase agreement could also be considered, in practice, in a severe liquidity stress scenario, the repo market can be expected to become less effective as a competitive source of funding. The experience of the global financial crisis and, more recently, the more contained financial turmoil in March 2023 mentioned above, points in this direction. This mechanism is therefore not included in this analysis.

Figure 2
Mechanisms for obtaining liquidity under stress scenarios



SOURCE: Banco de España.

The first strategy allows banks to raise liquidity by selling some of the assets they hold on their balance sheets. Although it entails the materialisation of any unrealised losses on debt holdings classified at amortised cost, there are arguments in its favour. These include the need to wind down assets in the case of sudden outflows of funds that are unlikely to be recovered, avoidance of the stigma associated with the use of funding facilities outside the market, or the lack of operational readiness to be able to resort quickly to Eurosystem funding.

Pledging assets to the Eurosystem enables banks to raise liquidity using assets as collateral in refinancing operations.[13] To obtain liquidity by this means banks must deliver unencumbered assets (such as sovereign bonds), which are then valued at market value, reflecting any unrealised loss. Moreover, the central bank applies additional valuation haircuts, with the level of such haircuts (which indicates the cost of the funding) being determined according to the liquidity and residual maturity of the instrument, the solvency of the bank and the issuer of the instrument. This mechanism prevents the sale of assets and, therefore, the potential materialisation of unrealised losses, although it requires payment of interest on the funding obtained, which also has a negative financial impact on the bank.

The stylised simulation exercise presented below illustrates the impact on solvency of urgent asset monetisation through these channels. The reference date for the exercise is December 2023.[14]

13 These operations may include the marginal lending facility, the main refinancing operations (MROs) and longer-term operations (LTROs).

14 This date was chosen to best reflect the role of unrealised losses in urgent asset monetisation. At December 2023, the balance sheets of Spain's significant institutions still contained a small but not negligible volume of unrealised losses, as a result of the interest rate hikes that began in 2022. At December 2024 these unrealised losses were significantly smaller, owing to debt portfolio turnover and the shift in the monetary policy stance.

The exercise compares the two liquidity-raising mechanisms described above. In each case, an order of preference is defined, determining which assets would be sold or pledged first.[15] This criterion aims to reflect the optimality decisions that banks would tend to follow under a liquidity stress scenario. For asset sales, the order of preference seeks to minimise the total loss realised (for instance, by first selling assets held at market value, followed by those held at amortised cost that entail lower unrealised losses). In the case of assets pledged, the order of preference seeks to optimise the funding obtained (that is, to minimise the volume of assets pledged).

Under the liquidity stress scenario considered, a volume of net outflows of funds is considered separately for each bank, based on their position at December 2023, taking into account the make-up of their sources of funding and different outflow rates for each. These rates are calibrated based on the experience of the above-mentioned liquidity stress episodes that affected certain Spanish banks in the past.[16]

On aggregate for all banks, this methodology leads to net outflows of €506 billion. To meet these outflows, banks would first use the cash and excess reserves held at the central bank, which would cover up to €362 billion. To meet the remaining liquidity outflows, they would rely on the asset monetisation mechanisms described.

Before presenting the results of the exercise, and to set Spanish banks' sovereign debt holdings on the reference date in context, Chart 6 shows the important role they play in covering possible liquidity outflows, measured by their contribution to the LCR. Although the rate of coverage has changed somewhat in recent years, as these assets have been used as collateral in Eurosystem refinancing operations, unencumbered sovereign debt holdings cover up to 89% of these outflows.

Chart 7 shows that unrealised losses in Spanish banks' amortised cost portfolios at December 2024 were low, amounting to barely 2.6% of the carrying amount. By contrast, during the rate hike cycle, these unrealised losses were higher, accounting for 7.2% and 5.3% of the portfolio carying amount on average at December 2022 and 2023, respectively. Considerable heterogeneity across banks is also observed.

The main results of the simulation exercise are displayed in Chart 8. To study the potential impact of unrealised losses on the deterioration of solvency, three scenarios in addition to the above-mentioned liquidity stress scenario are considered. These add further interest rate rises in the form of parallel rate hikes at all terms of 2 pp (percentage points), 3 pp and 4 pp,[17] which would reduce the value of government debt holdings classified at amortised cost (thereby driving up the unrealised losses) and of those classified at fair value.

Under the baseline scenario, the cost of funding obtained from the Eurosystem to meet liquidity needs is estimated at more than €1.5 billion per quarter, equivalent to 10 bp (basis points) of banks' CET1 solvency ratios. In the (unlikely) event that this scenario were to last for one year, the cost of funding would reach €6 billion, with an impact equivalent to 42 bp of the average CET1 ratio for the banking sector. In the case of sale of debt instruments, banks would obtain gains amounting to €100 million. This is attributable to the existence of a significant volume of debt classified at amortised cost, whose market value at December 2023 exceeded its carrying amount, and which would be sold first, generating this gain.

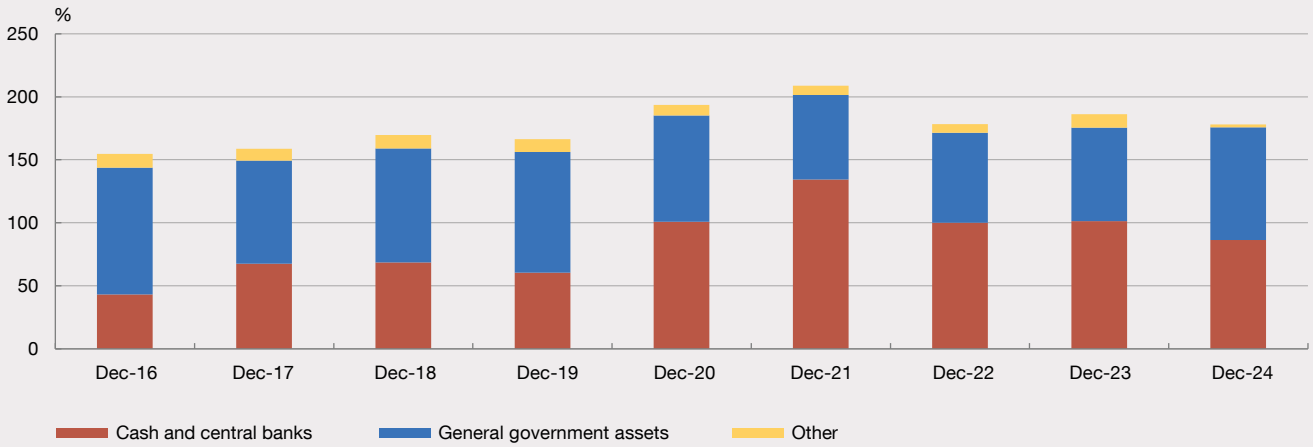
Under scenarios of a further increase in interest rates, there would first be a fall in the market value of bonds recorded at fair value on banks' balance sheets. This loss in bond value would give rise to an initial impact on banks' solvency (the brown bars in Chart 8) amounting to

15 For these purposes, only sovereign debt held by Spanish banks is considered, as it constitutes the bulk of banks' investment in debt instruments.

16 Considering a more severe scenario of outflows of funds than that defined in the LCR is a common component of this exercise and of that presented in the previous section, although it plays a slightly different role. In the case of the maturity analysis exercise, two outflow scenarios are considered: the scenario defined for the LCR ratio and the above-mentioned scenario with stressed outflows. The urgent asset monetisation exercise considers different scenarios for the interest rate curve used to determine the present value of government debt, all of which take into account the outflows of funds stress scenario. Moreover, the exercises presented are anchored to different time periods (December 2024 the first, December 2023 the second), so the total outflow volume differs as a result of the different composition of the balance sheet in those years.

17 At December 2023 monetary policy rates stood at their highest level of the monetary policy tightening period, at around 4% to 4.5%. However, owing to the turnover and growth of sovereign debt portfolios in the previous years, the percentage of unrealised losses built up at that date was not at its highest for the recent period. For this reason, the exercise considers the effect of additional interest rate rises, to analyse the impact of more severe unrealised loss scenarios.

Chart 6
Composition of the LCR by liquid asset class. Consolidated data



SOURCE: Banco de España. Latest observation: December 2024.

Chart 7
Distribution by bank of the percentage of unrealised losses in sovereign debt portfolios held at amortised cost. Consolidated data (a) (b)

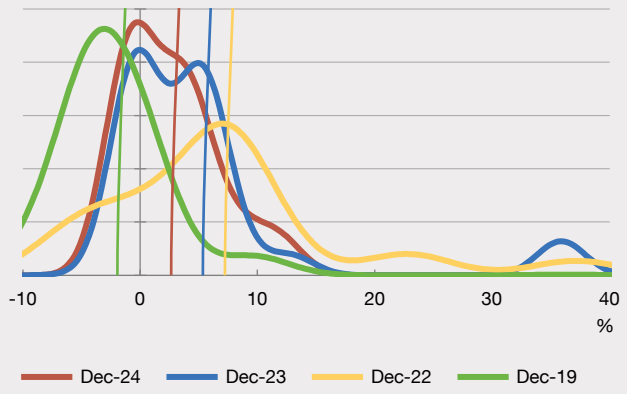
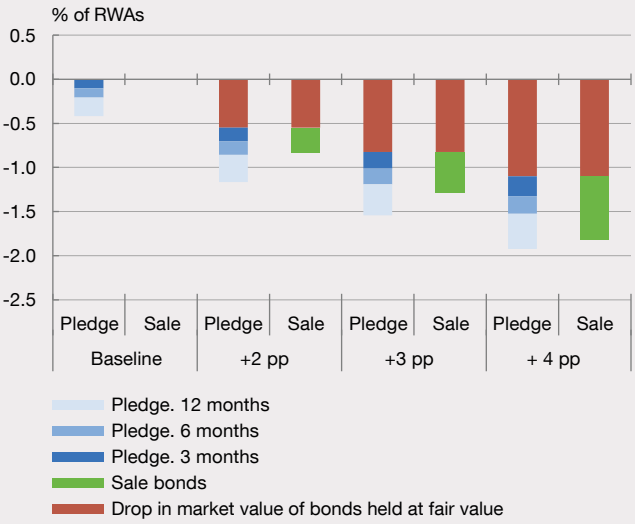


Chart 8
Solvency impact of the pledge and sale mechanisms under liquidity stress and interest rate hike scenarios. Significant institutions. Consolidated data (c)



SOURCE: Banco de España. Latest observation: December 2024 (Chart 7) and December 2023 (Chart 8).

a Negative unrealised losses are accumulated gains on the overall sovereign debt portfolio held at amortised cost.
b The chart shows the density functions of the percentage of accumulated unrealised losses in Spanish deposit institutions' sovereign debt portfolios classified at amortised cost, weighted by each one's total volume of such sovereign debt holdings. These density functions are proxied by a kernel estimator, which enables a non-parametric estimation of the density functions and provides a continuous and smoothed graphic representation of such functions. The vertical lines denote the weighted average percentage of the Spanish banking system overall on each of the dates considered.
c The chart shows the impact on solvency of both mechanisms under the baseline scenario (based on the balance sheet position at December 2023) and under scenarios of additional 2 pp, 3 pp and 4 pp interest rate hikes.

€4 billion and to almost 30 bp in terms of risk-weighted assets (RWAs) for each percentage point increase in interest rates.[18] This impact is not due to the interaction of liquidity and solvency risks.

In addition to these losses, the liquidity stress scenario considered would cause the CET1 solvency ratio to decline, potentially by up to an additional 72 bp in terms of RWAs in the case of asset sales (the green bar in the +4 pp class on the horizontal axis) under the most severe interest rate rise scenario. Under lower interest rate rise scenarios (for instance, 2 pp) the losses are considerably more moderate, up to 28 bp (the green bar in the +2 pp class on the horizontal axis).

To conclude, when unrealised losses are low, as was the case in December 2023, the asset sale option is the least burdensome as gains are obtained on part of the bond portfolio held at amortised cost. In periods of monetary tightening, when banks build up higher unrealised losses on their balance sheets, obtaining liquidity by pledging assets at the central bank could be a less damaging option, especially considering that liquidity crises are generally short-lived. In any event, given the severity of the assumptions used in the simulation (for instance, high interest rate rises or no account taken of the beneficial effect of interest rate risk hedges), the cost of the liquidity stress scenarios in terms of solvency for the main Spanish banks is remarkably low.

18 Interest rate risk hedging can help offset these losses, at least in part. However, in order to focus the analysis on the mechanics of the monetisation channels available in a liquidity crisis, the additional impact channel through hedging instruments is not considered here.