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SPAIN

FINANCIAL SECTOR ASSESSMENT PROGRAM

TECHNICAL NOTE ON SYSTEMIC RISK ANALYSIS

August 2024

This paper on Spain was prepared by a staff team of the International Monetary Fund as background documentation for the periodic consultation with Spain. It is based on the information available at the time it was completed on July 12, 2024.

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TECHNICAL NOTE

SYSTEMIC RISK ANALYSIS

Prepared By
Monetary and Capital Markets Department

This Technical Note was prepared by IMF staff in the context of the Financial Sector Assessment Program (FSAP) in Spain. It contains technical analysis and detailed information underpinning the FSAP's findings and recommendations. Further information on the FSAP can be found at http://www.imf.org/external/np/fsap/fssa.aspx

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Glossary

AC	Amortized Cost
BdE	Banco de España
BMA	Bayesian Model Averaging
CBs	Central banks
CBC	Counter-Balancing Capacity
CCoB	Capital Conservation Buffer
CET1	Common Equity Tier 1
CF	Cash-Flow
COREP	Common Reporting Standards
CPI	Consumer Price Index
CRE	Commercial Real Estate
CRR	Capital Requirements Regulation
CISS	Composite Indicator of Sovereign Stress (of the ECB)
DSECTI	Debt service and essential consumption-to-income
DSLI	Distance to Liquidity Stress Indicator
DSTI	Debt service-to-income
EA	Euro Area
EAD	Exposure at Default
EBA	European Banking Authority
EBIT	Earnings before interest and taxes
ECB	European Central Bank
ECL	Expected Credit Losses
EDF	Expected Default Frequency
EFF	Encuesta Financiera de las Familias (BdE's Survey of Household Finances)
ELA	Emergency Liquidity Assistance
EUR	Euro
FINREP	Financial Reporting Standards
FSAP	Financial Sector Assessment Program
FVOCI	Fair value though Other Comprehensive Income
FVPL	Fair value though Profit and Loss
GDP	Gross Domestic Product
GFC	Global Financial Crisis
G-SIB	Global Systemically Important Bank
HH	Households
HQLA	High-Quality Liquid Assets
ICO	Instituto de Crédito Oficial (Spain's Official Credit Institute)
ICR	Interest Coverage Ratio
IFRS	International Financial Reporting Standards

IMF	International Monetary Fund
IRB	Internal Ratings-based (approach)
LatAm	Latin America
LCR	Liquidity Coverage Ratio
LGD	Loss Given Default
LTV	Loan-to-Value
LSIs	Less Significant Institutions
MDBs	Multilateral Development Banks
NBFI	Nonbank Financial Intermediation
NFC	Nonfinancial corporates
NFCI	Net Fee and Commissions Income
NII	Net Interest Income
NIM	Net Interest Margin
NPE	Nonperforming Exposure
NPISH	Nonprofit Institutions Serving Households
NPL	Nonperforming Loans
NSFR	Net Stable Funding Ratio
OCI	Other Comprehensive Income
OLS	Ordinary Least Squares
O-SII	Other Systemically Important Institution
PD	Probability of Default
PL	Profit and Loss
PSE	Public Sector Entities
RAM	Risk Assessment Matrix
ROA	Return on Assets
ROE	Return on Equity
RoW	Rest of the world
RRE	Residential Real Estate
RWA	Risk-weighted Assets
SA	Standardized Approach
SIs	Significant Institutions
SMEs	Small-and-Medium Enterprises
SSM	Single Supervisory Mechanism
STA	Standardized Approach
STeM	Stress Test Matrix
TD	Top-Down
TLTRO	Targeted Longer-Term Refinancing Operations
TM	Transition Matrix
WEO	World Economic Outlook

EXECUTIVE SUMMARY

Spain's economy and its well-developed, bank-dominated financial system have shown resilience through the pandemic, rising global geo-political tensions and tighter financial conditions. The economy remains near potential and growth is projected to continue its robust performance in the coming quarters. The long running trend of deleveraging by households (HHs) and nonfinancial corporates (NFCs) continues, activity is cooling and very moderate overvaluation receding in the housing market, commercial real estate valuations remain below pre-pandemic levels, and foreign investments in the real estate market are on the rise.

The Spanish banking sector has a global imprint, operates a traditional business model, and is strongly profitable. Banks are deposit-funded credit intermediaries with low intra-financial system, and limited intra-group, exposures. A significant share of business and earnings of the largest banks emanates from foreign subsidiaries. Profitability surged strongly post-pandemic as financial impairments receded and has grown significantly further as lending margins rose in-step with rising interest rates. With asset quality remaining stable, this has allowed banks to increase dividend payouts and accelerate share buybacks while holding solvency buffers steady. Capitalization of Spain's significant banking institutions (SIs) is lower than their Euro Area (EA) peers owing to lower voluntary buffers and higher density of risk weighted assets. Banks' liquidity buffers are ample.

Downside risks are prominent and existing vulnerabilities could amplify the impact of exogenous shocks on financial stability. Further escalation of elevated global, geopolitical tensions and renewed volatility in commodity, especially energy, markets could create supply chain bottlenecks, further raise inflation, increase the likelihood of recession, and result in tighter domestic monetary and financial conditions. The associated increases in borrowing costs and consumption expenses and pessimism induced fall in demand and sales could challenge debt servicing of HHs and NFCs and dent banks' asset quality. Should materialization of downside risks occur via exogenous shocks having a global span, diversification benefits available under other circumstances from banks' international business would be unavailable and they may be compelled to deleverage to protect solvency.

The Spanish banking and real sectors' resilience was assessed against a severe but plausible adverse scenario that reflects these risks. The scenario spans a three-year horizon (2024-2026), with a significant and persistent recession entailing a cumulative loss of over two standard deviations of real GDP growth over 2024-25 with a gradual recovery in 2026. Under the adverse scenario, a combination of shocks results in a significant global economic downturn, with negative spillover effects across trade and financial channels. Energy price spikes yield a resurgence in inflation, with the resulting monetary tightening precipitating lower economic activity.

Stress on HH finances under the adverse scenario appears modest, on average, when considering the relative increase in incomes and borrowing costs but is material when the combined impact of rising interest and essential consumption expenses are accounted for. Under the adverse scenario, HH vulnerabilities appear concentrated in the lowest-income segment

when only assessing debt servicing costs. This has limited aggregate impact since these HHs hold a small share of overall HH debt. However, when consideration is also given to the stress from rising costs of living, low-to-middle-income HHs could find it challenging to meet rising borrowing costs.

The FSAP analysis suggests a moderate rise in the debt-at-risk of the NFC sector in the adverse scenario. The share of firms that may face challenges in meeting debt servicing costs out of earnings is projected to increase materially compared to the baseline scenario by 2026. Firms with low initial debt servicing capacity are more susceptible to the shocks and the share of such firms rises by over 6 percentage points in the adverse scenario relative to the baseline by end-2024.

Significant banking institutions (SIs) display resilience in the aggregate under the adverse stress test scenario, albeit with significant credit deleveraging and evidence of a weak tail of SIs. The CET1 capital of two SIs fall below their Maximum Distributable Amount (MDA) trigger, with one breaching the leverage ratio requirement. Large credit losses in the adverse scenario and the low incumbent voluntary capital buffers are important factors in explaining this breach of regulatory hurdles under stress. The total loss of capital across the ten SIs under the adverse scenario is also large: the aggregate CET1 ratio of the ten SIs declines to 9.6 percent in year 2, 1.2 percentage points above regulatory requirements, and recovering to just over 10 percent in year 3. This outcome, wherein on an aggregate, average basis, the 10 SIs' capital levels remain above regulatory requirements, reflects to a material degree, the significant scale and rapid speed of credit deleveraging for domestic exposures undertaken by banks under the scenario. Banks losses continue through the three years of the adverse scenario, albeit with reduced severity as the economic recovery begins in 2026.

Liquidity stress tests show that SIs can cope comfortably with market valuation shocks and would face cash flow challenges under large withdrawals of retail deposits. Banks' resilience is bolstered by the substantial share of retail deposits and large reserves of high-quality liquid assets (HQLA) which is reflected in strong starting positions of short- and long-term stable funding. Stress tests show that SIs' liquidity coverage ratios (LCR) are relatively insulated from market-valuation shocks and are primarily susceptible to significant (retail) deposit outflows which would, beyond a high threshold, outstrip cash inflow and liquidity reserves based counterbalancing capacity.

Interconnectedness analysis does not reveal significant vulnerabilities of Spanish banks to of cross-border contagion of foreign banking distress. The capital ratio of Spanish banks remains, in the aggregate, comfortably above regulatory thresholds under the full range of adverse shocks, reflecting the low intra-financial and interbank exposures of Spanish banks.

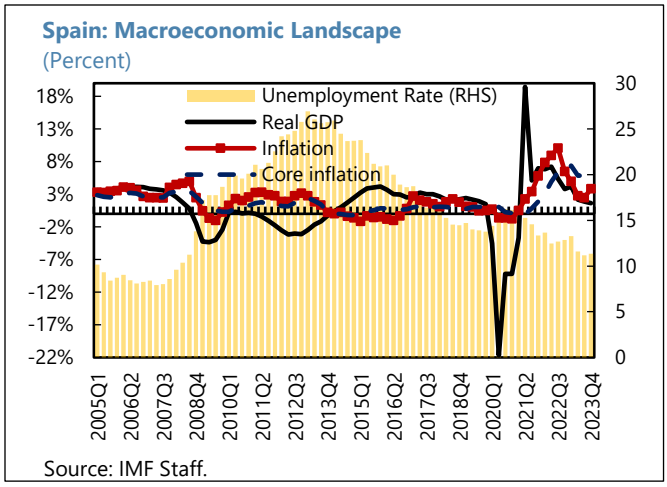
BdE could enhance its capability in risk identification in some areas, such as expanding the liquidity toolbox to incorporate cash flow analysis across all relevant currencies and enhancing data collection and monitoring of foreign investments in the domestic real estate market.

Table 1. Spain: Recommendations on Risk Analysis		
Recommendation	**Timing***	**Agency**
Enhance data collection and monitoring on foreign investments in the real estate market.	NT	BdE, CNMV
Create the infrastructure for a more granular cash-flow analysis (as designed by the FSAP) and report regular stress testing results for financial stability analysis and monitoring purposes.	NT	BdE
Integrate the interconnectedness and contagion analysis more systematically into the toolkit of BdE's financial stability framework.	MT	BdE
*" Immediate" is within one year; "NT-near-term" is 1–3 years; "MT-medium-term" is 3–5 years.		

INTRODUCTION[1]

A. Macroeconomic Landscape and Sectoral Vulnerabilities

1. The Spanish economy remains near potential with GDP in line with Euro Area (EA) peers (Figure 1). Robust private consumption, driven by recovering household purchasing power, offset slowing exports growth and subdued investment momentum. Growth is projected to continue its robust performance in the coming quarters, reaching an average of 1.9 percent in 2024 (April 2024 WEO), reflecting rebound of trading partners' import growth and normalization of global energy prices. Disbursements of NextGeneration EU (NGEU) grants, followed by the use of NGEU loans, will continue to support investment. Headline inflation rebounded to above 3 percent after falling below target levels in the summer, as the base effects from high energy prices in 2022 dissipated. Core inflation has continued to fall gradually but is expected to stay above the ECB's target until early-to-mid 2025. Inflation and a tight labor market—the unemployment rate reached a post-GFC low at below 12 percent—have led to a gradual build-up of wage pressures, although the national wage agreement should help contain the growth of collectively bargained wages.



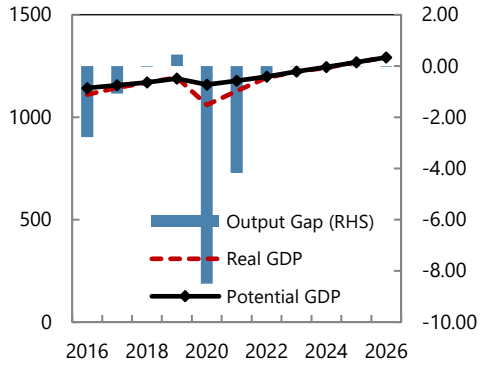
2. Deleveraging in key sectors over the last decade has contributed to a sustained downward trend in the credit-to-GDP gap which remains in negative territory (Figure 1).

- **Continuous deleveraging since the GFC has strengthened the HH sector's resilience against the surge in interest rates (Figure 2)**. The adverse balance-sheet impact of higher borrowing costs, reflecting the low share of fixed-rate mortgage rates in Spain (around 30 percent by 2023Q2), has been partially offset by robust wage growth and the strong labor market performance. The increase in non-performing HH loans has been limited thus far notwithstanding the large share of variable-rate mortgages that have already repriced. Vulnerability is concentrated among low-income households whose debt service burden may not be cushioned by savings accumulated during the pandemic. Since these HHs hold only a small share of total debt of this sector, the deterioration of HH loan quality is expected to be contained. The limited take-up so far by HHs of the package of measures adopted by the government at end-2022 to support families most affected by the increase in the Euribor also points to the resilience of HH balance sheets.

[1] The authors of this note are Sneha Agrawal, Elisa Letizia, Yu Shi, and Hamid Reza Tabarraei (all IMF). The analysis has benefitted from discussions with the staff of Banco de España, the Spanish Ministry of Economy, Trade and Enterprise, the European Central Bank, and the Spain FSAP team.

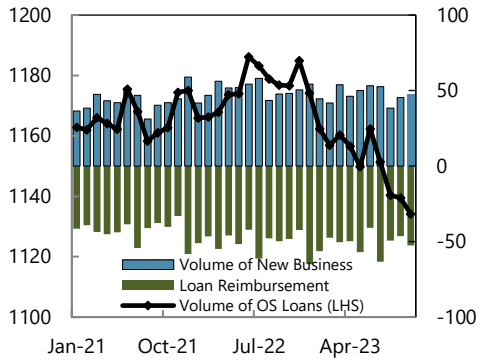
Figure 1. Spain: Economic and Financial Cycle

Spain Output Gap
(Bil EUR)



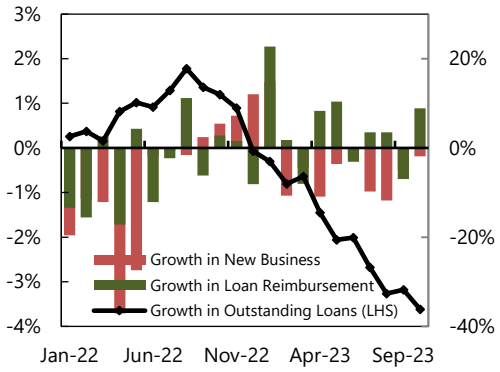
Source: IMF-WEO.

Loans to HHs, NPISHs and NFCs
(Bil EUR)



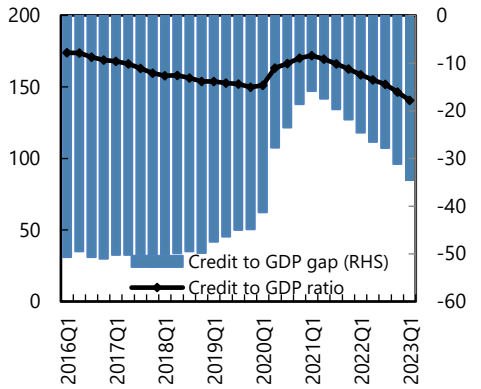
Sources: BDE and IMF staff calculations.

Loans to HHs, NPISHs and NFCs
(Percent)



Sources: BDE and IMF staff calculations.

Spain Credit to GDP Gap
(Million EUR (LHS), percent (RHS))



Sources: BDE and IMF staff calculations.

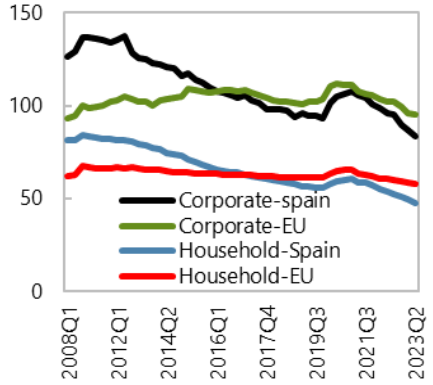
- **The NFC sector has also reduced its debt burden and improved its debt repayment capacity (Figure 2).** After declining continuously since the European debt crisis, the debt-to-GDP ratio of the NFC sector fell to 82 percent in 2023Q3, positioning Spain as among the least indebted corporate sectors in a comparison of European peers. Firms' debt repayment capacity as measured by their interest coverage ratio (ICR)[2] has increased through most of the previous decade, rebounding after a partial reversal during the pandemic. Firms' liquidity indicators have also improved since the GFC, and profitability has experienced an upward trend over the past decade except for a temporary drop during the pandemic.

[2] ICR is calculated as Earnings Before Interest and Taxes (EBIT) divided by Interest Expenses. When the ICR is less than one, a company is not generating sufficient revenue to service its debt without taking corrective actions, such as reducing operational costs or using cash reserves.

Figure 2. Spain: Trends in Household and Corporate Leverage

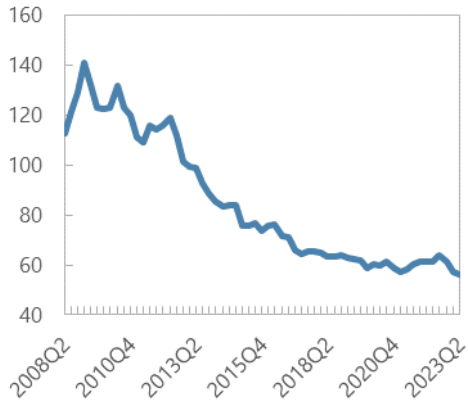
Corporate and household sectors have reduced their debt level relative to GDP, extending a decade-long trend.

Corporate and Household Debt, 2008-2023
(Percent of GDP)



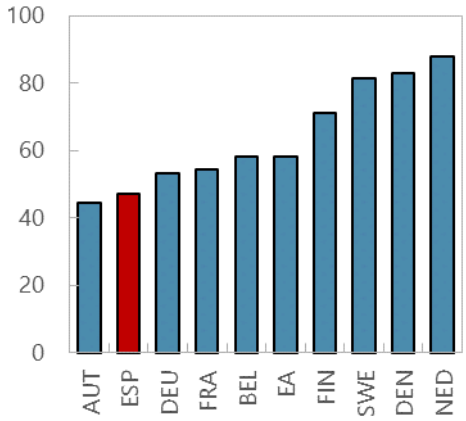
The leverage ratio of nonfinancial corporates has improved since the GFC.

NFC Leverage, 2008-2023
(Percent of Debt/Equity)

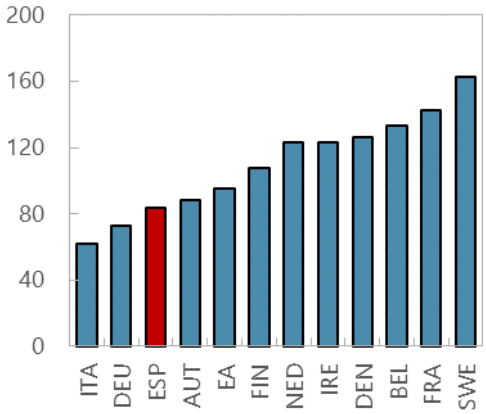


Household and corporate debt remain low compared to peers in the Euro Area.

Household Debt, 2023Q2
(Percent of GDP)

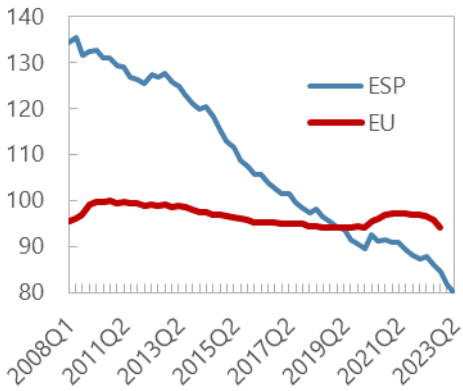


Corporate Debt, 2023Q2
(Percent of GDP)



Deleveraging serves to increase households' debt servicing capacity

Household Debt-to-Income Ratio, 2008-2023



NFCs' debt servicing capacity has picked up again, after a brief deterioration during the pandemic.

NFC Interest Coverage Ratio, 2008-2022

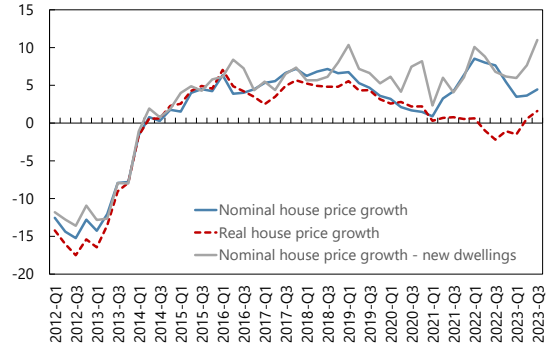
Sources: Bank of Spain; Haver Analytics; and IMF staff calculations.

3. Prices are growing steadily in the residential real estate (RRE) market even as activity is cooling down (Figure 3). Unlike other euro area countries, Spain did not experience a large house price boom in 2020-21. Housing transaction volumes exhibited significant signs of market correction, falling by 13.4 percent on average during the first three quarters of 2023. Nonetheless, while nominal house prices have started to decrease elsewhere in the EA, RRE prices in Spain have continued to register small increases in both nominal and real terms, supported by large immigration flows and supply shortages. The cumulative increase of RRE prices in Spain since 2019Q3 is in line with the average in the euro area, and RRE prices in real terms remain significantly below pre-GFC levels. Lending standards have remained prudent given the relatively low average LTV ratios and declining shares of loans with LTV ratios higher than 80 percent. On the other hand, there has been an increasing share of housing transactions that involve non-mortgage buyers[3], which warrants close monitoring, as does the new dwellings segment where price appreciation exceeded 10 percent year-on-year (Box 1).

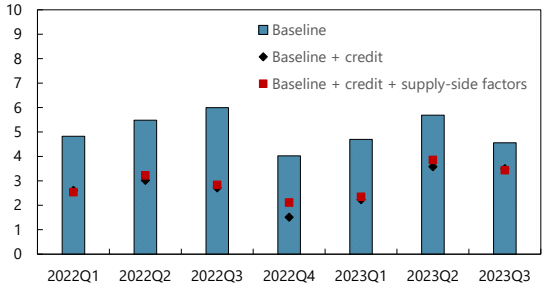
Box 1. Spain: Residential Real Estate – New Dwellings Prices

In the new dwellings segment, price appreciation exceeded 10 percent y-o-y in 2023Q3. Applying the same house price valuation model (including the same demand- and supply-side variables) to new dwelling prices results in an unexplained component of 3.5 to 4 percentage points. This suggests a greater extent of price misalignment for new houses compared to the overall market. The large unexplained component could be driven by the model not incorporating foreign buyers, or by aggregate indicators not adequately capturing new-housing-specific supply constraints. Nonetheless, it is important to continue analyzing and monitoring the segment.

House Price Growth
(Percent change, y-o-y)



House Price Misalignment Estimates - New Dwellings
(Percent deviation from fundamental price levels)

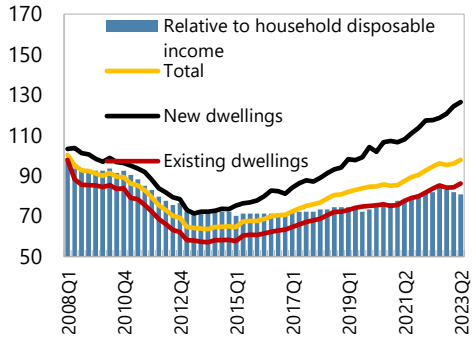


Note: The "baseline" model includes income and population growth, short-term and long-term interest rates, stock prices, price-to-income ratios, and crisis dummies as explanatory variables.

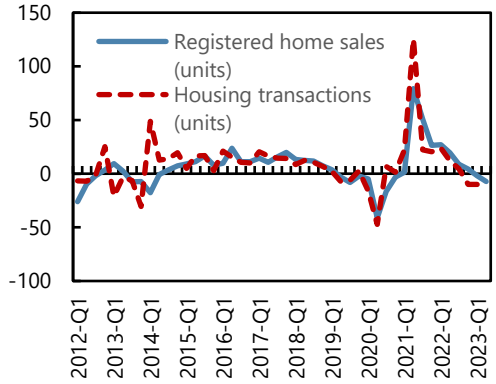
[3] Registradores de España: https://www.registradores.org/actualidad/portal-estadistico-registral

Figure 3. Spain: Residential Real Estate

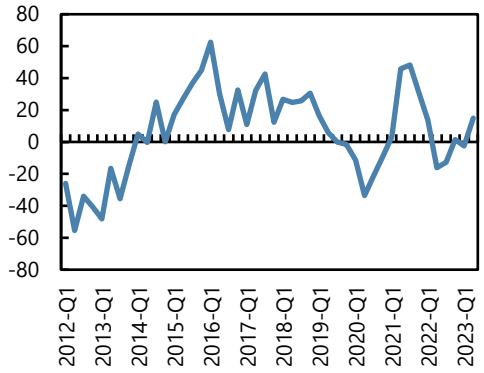
House Price, 2008-2023
(Index, 2007=100)



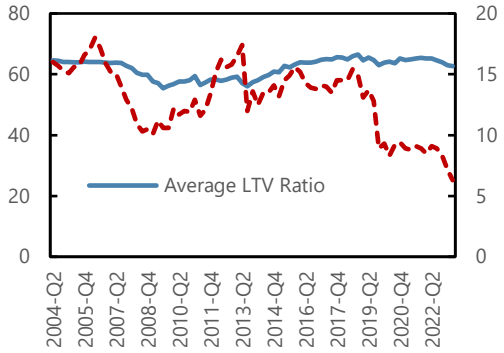
Housing Transaction Volumes
(y/y percent change)



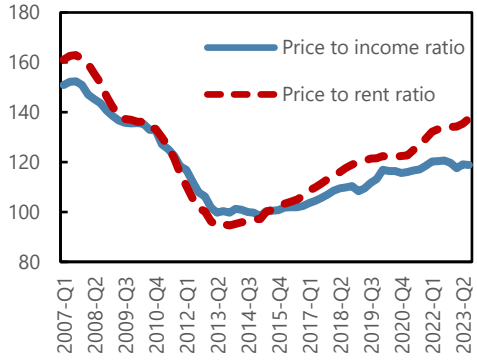
Number of Housing Construction Started
(y/y percent change)



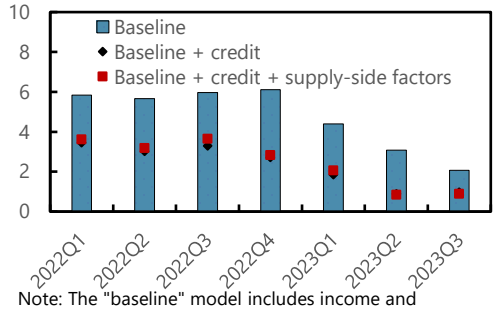
Spain: Mortgage Loan-to-Value (LTV) Ratios
(Percent)



Price-to-Income and Price-to-Rent Ratios
(Index, 2015 = 100)



House Price Misalignment Estimates
(Percent deviation from fundamental price levels)



Note: The "baseline" model includes income and population growth, short-term and long-term interest rates, stock prices, price-to-income ratios, and crisis dummies as explanatory variables.

Sources: Registradores de España, INE, Ministerio de Transportes y Movilidad Sostenible, OECD, BIS, BdE, Eurostat, and IMF staff calculations.

4. Housing valuations show no significant signs of overvaluation (Figure 3). Spain's ratio of house prices to income, stable since end-2019, declined moderately recently following the robust growth of household income. The price-to-rent ratio has been continuously increasing, reflecting in part, the fact that the rent index does not fully capture new rental contracts and in part limits on rent increases at contract renewals arising from the authorities' anti-inflation measures. Both ratios

remain significantly lower compared to pre-GFC levels. A pure demand-based assessment[4] of real house price misalignment that which takes account of income, population growth, and interest rates, suggests that house price overvaluation relative to fundamentals dropped from around 6 percent in 2022Q1 to most recently 2.1 percent in 2023Q3. Incorporating the credit cycle and supply constraints into the assessment results in a further reduction in price misalignment to around 0.9 percent in the recent two quarters. This suggests that looking forward, nominal house price growth in the baseline should be moderately lower than headline inflation.

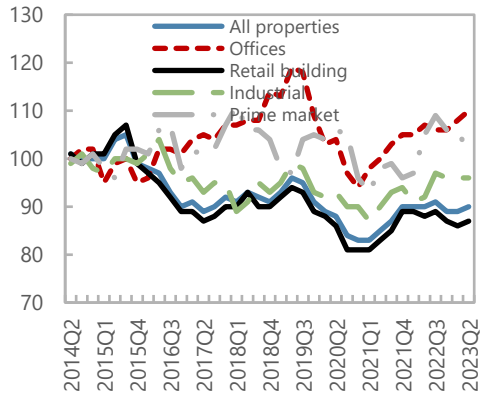
5. Commercial real estate (CRE) prices have stayed below pre-pandemic levels and bank exposures to the CRE market are contained (Figure 4). Spain's CRE market experienced a marked slowdown during the pandemic, recovery has been slow, with prices in all segments remaining below pre-pandemic levels as of 2023Q3, and transaction volumes and new mortgage credit in the CRE market are growing, albeit at a much slower pace compared to 2021–22. Office building is the only segment that still has prices increasing. Looking ahead, tightening lending standards could continue to weigh on CRE prices, and the accelerated trend of digitalization could also impose further downward presses. Downside risks are expected to have limited impact on banks, however, given the small size of the Spanish CRE market relative to European peers, the trend decrease in banks' CRE exposures following the stringent lending standards introduced after the GFC (in contrast to the high share of foreign funding), and the fact that the relatively high NPL ratios on banks' CRE portfolios are partly driven by legacies from previous crises. The increasing reliance on foreign funding by this sector points to the importance of enhancing data collection on foreign investment in the CRE market, potentially in collaboration with European institutions and foreign jurisdictions to help better monitor development and risks in the sector.

6. Public debt remains elevated despite a reduction since end-2020 and the financial sector's sovereign exposures are significant (Table 2). The deployment of fiscal resources to mitigate the pandemic impact took a toll on Spanish public finances. After a sharp increase in 2020, (of around 25 percentage points), the debt to-GDP-ratio decreased over the next two years, reaching 107 percent in December 2023. Spanish banks held around 15 percent of Spanish sovereign debt securities in June 2023, while the domestic NBFI sector held an additional 11 percent. While banks' public debt-to-assets ratios have been stable at 11 percent, they remain among the most exposed to sovereign risk across European peers. Sovereign debt also accounts for a significant proportion of assets held by insurance firms (44 percent), pension funds (30 percent) and open-ended funds (OEF, 30 percent). In such a context, adverse macro-financial implications could be higher if market sentiment shifts against highly indebted EA countries due to global and idiosyncratic factors.

[4] Please see Annex IX for a detailed discussion on the methodology and data used in the model-based evaluation of house price misalignment.

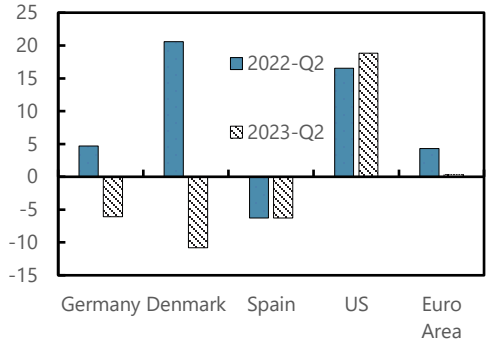
Figure 4. Spain: Commercial Real Estate

Spain: Commercial Real Estate Prices
(Index, non-seasonally adjusted, 2014 = 100)



Source: BIS.

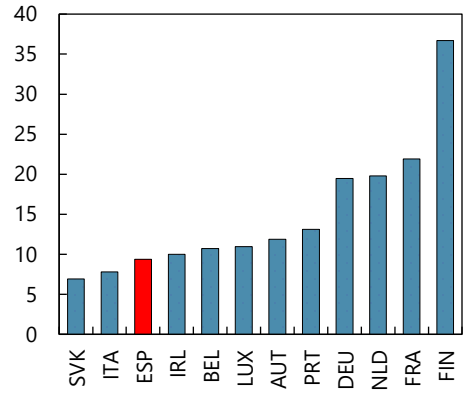
CRE Price Growth in Selected Economies
(y/y percent change)



Note: Data for the euro area is showing 2022-Q4, the latest available, instead of 2023-Q2.

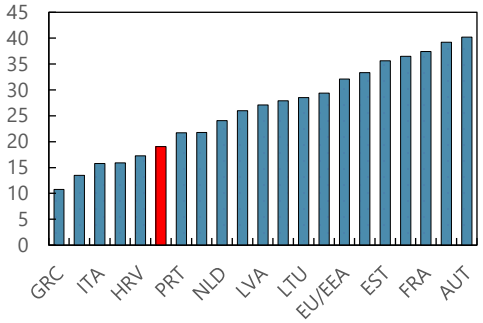
Sources: BIS and IMF staff calculations.

CRE Market Size in Selected Euro Area Economies
(In percent of nominal GDP, 2022)



Sources: MSCI, INE, and IMF staff calculations.

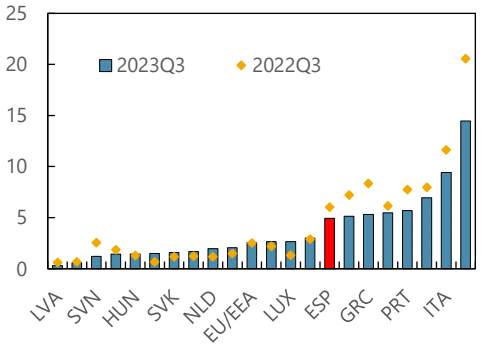
Real Estate and Construction Loans
(In percent of total NFC loans, 2023Q3)



Note: CRE loans include loans to the real estate and the construction sector.

Sources: EBA and IMF staff calculations.

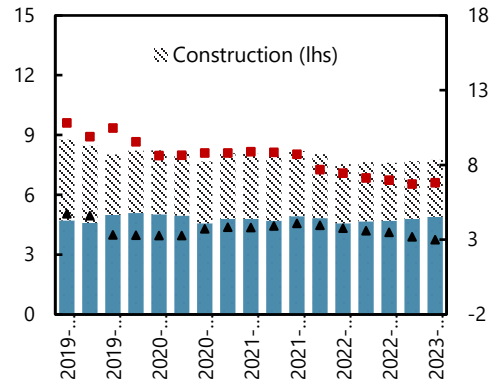
NPL Ratios in the CRE Loan Portfolio
(In percent of gross carrying loans)



Note: CRE loans include loans to the real estate and the construction sector.

Sources: EBA and IMF staff calculations.

Distribution and NPL Ratio of NFC loans and advances by NACE code
(Bil EUR, percent)



Sources: EBA; Haver Analytics; and IMF staff calculations.

Table 2. Spain: Collateral Concentration for Sovereign Bond Exposures of Spanish SIs
(Billion EUR)

Country	0-3mo	3mo-1 year	1-2 year	2-3 year	3-5 year	5-10 year	>10 years
Spain	11	39	36	17	38	85	29
EA	6	14	8	9	17	35	10
Others	11	21	26	20	22	21	27

Sources: ECB, IMF staff.
Note: [Heatmap scale] Red values are 15 times green values.
Others include Japan, Latin America, Qatar, South Africa, United Kingdom, and United States.

B. Banking Sector Structure and Vulnerabilities

7. The bank-dominated Spanish financial system is large and well-developed (Table 3). Aggregate assets of Spanish credit institutions amounted to 285 percent of GDP in June 2023. Spanish banks operate a universal model with a strong retail orientation. Bank funding is dominated by retail-sight deposits, and nearly 90 percent of bank lending is channeled towards lending to mortgages and NFCs, of which a significant amount is extended at floating rates (70 percent in case of household mortgages[5]). Spanish banks considered as Significant Institutions (SIs) hold almost 95 percent of bank sector assets.[6]

Table 3. Spain: Structure of the Financial System, June 2023
Total Assets (in billions of euros)

	In billion euros	In percent of total assets	In percent of GDP
Credit institutions	4147.9	74.8	285.3
Specialised lending institutions (CFI)	53.2	1.0	3.7
Money Market Funds	7.1	0.1	0.5
Investment Funds	374.6	6.8	25.8
Other financial intermediaries	205.5	3.7	14.1
Financial auxiliaries, Captive financial institutions and money lenders	310.2	5.6	21.3
Insurance corporations	293.6	5.3	20.2
Pension funds	152.5	2.7	10.5

Sources: Banco de España, Comisión Nacional del Mercado de Valores, CEIC

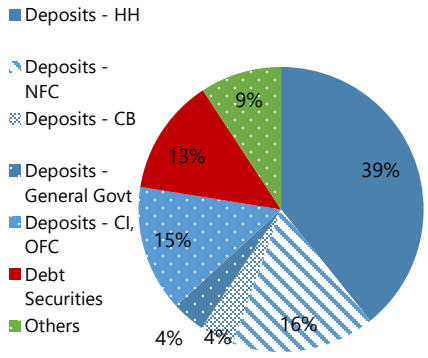
8. Spanish banks operate on a deposit funded business model (Figure 5). As of June 2023, deposits are the main funding source for Spanish significant institutions representing 77.5 percent of total liabilities, with 56 percent being customer deposits coming from HHs and NFCs. The current process of monetary policy normalization is leading to a reduction in the share of central bank funding, dropping by 6.2 percentage points as a share of total assets between June 2022 and June 2023 as it becomes more expensive, and targeted refinancing operations have expired. Regarding the geographic distribution of deposits and debt securities of the Spanish SIs, in June 2023 almost half of the deposits came from Spanish depositors, while 59 percent of the securities issued were also held by Spanish counterparts. The remaining share of deposits and debt securities showed a

[5] In the last six years, variable rate mortgages have represented around 30 percent of new mortgage credits with the rest being fixed rate mortgage loans.
[6] Significant (credit) Institutions (SI) are under the ECB's direct supervision while Less Significant Institutions (LSI) are supervised by national competent authorities under the oversight of the ECB.

diversified composition across Brazil, EA, Mexico, the United Kingdom, and the United States (Figure 5). For less significant institutions (LSIs), nearly all their funding is domestic.

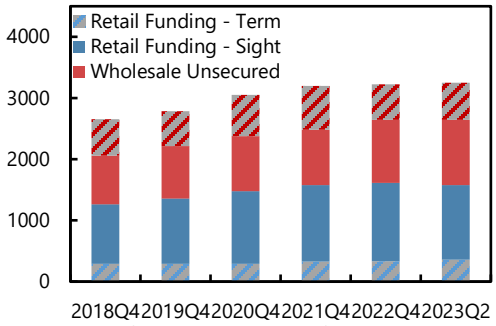
Figure 5. Spain: Banking Sector Liabilities and Funding

Spain Liabilities Composition for SIs
(Percent of total non-equity liabilities, June 2023)



Sources: BDE, IMF Staff.

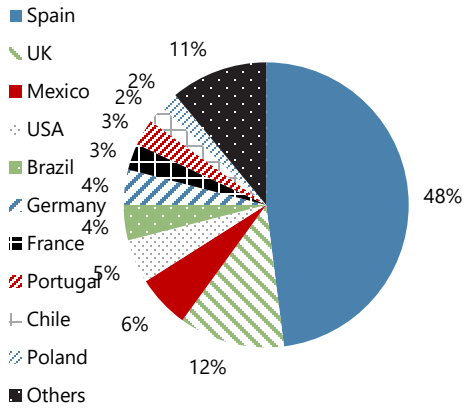
Spanish Banks Funding Composition
(Mil EUR)



Note: Retail funding comprises of sight and term deposits by retail customers, wholesale funding has all other counterparties.

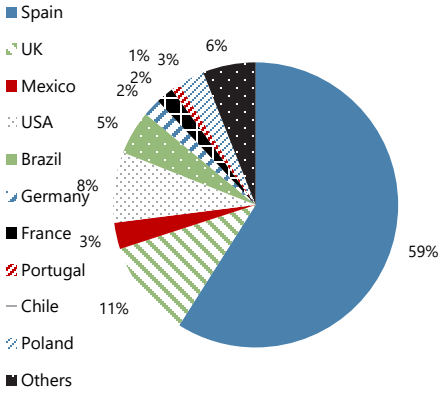
Sources: ECB-SDW, IMF Staff.

Geographical Distribution of Spanish Deposits
(June 2023, percent)



Source: BDE.

Geographical Distribution of Spanish Debt Securities
(June 2023, percent)

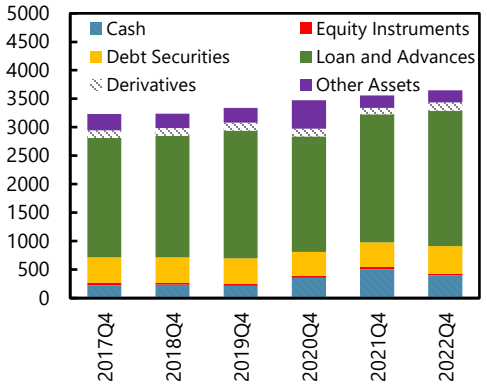


Source: BDE.

9. The asset side of banks' balance-sheets in Spain is dominated by lending to HHs and NFCs (Error! Reference source not found.**6).** As of June 2023, loans account for 65.4 percent of total assets of all banks, with the largest share going to households and NFCs while debt securities represent 14.2 percent of the balance sheet. The borrower composition of loans has remained stable with HH mortgages having the highest share, with an average maturity of 14.7 years. As at Sept-2023, 63 (57) percent of the outstanding loans to HHs (NFCs) were at floating rates.

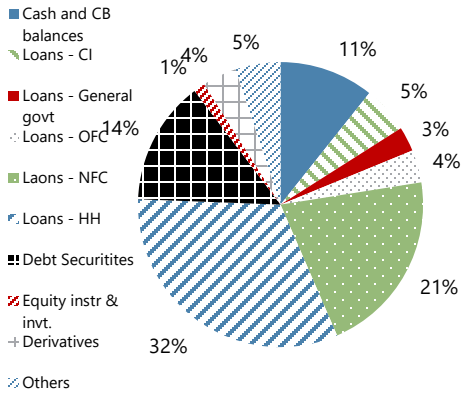
Figure 6. Spain: Banking Sector Asset Composition

ESP Banks' Assets Allocation
(Bil EUR)



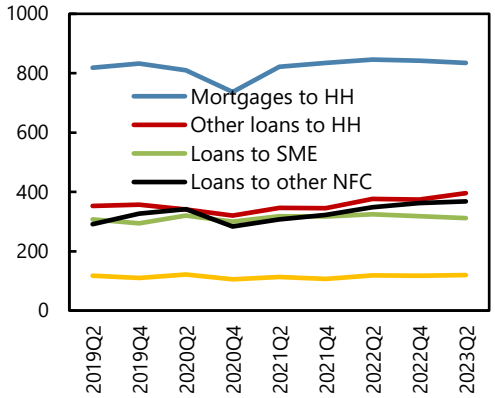
Sources: EBA; Haver Analytics; and IMF staff calculations.

Spain SI Asset Holdings
(Percent of total assets, 2023Q2)



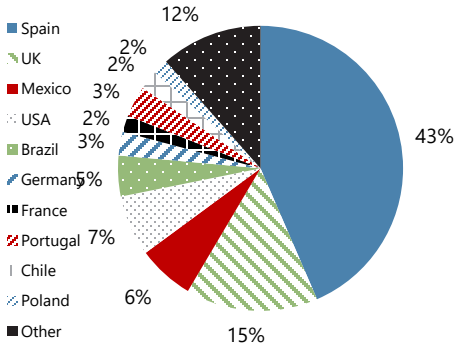
Sources: BDE and IMF staff.

Loans by Categories of Borrowers
(Bil EUR)



Sources: EBA; Haver Analytics; and IMF staff calculations.

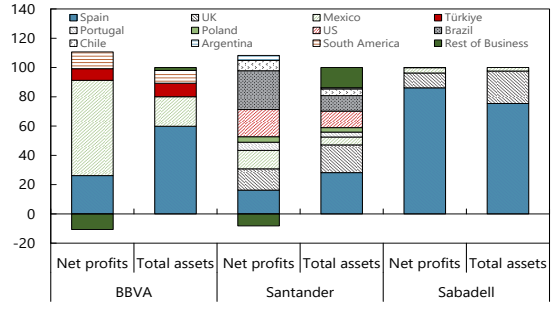
Geographical Dist. of Spanish Credit to the Private Sector
(Q32023, percent)



Sources: BDE and IMF staff.

10. The largest banks—one of which is global systemically important (G-SIB)—have significant presence in foreign jurisdictions structured in the form of independent subsidiaries. These span Brazil, Mexico, Türkiye, the United Kingdom, and the United States, and contribute significantly to their total assets and profits (text chart, Figure 7). Spanish SIs with material international presence are structured into subsidiaries that have low intra-financial sector, and limited intra-group, exposures. The subsidiaries finance their liquidity by reliance on local deposits and accessing financial markets using their own issuance programs. As a result, the extent of intragroup claims and liabilities within Spanish banks is significantly lower than in other major banking systems, but this could change in a crisis during which parent entities and their subsidiaries may have to rely more on each other to manage funding pressures.

Spanish Banks: Profits and Assets Geogrpahic Distribution
(in percent of group-level net profits/assets, 2022)

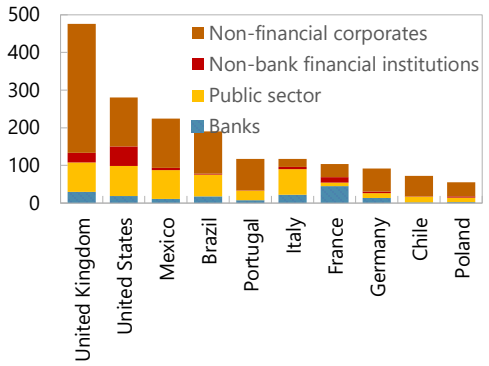


Sources: Banks' annual reports and IMF staff calculations.

Figure 7. Spain: Cross-Border Banking Activities

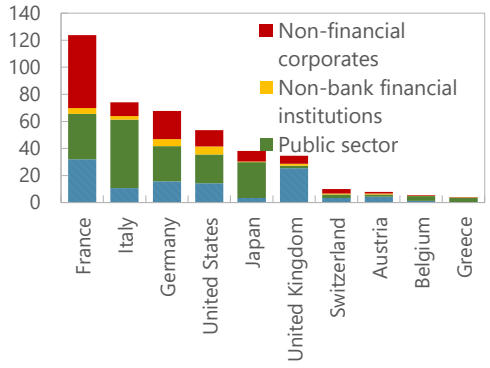
Spanish banks exhibit concentrated foreign claims in the United Kingdom, United States, Brazil, and Mexico (2023Q2.

Consolidated Foreign Claims of Spanish Banks
(Billions of USD)



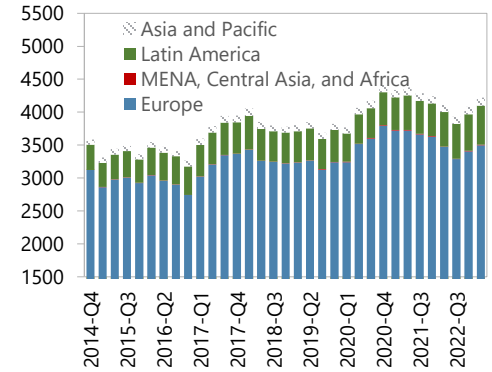
Foreign banks' exposure to Spain is significantly smaller, totaling approximately US$450 billion (2023Q2).

Consolidated Foreign Claims on Spain
(Billions of USD)



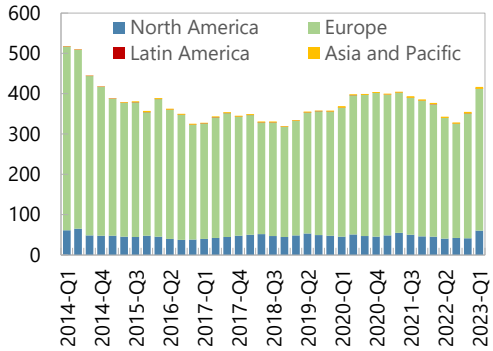
The international claims of Spanish banks have witnessed a steady increase post euro-crisis.

Consolidated Foreign Claims of Spanish Banks
(Billions of USD)



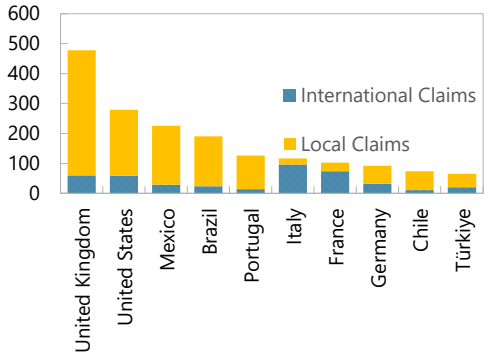
In contrast, the consolidated foreign claims on Spain have seen a notable decline since the GFC.

Consolidated Foreign Claims of Spanish Banks
(Billions of USD)



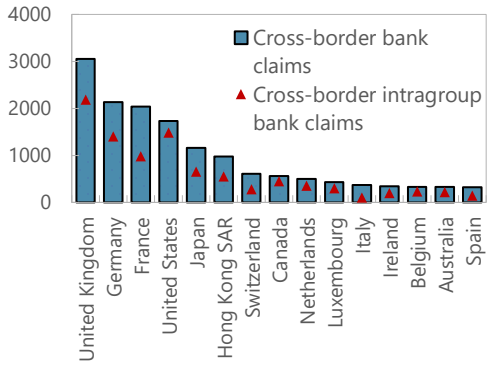
Spanish banks' foreign claims primarily take the form of loans by their foreign subsidiaries.

Cross Border vs Local Consolidated Foreign Claims
(Billions of USD)



The degree of intragroup transfer within Spanish banks seems relatively limited when compared to their international counterparts.

Cross-Border Intra-Group Claims
(Billions of USD)



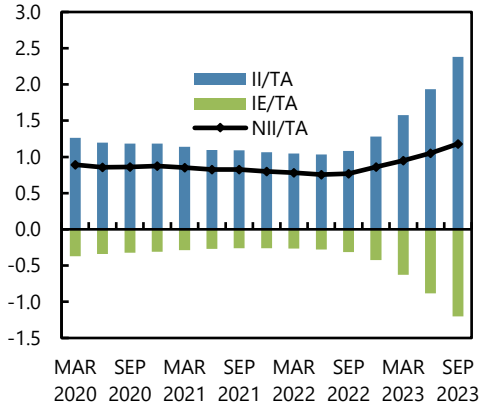
Sources: BIS Consolidated and Locational Banking Statistics, and IMF staff calculations.

11. Profitability of SIs has been strong and boosted by a recent increase in net interest income (NII), although saturation of margins and deposit migration may reverse this trend in 2024 (Figure 8). The return on equity (ROE) stood at 12.1 percent, while the return on assets (ROA) was 0.76 percent in June 2023. In the coming quarters, SIs' profitability may decline for a few reasons. First, if funding costs rise, e.g., due to an increase in deposit betas or a switch in depositors' preferred habit from sight to term deposits and alternative interest yielding investment instruments as the transmission of higher monetary policy rates continues. Second, if the economy slows down or downside risks materialize, and financial impairments increase. These effects could more than compensate pending repricing in existing variable rate loans and the income from new loan production. Internationally, Spanish banks have been well positioned compared to other EA banking systems, in terms of both ROA and ROE, having experienced a complete rebound in profitability to pre-pandemic levels.

12. Monetary policy normalization has impacted, and may impact, SIs' profitability and credit quality through several channels (Figure 9). First, the interest rate passthrough channel. Interest rate pass-through by banks has been faster and, on average, more pronounced on the asset side of their balance-sheets than on the liability side. This has contributed to increasing net interest margins (Figure 8), albeit the more recent catch-up of deposit rates on all but sight contracts (Figure 9) indicates that this factor is now less significant. Second, a significant share of SIs' sovereign debt portfolio is held at fair value (40 percent in June 2023), and higher interest rates have led to realized losses in these assets valued at fair value. Finally, the impact on credit quality. Finally, resilient economic performance has ensured that credit quality of SIs' loans has not worsened, with the nonperforming loans (NPL) ratio (at 3.4 percent at end-2023 H1), remaining on its longer-term downward trend. Should downside risks materialize, this could change.

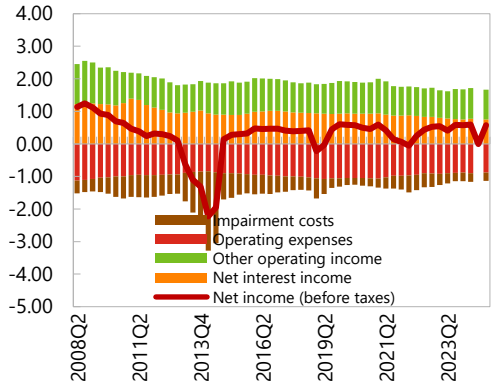
Figure 8. Spain: SI Profitability

Spain Net Interest Income
(Percent)



Sources: BDE and IMF Staff.

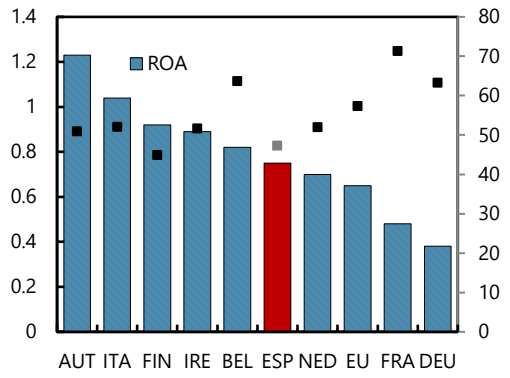
Profitability of Banks in Spain, 2008-2023
(Net income in percent of average total assets)



Sources: BDE and IMF Staff.

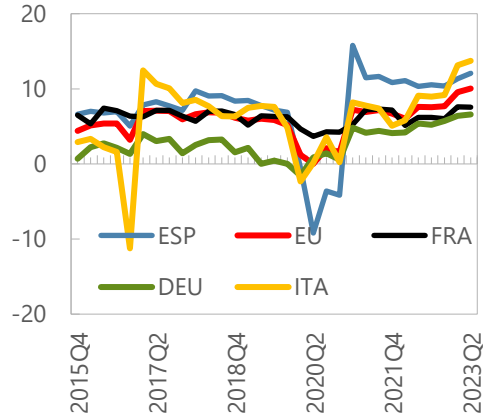
Figure 8. Spain: SI Profitability (concluded)

Profitability Indicators
(2023Q2, percent)



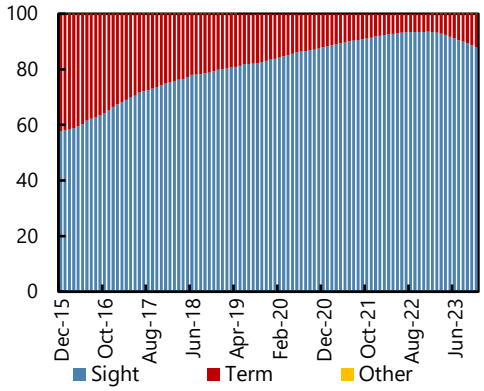
Sources: ECB and IMF Staff.

Return on Equity, 2015-2023
(Percent)



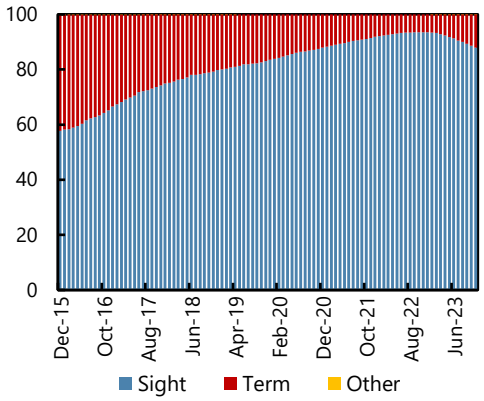
Sources: ECB and IMF Staff.

NFC: Share of Sight and Term Deposits (Percent, domestic)



Sources: BdE and IMF staff calculation.

HH: Share of Sight and Term Deposits (Percent, domestic)

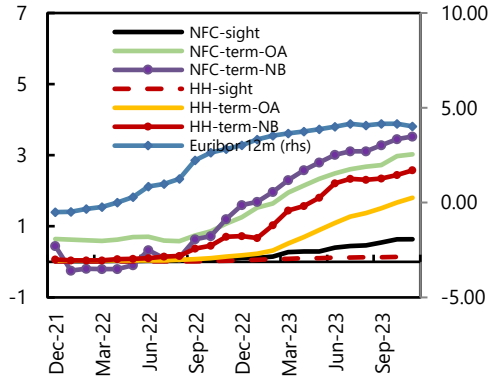


Sources: BdE and IMF staff calculation.

Figure 9. Spain: Pass-Through of Recent Interest Rate Surge

Interest rates have increased significantly since end-2021.

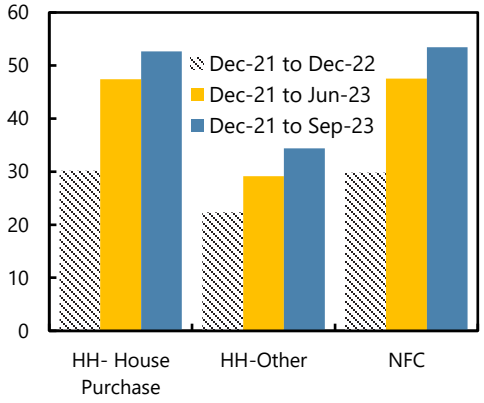
Interest Rate (Business in Spain)
(Percent)



Sources: BdE and IMF staff calculation.

Average passthrough on lending has been quicker and higher…

Pass-through of increase in Euribor to Loan Rates
(Percent)

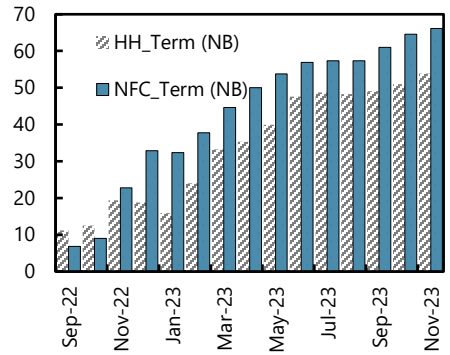


Sources: BdE- FSR and IMF Staff calculation.

Figure 9. Spain: Pass-Through of Recent Interest Rate Surge (concluded)

…but has now caught up for new term deposits.

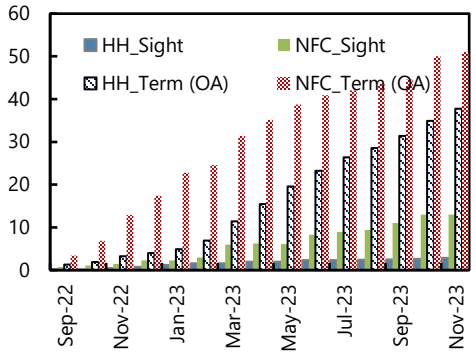
Term (New Business) Deposit Pass-through
(Percent)



Sources: BDE, IMF Staff.

…but is lagging for outstanding term and especially sight deposits.[1]

Pass-through of Increase in Euribor on Deposit Rates
(Percent)



Sources: BDE, IMF Staff.

[1] Passthrough is calculated as the ratio of change in deposit beta for the concerned category of deposit to the maximum variation in Euribor 12-month relative to the concerned time period. OA refers to outstanding amounts and NB to new business.

13. In terms of capitalization, the CET1 ratios of Spanish SIs are above the average requirements, albeit lower than European peers (Figure 10). Capital ratios have improved moderately for the aggregate of the Spanish SIs with the CET1 ratio at 12.6 percent as of June 2023. This reflects the fact that retained earnings, after dividends and share buy backs, more than compensated for the increase in RWA ensuing from foreign exposures and the impact of revisions of the internal ratings models. Spanish SIs' CET1 ratios remain lower than EA peers owing to higher risk-weight density, and lower voluntary buffers, with banks preferring to issue high dividend payouts and buy-back shares over retaining earnings to increase capital levels. On the other hand, Spanish SIs' leverage ratios are comparable to most EA peers, and they faced the least amount of capital depletion in the 2023 EBA stress test adverse scenario.

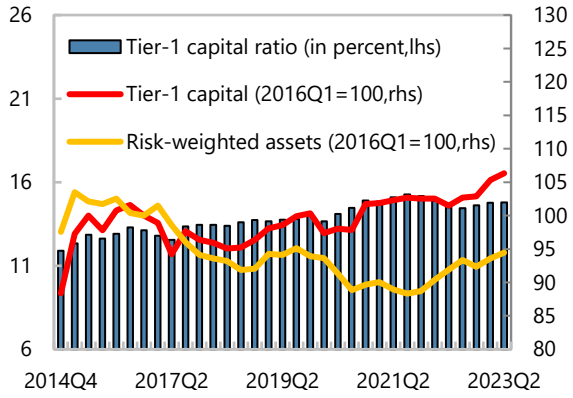
14. System-wide NPL ratios and the share of Stage 2 loans—a leading indicator of future NPLs—have remained stable (Figure 11). NPL ratios have decreased in Spain since the end of the global financial crisis (GFC), falling by 3 percentage points in the five years through June 2023. This improvement in asset quality was broad-based, across all credit portfolios and banks. Within the business sectors, the highest NPL ratio is observed in the sectors sensitive to the COVID-19 pandemic, particularly the hospitality, restaurant, and leisure sector and construction and real estate activities (respectively 7.5 percent and 4.6 percent by June 2023). By company size, the highest NPL ratios are observed in the small-and-medium enterprises (SMEs) segment, at 6.6 percent in June 2023, especially in the microenterprises segment (8 percent). The share of Stage 2 loans increased moderately over the last year, to an average of 7.6 percent of lending to the private sector (households, NFCs, and industrial entrepreneurs) by 2023Q3. These loans still account for a higher share of lending to the private sector than before the pandemic (6.2 percent as of Dec 2019). Finally,

outstanding loans issued under a pandemic related guarantee program exhibit a higher-than-average share of stage 2, stage 3, and NPLs (Box 2).

Figure 10. Spain: Capitalization of Banking SIs

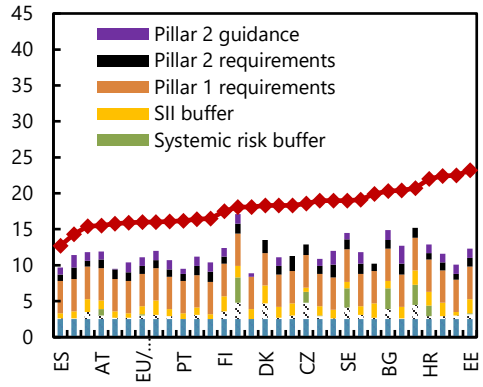
Capital ratios have improved since 2017 resulting both from a reduction in RWAs, and, from increased capital levels

Risk-Weighted and Tier-1 Capital



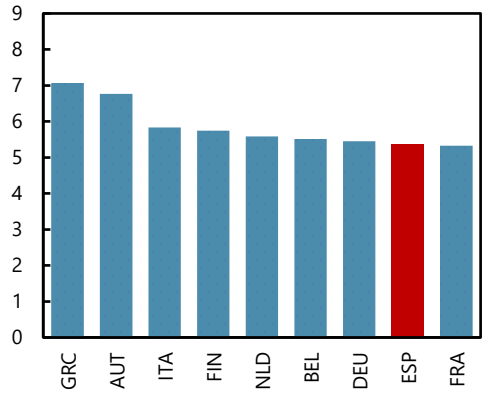
Spanish banks' regulatory capital ratios remain lower than European peers primarily reflecting lower voluntary buffers…

CET 1 requirements including Pillar 2 guidance
(Percent)



… but their leverage ratios are comparable to most EA peer countries, and …

Leverage Ratio: Fully Phased in Definition, 2023Q2
(Percent)



…they their capital depletion in the latest EBA stress tests was lower than EA peers.

CET 1 Ratio EBA. EU/EEA Wide Stress Test 2023
(Depletion percentage point (lhs); percent (rhs))

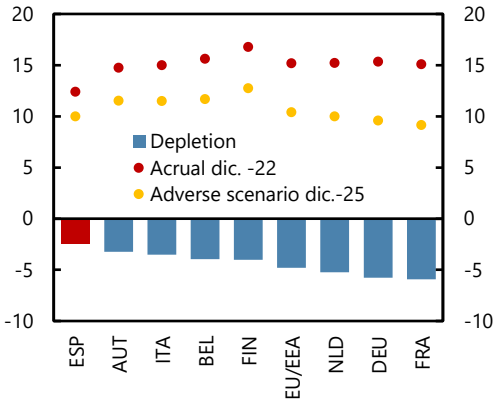
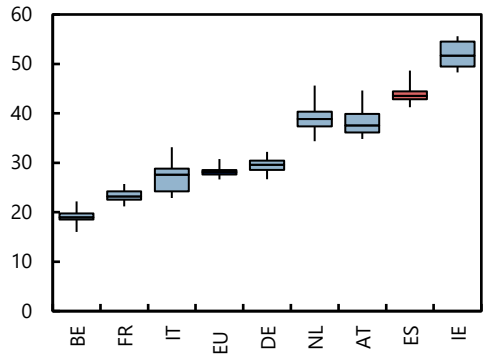


Figure 10. Spain: Capitalization of Banking SIs (concluded)

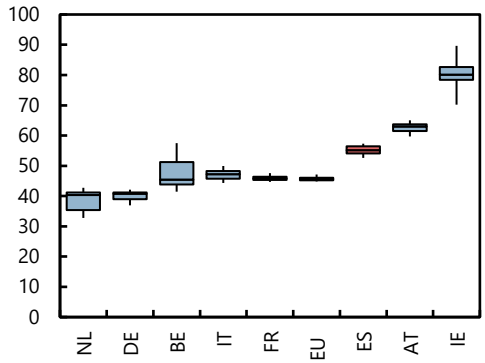
Banks in Spain have higher risk weight density for both retail…

Risk Weights Distribution for SIs - Retail
(2015Q2-2023Q3, percent, IRB approach)



…and corporate sector exposures.

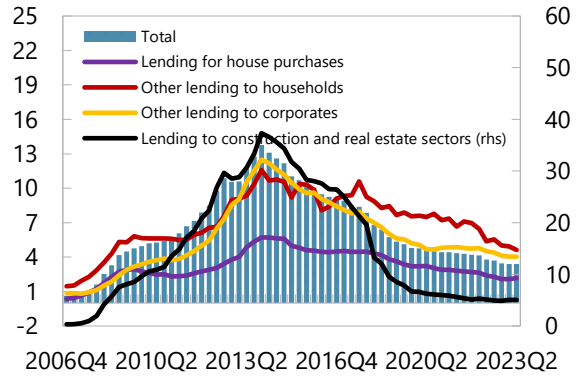
Risk Weights Distribution for SIs - Corporates
(2015Q2-2023Q3, percent, IRB approach)



Sources: BDE, ECB, Haver analytics, and IMF staff calculations

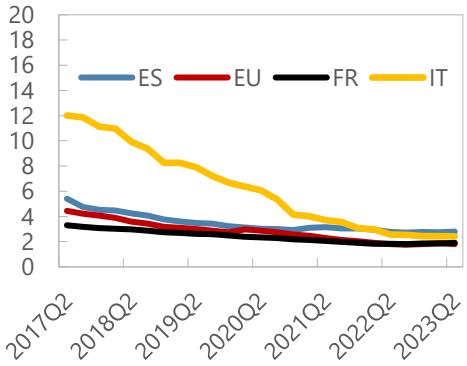
Figure 11. Spain: Banking Sector Asset Quality

Nonperforming Loans in Spain, 2006-2023
(Percent of total loans)



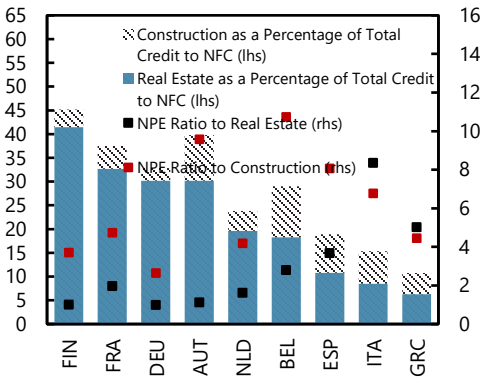
Sources: BDE, IMF Staff.

Non-performing Loans, 2017-2023
(Percent of total loans)



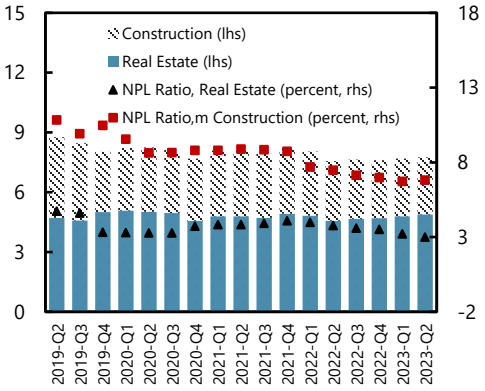
Sources: BDE, IMF Staff.

Exposures to Real Estate Activities and Construction
(Percent)



Sources: EBA; Haver Analytics; and IMF staff calculations.

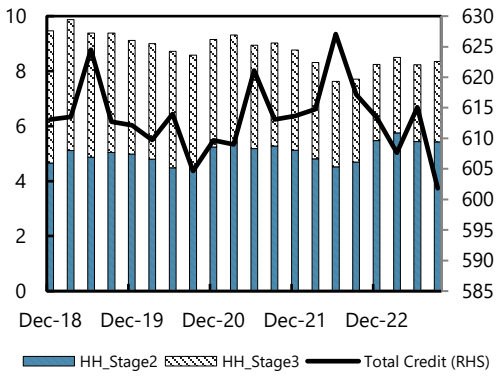
Distribution and NPL Ratio of NFC loans and advances by NACE code
(Bil EUR, percent)



Sources: EBA; Haver Analytics; and IMF staff calculations.

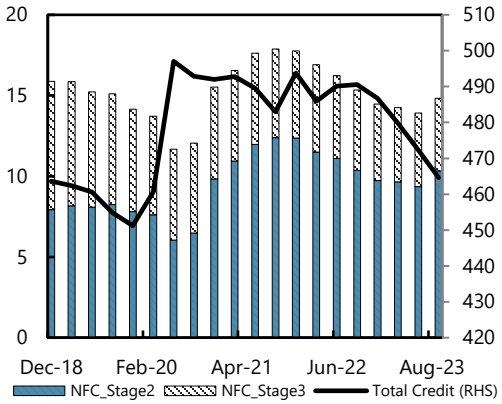
Figure 11. Spain: Banking Sector Asset Quality (concluded)

Households- Loans in Stage 2 and Stage 3
(Percent of total credit to households, billion EUR (rhs))



Source: BDE.

NFC + IND. Entrepreneurs - Loans in Stage 2 and Stage 3
(Percent of total credit to NFC + Ind. entrepreneurs, billion EUR (rhs))



Source: BDE.

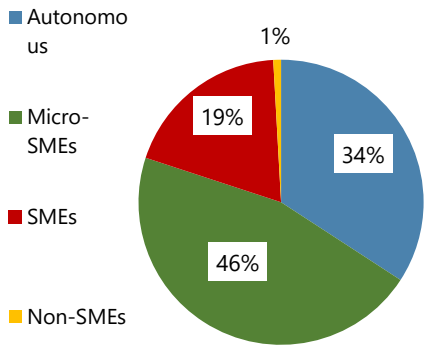
Table 4. Spain: Banking System Share of NPL by Duration
(2023 Q2, percent, consolidated)

	Significant Institutions	Others	All banks
Not Past Due	53.2	39.9	51.5
Past Due	46.8	60.1	48.5
<180 days	7.3	10.3	7.7
180 days – 1 year	9.6	11.8	9.9
1-2 years	9.4	11.3	9.7
2-5 years	11.6	14.7	12.0
5-7 years	2.4	3.2	2.5
>7 years	6.4	8.7	6.7

Box 2. Spain: ICO Loans

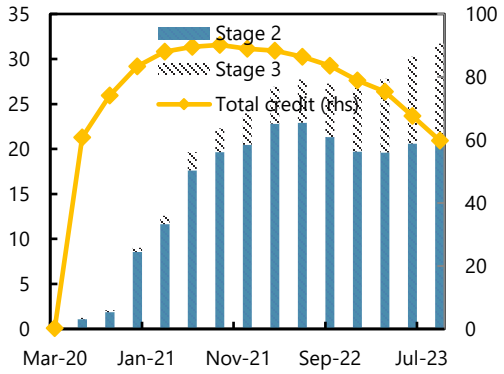
As a part of COVID relief measures, banks issued over €80 billion worth of loans to SMEs and autonomous institutions (about 6 percent of total private sector credit) under a loss sharing guarantee program of Spain's official credit institute (ICO). In the event of nonperformance of loans to SMEs and entrepreneurs, ICO covers 80 percent of the loss on the outstanding principal amount of new, and renewed, loans. For other NFCs, ICO covers 70 percent of the outstanding principal of new loans and 60 percent for renewed loans. ICO does not cover loss of interest, fees, commissions, and any recovery costs incurred by the banks. Although the volume of such credit has declined by 10 percent in 2023Q3, the share of stage 2 and stage 3 loans has risen to 32 percent of total ICO credit. The impact on banks is significantly attenuated by the ICO guarantee and the program is now closed.

ICO: Distribution of the number of unpaid transactions by type of company, 2023Q2
(Percent)



Sources: ICO and IMF Staff calculation.

Loans by Official Credit Institute (ICO)
(Percent of total ICO backed loans, mil of EUR (rhs))

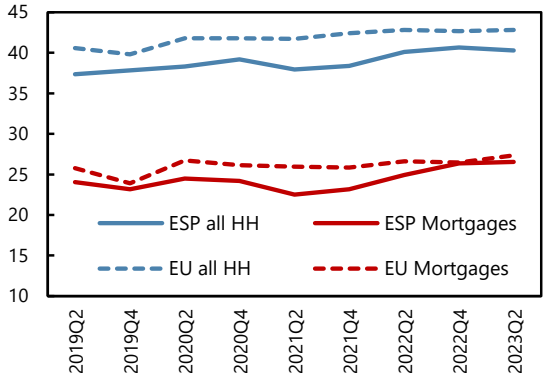


Source: BDE.

15. SIs' provisioning coverage of NPLs grew in the twelve months prior to June 2023, reaching over 46 percent for the resident private sector as a whole (Figure 12). The coverage ratio remains higher for corporate exposures than households. The coverage ratios are lower than the EU average for HHs and started exceeding the EU average for NFCs in 2023Q2.

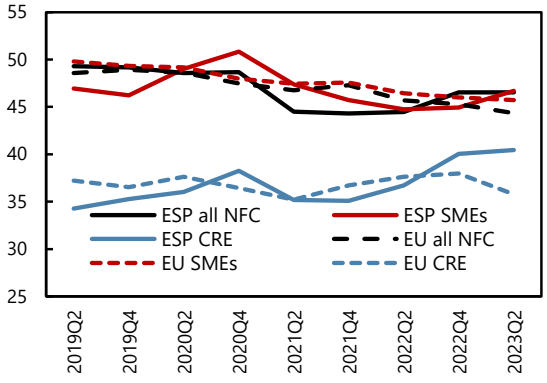
Figure 12. Spain: Banking Sector Coverage Ratios for SIs

Coverage Ratios for HH
(Percent)



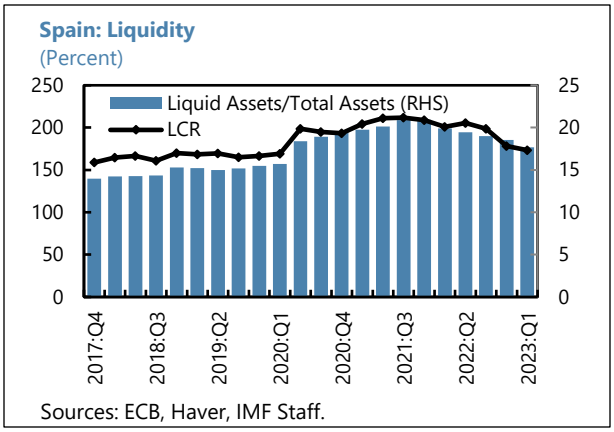
Sources: EBA; Haver Analytics; and IMF staff calculations.

Coverage Ratio for NFC
(Percent)



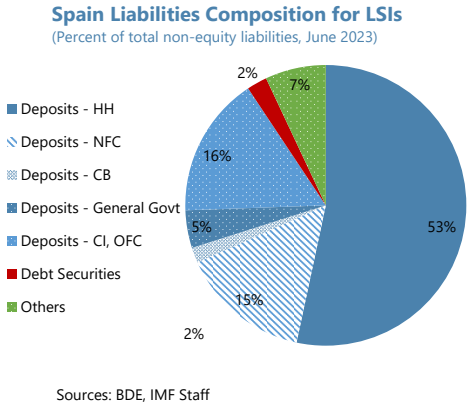
Sources: EBA; Haver Analytics; and IMF staff calculations.

16. Spanish banks have ample liquidity buffers. The Liquidity Coverage Ratio (LCR) of SIs stood at 182 percent in June 2023, well above the minimum required threshold. Spanish SIs with material international presence have lower LCR levels (153 percent in June 2023), in line with European peers, albeit still well above minimum requirements. The vast majority of Spanish LSIs maintain a conservative liquidity profile, supported by a base of stable retail deposits, which bolsters their capacity to absorb adverse shocks to wholesale market financing conditions. Spanish LSIs present relatively low loan-to-deposit (LTD) ratios and high volume of liquid assets, most of them eligible for monetary operations with the ECB. Overall, their liquidity position (in terms of LCR and NSFR) is well above the regulatory ratios.



17. Financial soundness indicators of Spain's small LSI sector are strong (Figure 13). The 57 LSIs, including 35 credit cooperatives, 20 banks and 2 savings banks, in aggregate, hold 5.5 percent of Spanish banking assets, are financed almost exclusively domestically (92 percent of Spanish counterparties). LSIs are well capitalized relative to European peers (aggregate, fully loaded CET1 ratio improving y-o-y from 19.2 percent to 21 percent by June 2023); have a strong liquidity profile (LCR of 305 percent, NSFR of 162 percent as of June 2023); low NPL ratios; have experienced a strong increase in profitability, with ROA close to doubling y-o-y through 2023H1 due to widening interest margins; and have performed well in the BDE's 2023Q3 supervisory stress tests.

Figure 13. Spain: Less Significant Institutions



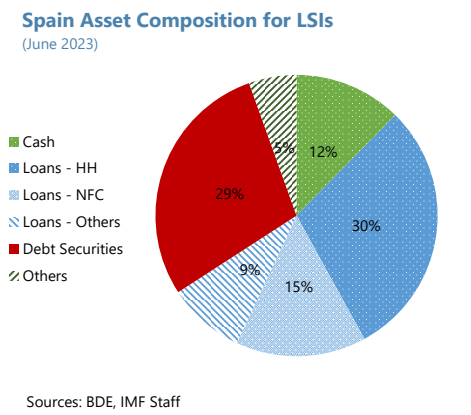
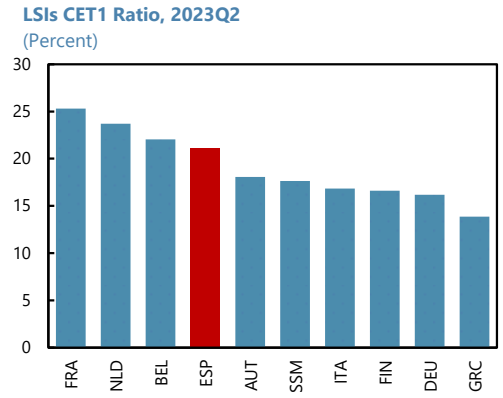
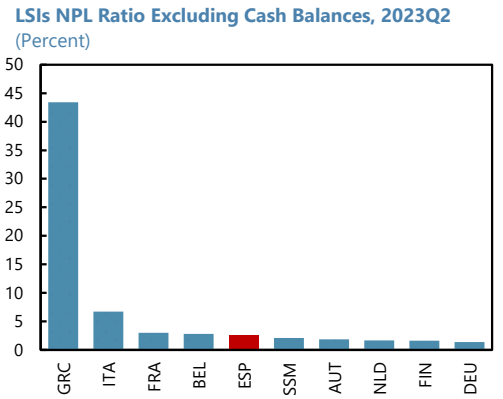


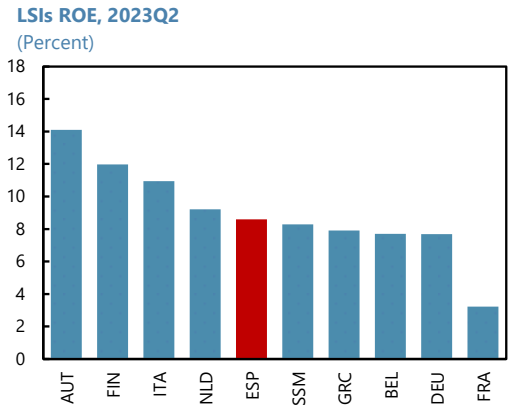
Figure 13. Spain: Less Significant Institutions (concluded)



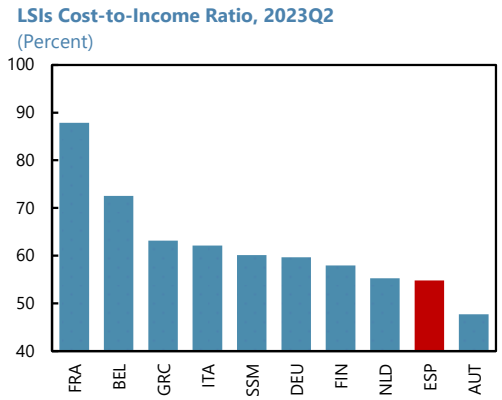
Sources: ECB; and IMF staff calculation.



Sources: ECB; and IMF staff calculation



Sources: ECB; and IMF staff calculation.



Sources: ECB; and IMF staff calculation.

C. Cross-Border Banking Claims and Interconnectedness

18. Reflecting the location of their international banking business, Spanish SIs exhibit concentrated foreign claims in Brazil, Mexico, the United Kingdom, and the United States.[7] The total consolidated foreign claims of Spanish banks on top 10 counterparty foreign banks, NBFIs, NFCs, and the public sector amounted to US$1.8 trillion in 2022Q4, of which $1.2 trillion foreign claims are associated with the four countries (Figure 14). Given that SIs have low intra-financial, and limited intra-group, exposures, their foreign claims are predominantly over NFCs (58 percent), followed by the public sector (25 percent), banks (10.5 percent), and NBFI (6.5 percent).

19. Foreign banks' exposures to Spain are significantly lower at US$ 450 billion in 2023Q2. Claims from banks headquartered in France, Germany, Italy, and the United States are prominent (Figure 14). Notably, around 26 percent of these foreign claims are directed towards the Spanish

[7] Foreign claims refer to the exposure or claims that banks in one country have on borrowers in another country. These claims can include loans, deposits, and other types of credit and financial investments that banks have made across borders.

nonbank private sector, while the remaining claims are distributed between the public sector (41 percent) and banks (28 percent).

20. International claims of Spanish SIs have witnessed a steady increase and foreign banks' claims on Spain a steady decrease since the EA sovereign debt crisis (Figure 14). The decrease in foreign bank claims is primarily attributed to a reduction in claims from other European countries.

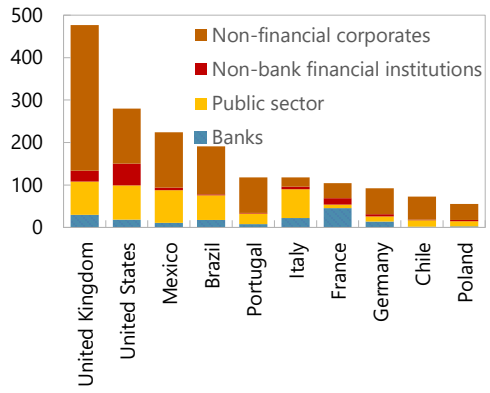
21. The primary orientation of Spanish SIs' foreign claims is domestic rather than international, primarily attributed to their subsidiary business model (Figure 14) and the degree of intragroup transfers are relatively limited compared to their peers.[8] This business model, which diverges from many other EA peers, indicates that Spanish banks prioritize establishing a strong local presence in foreign markets. Using the BIS Locational Banking Statistics to assess the extent of intragroup transfers, and in line with the conclusion from Consolidated Banking Statistics, Spain exhibits a moderate level of pure cross-border banking linkages. Spanish SIs' exposure to other banks located in other jurisdictions remain moderate when compared to countries like, France, Germany, Japan, the United Kingdom, and the United States (Figure 14). Moreover, the proportion of intragroup bank claims and liabilities for Spanish banks is notably lower than that of their peers. On the asset side, approximately 44 percent of cross-border bank claims for Spanish banks are intragroup, a figure substantially lower than the 71.5 percent reported by British banks and 67 percent by German banks at 2023Q2.

Figure 14. Spain: Cross-Border Banking Activities

Spanish banks exhibit concentrated foreign claims in the United Kingdom, United States, Brazil, and Mexico (2023Q2)

Consolidated Foreign Claims of Spanish Banks

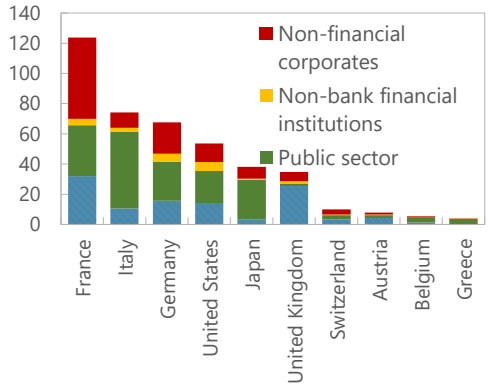
(Billions of USD)



Foreign banks' exposure to Spain is significantly smaller, totaling approximately US$ 450 billion (2023Q2)

Consolidated Foreign Claims on Spain

(Billions of USD)

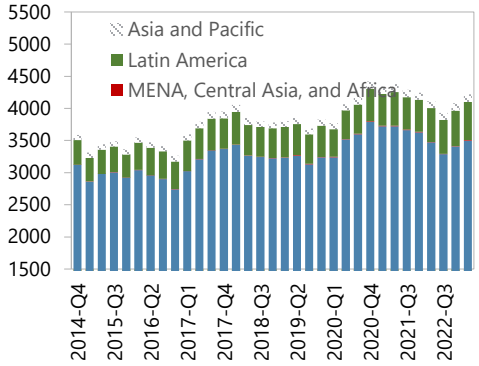


[8] International claims refer to cross-border financial claims that banks in one country have on residents of other countries. In contrast, local claims typically refer to the claims of banks on residents of the same country, but they can be denominated in foreign currencies. Hence Spanish subsidiaries claims on the host countries' residents are considered local claims.

Figure 14. Spain: Cross-Border Banking Activities (concluded)

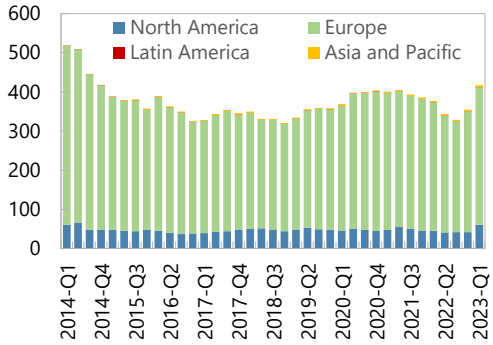
The international claims of Spanish banks have witnessed a steady increase post euro-crisis

Consolidated Foreign Claims of Spanish Banks
(Billions of USD)



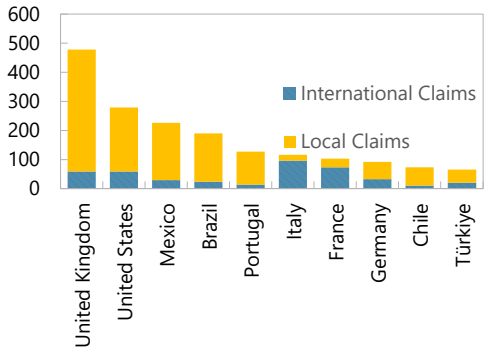
In contrast, the consolidated foreign claims on Spain have seen a notable decline since the GFC

Consolidated Foreign Claims of Spanish Banks
(Billions of USD)



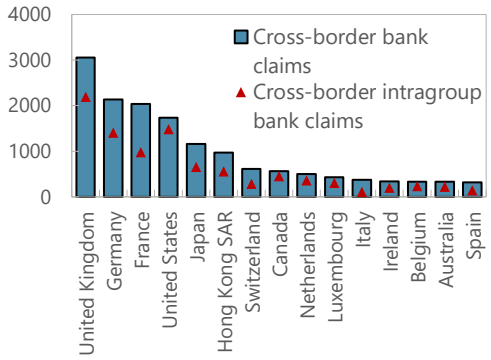
Spanish banks' foreign claims primarily take the form of loans by their foreign subsidiaries

Cross Border vs Local Consolidated Foreign Claims
(Billions of USD)



The degree of intragroup transfer within Spanish banks seems relatively limited when compared to their international counterparts

Cross-Border Intra-Group Claims
(Billions of USD)



Sources: BIS Consolidated and Locational Banking Statistics, and IMF staff calculations.

SYSTEMIC RISK ASSESSMENT

A. Key Risks to Financial Stability

22. The key risks to financial stability in the current situation are geopolitical risks, a higher and more persistent inflation, weaker exports and investment growth, and tighter financial conditions (Appendix I). Further escalation of geo-political tensions, higher-for-longer interest rates, renewed volatility in commodity, especially energy, markets could create shortages in critical supply chain components, further raise inflation, increase the likelihood of recession, and result in even tighter domestic financial conditions. Economic actors could become more pessimistic about the macro-financial environment, increasing risk aversion, with negative macro-financial consequences. All of this would, in turn, weigh on households, NFCs, the property market, and

ultimately, on banks' asset quality. In such context, domestic policy miscalibration or exogenous events, such as cyber threats, could amplify the financial stability impact of shocks.

23. FSAP stress tests analyze the impact of an adverse macroeconomic scenario comprising of two consecutive years of recession (Appendix II). The scenarios span three years (2024-2026). The baseline scenario underlying the banking solvency stress tests is aligned with the October 2023 World Economic Outlook projections. The adverse stress test scenario is characterized by a significant and persistent recession entailing a cumulative loss of 7 percentage points of real GDP over two years (-4 p.p. and -3 p.p. respectively in 2024 and 2025) with modest recovery in 2026.[9] The shock is equivalent to 2.1 standard deviations in cumulative terms relative to the baseline over 2024-25, and 2.3 standard deviation from historical mean. Under the adverse scenario, a combination of shocks results in a significant global economic downturn, with negative spillover effects across trade and financial channels. Rising geopolitical concerns and related energy price spikes increase inflation, with the resulting monetary tightening precipitating lower economic activity. This scenario will impact banks and NBFI through adverse changes in asset valuations, funding costs, and credit quality. For example, decreasing property prices accompanying rising interest rates will dent mortgage credit performance. Rising sovereign spreads, reflecting the weaker economic environment and attendant political uncertainty regarding structural reforms, will add pressure on banks' returns under the adverse scenario. The scenarios are common to all banks and cover all major jurisdictions where Spanish banks are active, i.e., Latin America (LatAm),[10] Türkiye, the United Kingdom, and the United States. The scenario reflects the main risks in the Risk Assessment Matrix (RAM) and is based on the Global Macro-Financial Model (GFM), a structural macro-econometric model of the world economy, disaggregated into forty national economies.[11]

B. HH Vulnerability Analysis

Scope and Methodology

24. The household vulnerability analysis examines the adequacy of HH income in meeting expenditure needs using micro data from the BdE's Survey of Household Finances (EFF). The representative sample of Spanish HHs from the survey enables us to analyze the aggregate and distributional impacts of macroeconomic developments on HHs' incomes and spending pressures. On the income side, this analysis considers both labor and non-labor income. On the expenditure side, we include essential expenses on food, utilities, and rents for HHs who do not own their primary residence.

25. Two alternative measures of HH vulnerability are constructed, including a debt-servicing based measure and a cost-of-living adjusted measure.[12] A HH can be in stress when its

[9] For comparison, the previous FSAP's stress test calculated FSAP cumulative loss over the first two years of 5 percentage points of GDP, while during the GFC, the actual loss amounted to 3.6 percentage points of GDP.
[10] Latin American countries in the sample are Argentina, Brazil, Colombia, Chile, and Mexico.

[11] Vitek, F. (2015), Macrofinancial analysis in the world economy: A Panel Dynamic Stochastic General Equilibrium Approach, International Monetary Fund Working Paper, 227.

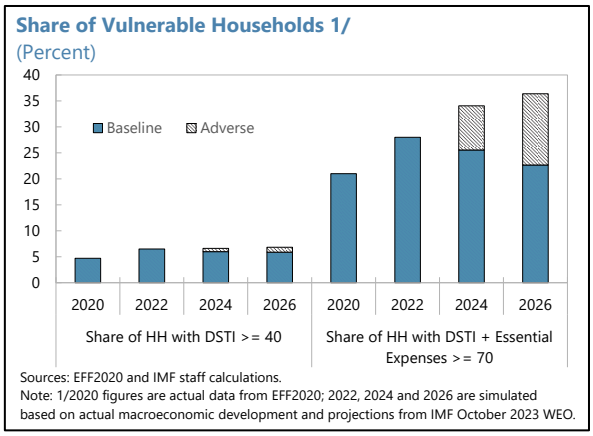
[12] For the construction and aging of the two vulnerability measures, see Annex VIII for details.

debt service payments take up a large proportion of income, or when its income is just enough to cover debt service payments and essential expenses on food, utilities, and rents. From a pure debt servicing perspective, we define a HH as vulnerable if the debt-service-to-income (DSTI) ratio is greater than or equal to 40 percent. When also considering the cost of living, the alternative measure of HH vulnerability defines a HH as vulnerable when its debt service payments and essential expenses on food, utilities, and rents exceed 70 percent of its income.[13]

26. We simulate the evolution of the HH income statement using EFF2020 under the baseline and the adverse scenarios from the bank stress tests. Given that the latest round of EFF was conducted in 2020, we simulate the evolution of income and essential expense items for each HH based on macroeconomic developments. For 2020–2022, the simulation relies on actual outturns; while for 2023 and onwards, two separate results are generated corresponding to the baseline scenario and the adverse scenario in the bank solvency stress test. Appendix VIII discusses in detail the application of macroeconomic shocks to individual HHs' income statement.

Results

27. HH vulnerability is expected to gradually improve under the baseline scenario from its peak levels in 2022 (text chart). The share of vulnerable HHs, defined in both the debt-servicing and the cost-of-living standards, had increased considerably by 2022 compared to 2020, in an environment of high energy and overall inflation, rising interest rates, and lack of income growth. Income started to catch up with inflation in 2023 and the strong labor market performance supported HH income growth. Together with the normalization of energy and food prices, and HHs' deleveraging, the impact from monetary policy tightening should be largely mitigated and the overall financial health of the HH sector should continue to improve in the baseline scenario.

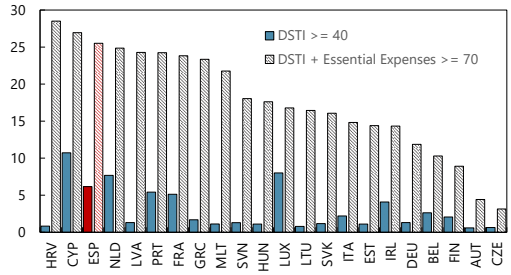


28. Nevertheless, Spanish households remain relatively more vulnerable compared to European peers in the baseline scenario (Figure 15). A simulation for European HHs using the 2021 ECB Household Financial and Consumption Survey suggests that by 2024, the share of HHs at risk in Spain, using both debt-servicing based and cost-of-living adjusted definitions, is on the higher end compared to other EU countries. In addition, although Spanish HHs accumulated higher financial assets relative to European peers, there was less asset accumulation among low-income HHs, making them more vulnerable against adverse shocks.

[13] The potential role of assets in this respect is only taken into account through the interest payments and rents they generate. The possibility of liquidating part of them is not contemplated even for older population.

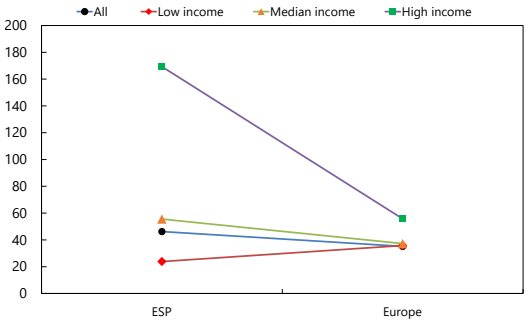
Figure 15. Spain: Household Vulnerability Compared to European Peers

Households at Risk by Different Vulnerability Standards
(Percent of total number of households, 2024)



Note: Macroeconomic developments are simulated based on IMF 2023 October WEO projections.

Financial Assets to Income Ratio, 2020-2021
(Percent)

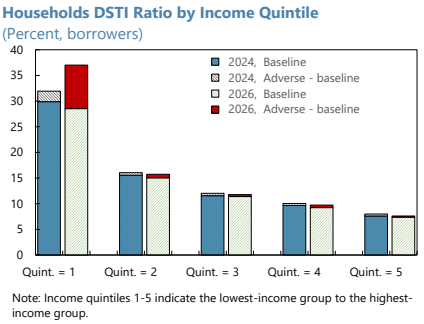


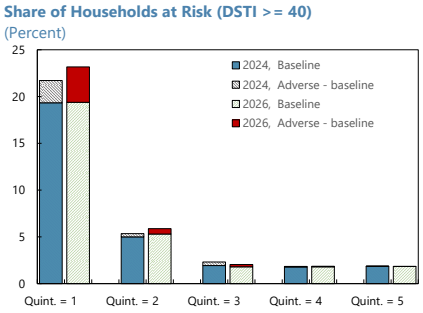
Sources: 2021 ECB Household Financial and Consumption Survey, EU-SILC, Valderrama et al. (2023), and IMF staff calculations.

29. Under the adverse scenario, HH debt servicing pressures are expected to remain contained, although higher costs of living will weigh on HHs. The average DSTI ratio for borrowers would increase from 14.9 and 14.3 in 2024 and 2026, respectively, in the baseline, to 15.6 and 16.4 in the adverse scenario. The share of HHs with DSTI ratio greater or equal to 40 percent is expected to increase only marginally compared to the baseline scenario, by an average of 0.8 percentage points in 2024 and 2026. Under the cost-of-living adjusted definition of vulnerability, the share of vulnerable HHs would increase by 8.5 and 13.7 percentage points in 2024 and 2026 under the adverse scenario, given that both food prices and energy prices are expected to remain elevated until 2026 under this scenario.

30. From a debt servicing perspective, pockets of vulnerability concentrate among low-income HHs. Simulation results by different income quintiles suggests that only the lowest-income quintile of HHs earning less than 1150 euro in 2019, is expected to see sizable increases both in borrowers' DSTI ratio and in the share of vulnerable HHs. HHs in the remaining higher income quintiles will not become necessarily more vulnerable in the adverse scenario. Overall, this implies limited increases in HHs' debt risk (Figure 16), given that the lowest-quintile income group holds only a small share of total household debt.

Figure 16. Spain: Household Vulnerability Based on Debt Servicing

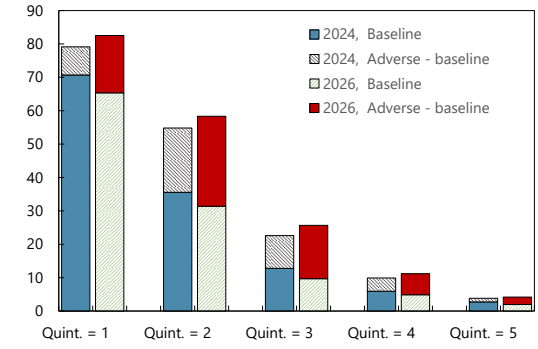


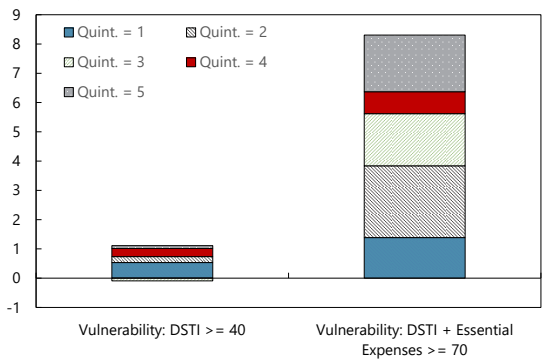


Sources: 2020 BDE Survey of Household Finances (EFF2020) and IMF staff calculations.

31. Adjusting for cost-of-living standards, high inflation originating from global commodity price spikes under the adverse scenario would increase vulnerability among low-to-middle-income HHs (Figure 17). Under an alternative cost-of-living adjusted definition of vulnerability, the share of vulnerable HHs in Spain would increase from the already-higher-than-peers levels of the baseline, i.e., 26 percent, to 34 percent in 2024 under the adverse scenario. The lowest three quintiles are expected to observe significantly higher shares of vulnerable HHs by 2026, when commodity prices would still be high in the adverse scenario. The share of HH debt-at-risk would also increase by 8.4 percentage points, with contributions from all income quintiles.

Figure 17. Spain: Household Vulnerability Based on Costs of Living





Sources: 2020 BDE Survey of Household Finances (EFF2020) and IMF staff calculations.

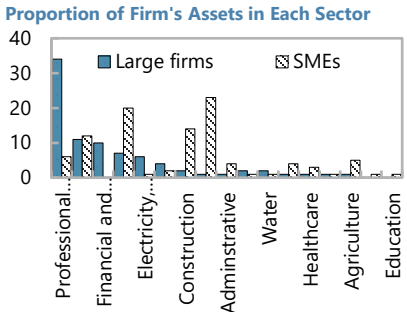
C. NFC Vulnerabilities

Overview

32. This analysis utilizes data at the firm level for Spanish companies sourced from the Central Balance Sheet Data Office Microdata. It involves the use of annual financial and income statements for all corporations during the period spanning 1995 to 2022, encompassing 19 different industries and covering around 950,000 firms a year, of which around 50,000 firms are large

corporations, and the rest are categorized as micro, small and medium enterprises (SMEs).[14] The entities included in this sample collectively represent 51 percent of the gross loan portfolio of banks, with large corporations accounting for two-thirds and SMEs contributing one-third to this total.

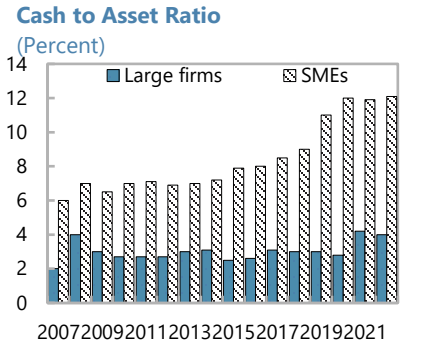
33. Large corporations tend to be focused on specific sectors with similarities in terms of their total assets and the number of companies, although there are some distinctions when it comes to SMEs. When considering the distribution of assets or firms' concentrations in terms of numbers, large corporations are predominantly clustered in the professional activities, financial services, and manufacturing sectors with minimal presence in accommodation and agriculture. SMEs do not compete in many sectors with large corporations, such as in finance and infrastructure sectors, including electricity, gas, and water, and are mostly concentrated in the retail, real estate, manufacturing, and professional activities sectors.



Sources: Spanish Authorities and IMF Staff calculation.

34. Over the past 10 years, there has been a consistent upward trend in the profitability of NFCs, although the impact of the COVID-19 crisis has somewhat diminished this positive trajectory (Figure 18). Before the onset of the COVID-19 crisis, larger corporations consistently surpassed their smaller counterparts in performance, whereas post-COVID, smaller firms have been generating more profits, surpassing pre-COVID earnings levels.

35. Post European debt crisis, all firms have shown improvements in their liquidity indicators. SMEs typically maintain higher levels of liquid assets compared to large corporations (Figure 19). Over the past decade, the current ratio has increased, with both large corporations and SMEs holding more liquid assets than their short-term liabilities. This trend is consistent for cash availability and cash-to-asset ratios which as of the end-2022 remains above 20 percent for large firms and SMEs in most sectors (text chart).



Sources: Spanish Authorities and IMF Staff calculation

36. Except a temporary drop during covid-19 crisis in 2020, the repayment capacity of firms has continued to improve (Figure 19). The interest coverage ratio (ICR)[15] of all firms increased from 2.5 in 2012 to close to 6 for large firms and 7.5 for SMEs, indicating a comfortable margin of safety.

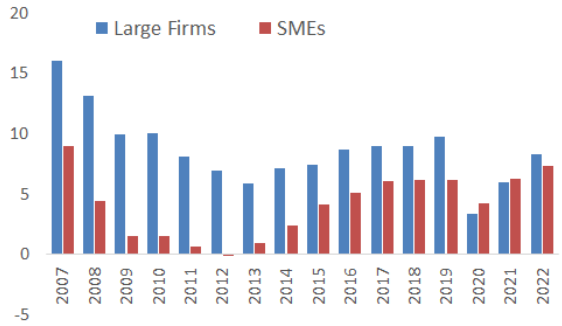
[14] Based on the criteria of European Recommendation '2003/361/EC' which categorizes businesses into different size categories based on their annual turnover, balance sheet total, and number of employees. The category of micro, SMEs is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding EUR 50 million, and/or an annual balance sheet total not exceeding EUR 43 million.

[15] Interest Coverage Ratio is defined as the ratio of earnings before interest and taxes (EBIT) to interest expenses, hence, proxying the debt repayment capacity of a firm.

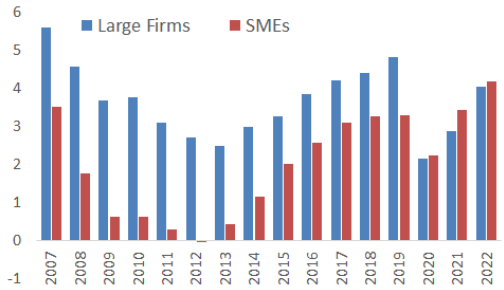
37. Consistent with other indicators, leverage as measured by debt-to-asset and debt-to-equity ratios, has been continuously declining since the European debt crisis (Figure 19). The debt ratio[16] is decreasing for firms with an ICR below one or a cash availability ratio below one (Figure 19), indicating reduced risks of illiquidity and insolvency within the corporate sector. The debt ratio at risk exhibits a similar trend for both SMEs and large firms, but there is greater diversity across sectors with extractive industries, utility, and wholesale and retail sectors as more susceptible to the risks associated with the debt ratio.

Figure 18. Spain: NFC Profitability Over Time and Across Sectors

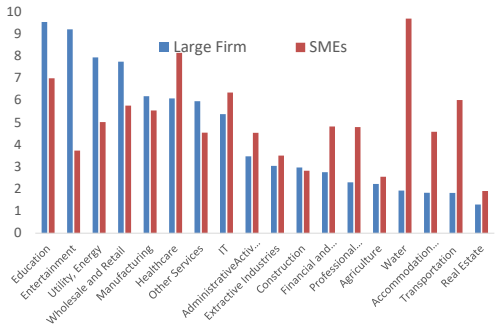
There is upward trend in the profitability of firms …
(ROE, percent)



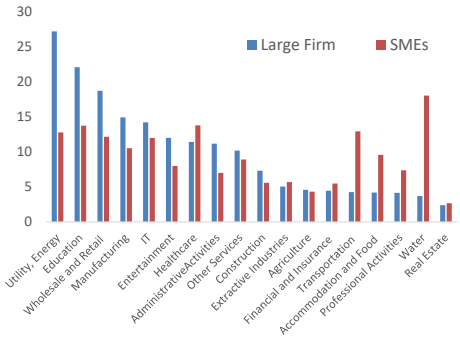
was somewhat diminished by the impact of the COVID-19 crisis
(ROA, percent)



(ROE remains above 1 for all sectors at end-2022
(ROE, percent)



Overall, profitability remains similar for SMEs and large firms
(ROA, percent)

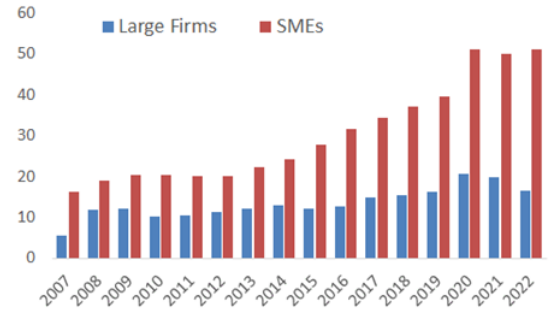


Sources: Spanish Authorities and IMF staff calculation.

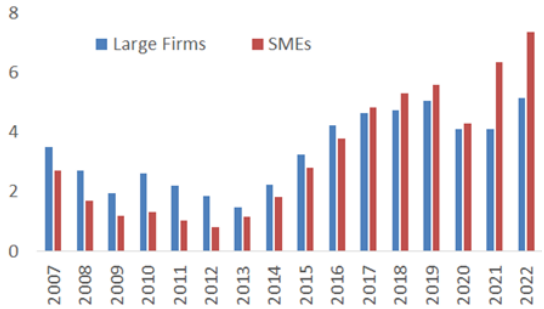
[16] Debt ratio is defined as (current liabilities + non-current liabilities)/total liabilities.

Figure 19. Spain: NFC Liquidity and Leverage

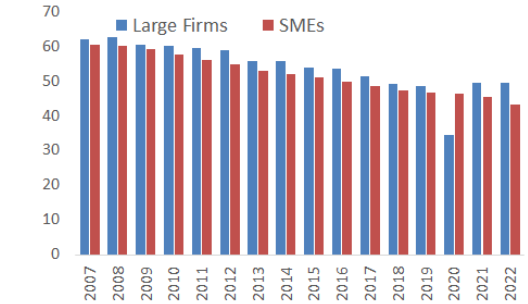
NFCs' liquidity has increased over the last decade (Cash availability ratio: cash and cash equivalent/ current liabilities, percent)



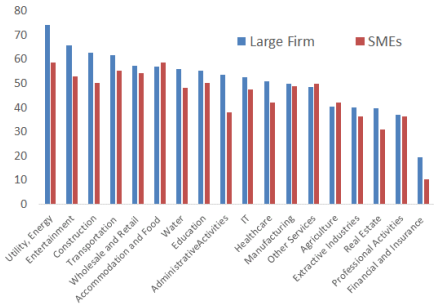
… as has the interest coverage ratio (ICR).



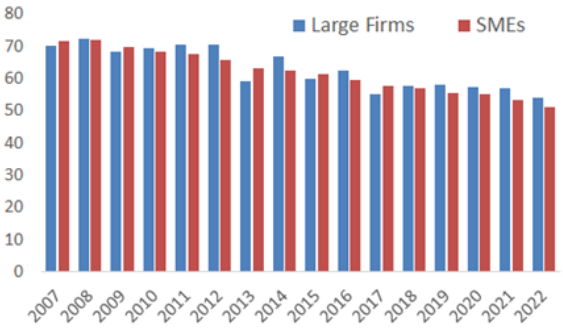
Leverage as measured by debt-to-asset ratio has been falling …
(Debt-to-Asset Ratio, in percentage points)



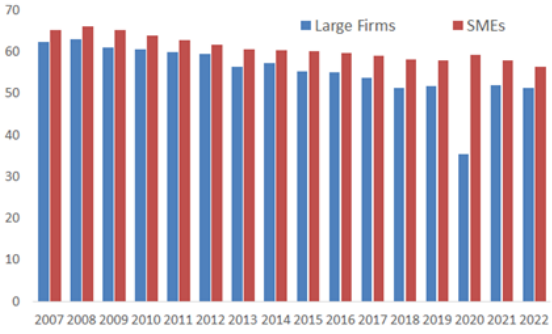
…. with a lower cross-sector dispersion for smaller firms
(Debt-to-Asset Ratio, by sector, in percentage points)



Debt Ratio for firms with ICR less than one has been falling too …
(Debt ratio, in percentage points)



and the same pattern holds for firms with a cash ratio below one, albeit to a lesser extent.
(Debt ratio, in percentage points)



Sources: Spanish Authorities and IMF staff calculation.
Note: Cash Availability Ratio = (Cash and Cash Equivalents) / (Short-Term Liabilities or Current Liabilities). Debt ratio is defined as the sum of current and non-current liabilities to total assets.

Methodology and Results

38. A solvency stress test[17] compares different scenarios related to NFCs' ability to manage their debt obligations and their borrowing needs. Using the bank solvency stress test scenarios, and data till end-2022, the exercise compares the number of firms facing challenges in servicing their debt under the baseline and adverse scenarios. A firm's ability to meet its debt obligations depends on its ICR. When the ICR is less than one, the firm is not generating revenue sufficient in value to service its debt and must take corrective action, such as reducing operational cost or using cash reserves. To assess this risk, the analysis categorizes NFCs into different risk levels based on their incumbent ICRs. Debt in the lower ICR category carries a higher likelihood of becoming nonperforming. In addition to NFCs already in trouble for debt servicing, the analysis also estimates the number of firms with ICR above one but less than two, since such NFCs could potentially face difficulties in servicing their debt in the near future if financial conditions worsen, such as lower sales or higher interest rates, both characteristics of the situation under the adverse scenario relative to the baseline. The exercise also assesses the number as well as the share of NFCs that might face liquidity problems, proxied by a firm's cash ratio turning negative.[18] A negative cash balance indicates a need for firms to raise debt to ensure incoming cash flow meets or exceeds outgoing cash flow.

39. The analysis reveals a moderate increase in NFC debt-at-risk[19] and liquidity imbalances in the first two years under the adverse scenario compared to the baseline scenario (Figure 20). The share of firms with ICR less than one is estimated to rise by around 6pp under the adverse relative to the baseline scenario within a year and remain 5pp above the baseline estimate at end-2025 (Figure 20). The share of debt of NFCs with ICR less than one increases by 0.9pp with respect to the baseline scenario, reaching around 29 percent of the total debt of these firms by end-2024 (Figure 20). Econometric estimates indicate that the primary driver of this increase in NFCs' debt distress in the adverse scenario is the fall in economic growth, with the difference in NFC debt-at-risk across the two scenarios falling gradually during 2024–2026 as the shock abates (Figure 20). The increase in NFCs' liquidity problems under the adverse scenario peak by 2025 (Figure 20).

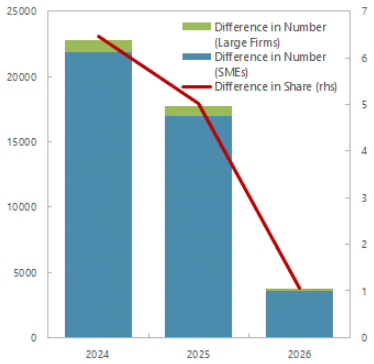
[17] The stress test exercise is based on the model described in Tressel and Ding (2021). For more details, please see the Appendix X.

[18] (Cash and Cash Equivalents) / (Short-Term Liabilities or Current Liabilities)

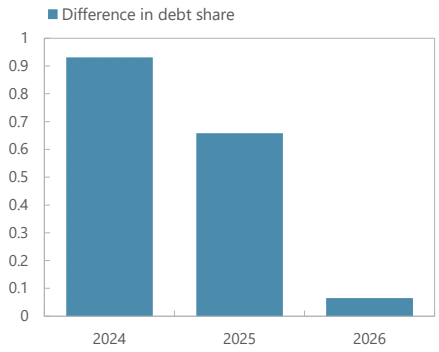
[19] Share of NFCs with ICR less than unity.

Figure 20. Spain: Nonfinancial Corporates –Scenario Analysis

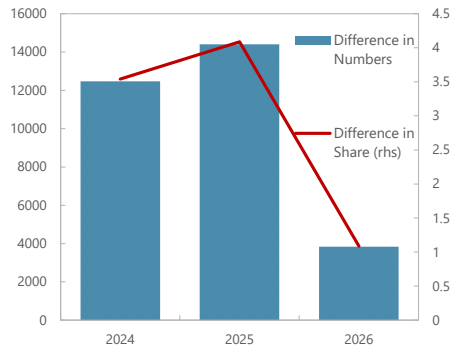
Share of Firms, Facing ICR Problems (ICR< 1)



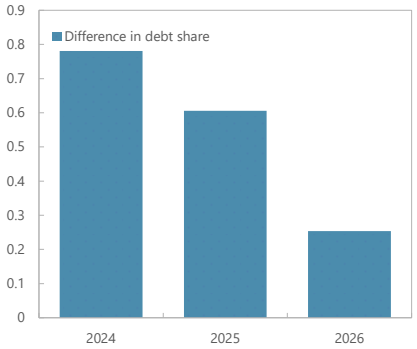
Share of Debt facing ICR Problem (ICR< 1)



Share of Firms, with Cash Problems (Cash Ratio <0)



Share of Debt facing Cash Problem (Cash Ratio <0)



Sources: Spanish Authorities and IMF Staff Calculation

The stress-test is based on Tressel and Ding (2021). The macro shocks are those discussed in **Error! Reference source not found.**1 in Appendix II.

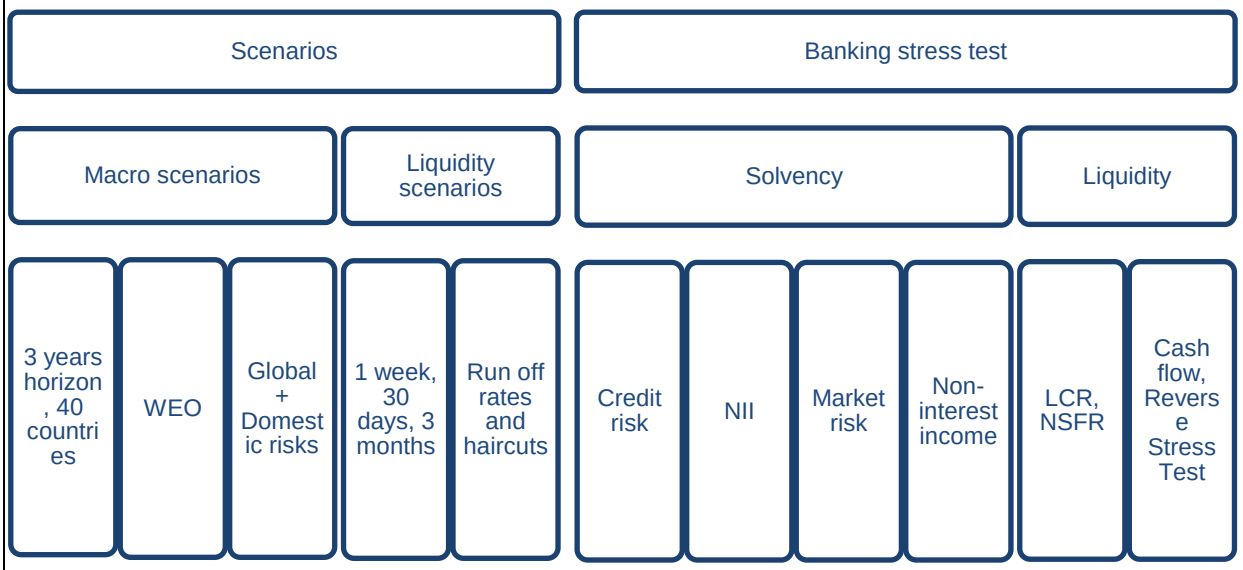
BANKS STRESS TESTS

A. Scope

40. The FSAP stress tests examine the resilience of the banking system to solvency and liquidity risks. The stress tests are Top-Down (TD), based on supervisory data and other confidential and market data. The solvency stress test measures the effects of the macroeconomic shocks on individual banks' profitability and capitalization, through satellite models and methodologies developed by IMF staff (Figure 21). The TD liquidity tests assess the capacity of banks to withstand large withdrawals of funding. It encompasses estimation of the LCR and NSFR under alternative liquidity stress scenarios and a cash flow-based test over different stress horizons.

41. The stress tests cover the 10 banking SIs.[20] The Spanish banking system is concentrated, also following a wave of consolidation after the European Sovereign debt crisis.[21] The three largest banks hold over 80 percent of banks assets, while the 10 SIs reach close to 95 percent of banking system asset.

Figure 21. Spain: IMF Approach to Bank Stress Test



Source: IMF staff

[20] These are: ABANCA Corporación Bancaria, Banco Bilbao Vizcaya Argentaria, Banco de Crédito Social Cooperativo, Banco de Sabadell, Banco Santander, Bankinter, CaixaBank, Ibercaja Banco, Kutxabank, Unicaja Banco.

[21] https://www.bde.es/wbe/en/publicaciones/informes-memorias-anuales/memoria-supervision/In 2008, the number of banks declined from 55 to 14.

B. Solvency Stress Test

42. This section explains the top-down solvency stress tests to assess the resilience of the ten largest Spanish banks to system-wide shocks (see Figure 1 in Appendix II). The methodology is in line with other FSAPs, namely Euro Area (2018), Finland (2022),[22] and Sweden (2022).[23]

Stress Test Methodology

43. The projections of revenues, expenses, and loan losses are based on modelled output of the balance sheet for each bank over the scenario horizon. Most components of pre-provision net revenue, which contains consolidated income statement and balance sheet information for each bank, are projected using data on historical revenues and operating and other non-credit-related expenses based on a mix of regression and structural models. Cut-off date for the stress test will be September 30, 2023, and the main source will be supervisory data collected under the Financial Reporting (FINREP) and Common Reporting (COREP) Standards.

Credit Risk[25]

44. Provisions are calculated as expected credit losses (ECL) for all asset classes/economic sectors with exposure at default (EaD), including off-balance sheet (Figure 22).[24] The key risk parameters used include probability of default (PD), Loss Given Default (LGD), EaD, RWA broken down by exposure class and domicile of the borrower for a total of 29 portfolios.[25] Starting points for risk parameters assigned to each portfolio are sourced from COREP C09.01 (standardized approach, SA) and C09.02 (Internal ratings-based approach, IRB).

45. PD projections were obtained via panel Bayesian Model Averaging (BMA).[26] The BMA approach addresses model uncertainty and different drivers of credit risk dynamics. For domestic portfolios, the BdE provided bank-level, historical PD data, hence panel BMA was used which provided bank-specific PD paths. For foreign exposures, PD time series was sourced from average estimates of Moody's one-year Expected Default Frequency (EDF).

46. As the 10 SIs have adopted and calibrated credit impairments according to IFRS9, some assumptions have been made to build historical and projected TM. Due to the lack of a long historical time-series of credit risk transition matrices (TM), scenario TM projections are

[22] Finland: Financial Sector Assessment Program-Technical Note on Systemic Risk Analysis and Stress Testing (imf.org)

[23] Sweden: Financial Sector Assessment Program–Technical Note on Stress Testing of the Financial Sector (imf.org)

[24] These include triggered credit lines, revolving facilities and guarantees.

[25] These are: Spain – financial institutions (FI), government (gov), mortgage, consumption, corporates (NFC); other euro area – FI, gov, - households (HH); NFC, Brazil – gov, HH, NFC; Great Britain – gov, HH, NFC; other Latam – gov, HH, NFC; Mexico – FI, gov, HH, NFC; United States – FI, gov, HH, NFC; Türkiye – gov, HH, NFC.

[26] Gross, M., and Población, J. 2019. "Implications of Model Uncertainty for Bank Stress Testing," Journal of Financial Services Research, 55(1):31-58.

estimated through beta linking,[27] where an aggregate PD is projected and adapted to stage 1 and stage 2 exposures according to the most recent observed TMs. For domestic exposures, TMs were provided by BdE based on national credit registry data, while for foreign exposures, they were computed from vintages of supervisory data on exposure stage migration.

47. LGDs for collateralized lending were calibrated through structural modelling, using reported information on collateral values, starting point reported LGDs, and house price paths from the macro scenario. LGD for unsecured lending in advanced economies is calibrated through the Frye-Jacobs method.[28] Other exposures have constant LGDs over the scenario.

48. Credit risk RWA are updated according to the portfolio regulatory treatment. For SA exposures, densities at the cut-off point are assumed constant over the scenario horizon. For IRB exposures, Basel formulas are used to calculate credit RWAs for each asset class in the segmentation, using projection of point-in-time default rates to obtain through-the-cycle PDs. Carrying amount of credit exposures evolve according to the assumptions in par 57 below. Downturn LGDs are updated only if stressed LGDs exceed what is reported by banks and kept constant otherwise.

Interest Rate Risk

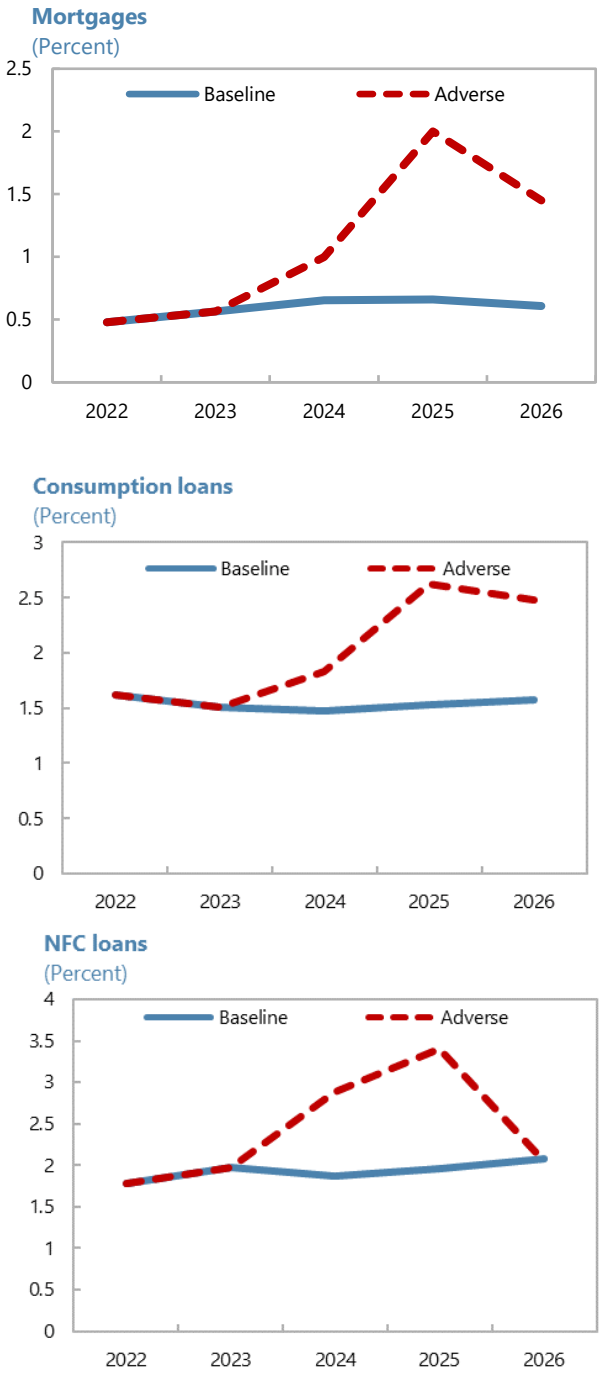
49. The FSAP used a structural model to project interest rates on new business over the scenario horizon and estimate net interest income (NII). Several interest-bearing assets and interest-paying liabilities were considered, aggregating portfolios considered in the credit and market risk modules, resulting in 50 accounts.[29] Bank-specific projection were obtained based on their repricing and maturity profile, derived from IRRBB, and maturity ladder reporting, which stays constant during the stress test horizon. Interest on nonperforming exposures is excluded, but no relative change in asset or liability composition is assumed. See Appendix V for more details.

[27] Gross, M., Laliotis, D., Leika, M., Lukyantsau, P. 2020. Expected Credit Loss Modeling from a Top-Down Stress Testing Perspective. IMF working paper WP/20/111.

[28] J. Frye and M. Jacobs (2012). Credit loss and systematic LGD. "Journal of Credit Risk," 8(1).

[29] Assets and liabilities are broken down based on the granularity of IRRBB report, which includes information by currency of the exposure. These include EUR - loans, EUR – exposures to central bank, EUR - securities held, DUSD – loans, DUSD – securities held, GBP – loans, GBP – securities held, LatAm – loans, LatAm – securities held, other assets. Liabilities were broken down into: ES – HH sight deposit, ES – HH term deposit, ES – Other deposits; EA – HH deposits, EA – other deposits; securities issued; LatAm – retail deposits, other liabilities. A weighted average path of rates, based on bank-specific portfolio decompositions was considered for domestic loans, for which rates information is more granular than repricing ladder data.

Figure 22. Spain: Domestic PDs Projections



Sources: BdE and IMF staff calculations.

50. Interest rates on new business for asset and liabilities were linked to the macro scenario via satellite models (Figure 23). Pass-through rates (betas) for domestic portfolios were estimated via Panel Error Correction Models (PECM), based on bank-specific panel data of interest rates on new business for sight and term deposits, and mortgage, consumption, and corporate loans provided by the BdE (Table 5). For foreign exposures, publicly available data on bank rates for the various jurisdictions was used[30] to estimate Vector Error Correction Models (VECM) for household, corporate loans, and deposit rates (Table 6). In the case insufficient data was available, a stylized pass-through of 50 percent for deposits and 100 for loans was used.

Table 5. Spain: Interest Rate Betas on Domestic Exposures, Banking System Averages

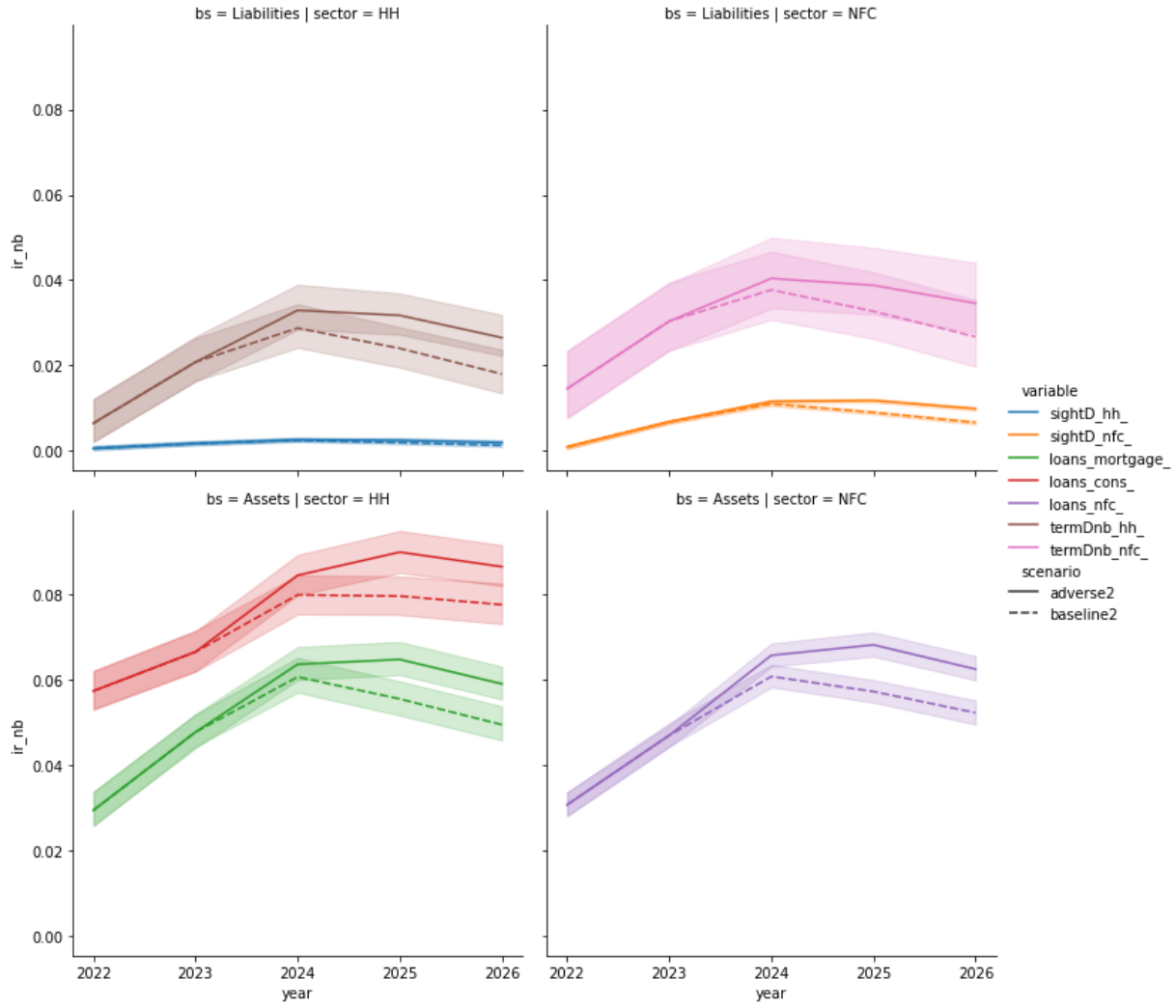
Sector	**HH**				**NFC**		
Item	Deposits		Loans		Deposits		Loans
type	Sight	Term	Mortgage	Consumption	Sight	Term	all
Beta	0.06	0.27	0.78	0.6	0.49	0.48	0.73

Table 6. Spain: Interest Rate Betas on Foreign Exposures

Country	**Loans**	**Deposits**	
	all	**HH**	**NFC**
BR	1	0.67	1
MX	0.95	0.49	0.49
TK	1	0.50	0.50
UK	0.50	0.34	0.59
US	0.50	0.32	0.59
EA	0.71	0.28	0.38
LatAm	0.98	0.58	0.74

[30] The data were sourced from Haver and CEIC. For remaining data, each country's central bank websites' data releases were used.

Figure 23. Spain: Interest Rate Projections



Sources: BdE, ECB, and IMF staff calculations.
Note: Solid lines indicate median rate, while shaded areas span the interquartile range across the banks in the sample.

Market Risk

51. The module considers the change in market prices due to interest rates changes. Market risk losses have an impact on capital resources, either via profit and loss (PL) or via other comprehensive income (OCI), depending on the accounting treatment of securities.

52. Valuation losses for debt securities were assessed through a modified duration approach. The module considered losses in the value of Fair Value-Through PL (FVPL) and -Through OCI (FVOCI) fixed income securities due to interest rate and sovereign spread shocks. Losses on FVOCI securities contribute to accumulated OCI. The amortized cost portfolio (AC) was not included in this module, to comply with accounting standard, but a sensitivity analysis was performed to gauge the extent of unrealized losses (see below par 69-71).

53. Supervisory reporting on sovereign exposures (C33.00.a)[31] was used as the main source of banks' positions and duration in seven classes of fixed-income securities,[32] and seven maturity buckets.[33] Duration is approximated as the mid-point bucket maturity. For securities denominated in currencies other than EUR, losses are calculated as the product of the size of each bond portfolio, average duration, changes in yields, and respective exchange rate change.

54. Impact of hedging was disregarded. The assessment of market gains and losses pertaining to the derivatives portfolio is impaired by data availability which limits its precise valuation and risk assessment, thus precluding a substantial stress testing of the derivatives portfolio. Given the overall small size of the exposures, it was deemed unnecessary to make further assumptions in this regard.

Market RWA was updated based on assumption on balance sheet growth. The projection of RWA ensures that the ratio is kept constant over the stress test horizon.

$$\frac{RWA_{market\ isk}}{RWA}$$

Non-interest Income and Expenses

55. Net fee and commissions income (NFCI) was projected in stressed conditions based on the historical variance of the non-interest income components by income activity. A conservative estimate of projected bank-specific income was obtained by adjusting annual profits by activity. Under the adverse scenario, profits from each business activity[34] is projected to be equal to the latest income minus one standard deviation of the historical variability of the income. For the baseline, the income grows at the same rate as the balance sheet (Para. 60).

Other Assumptions

56. Balance-sheet growth depends on the domicile of the exposures. Domestic exposures, both in terms of assets and liabilities grow at the credit growth rate, which for the adverse scenario entails deleveraging, but no further feedback loop or second round effect between banks' performance under the adverse scenario and subsequent credit growth is considered. For foreign exposures, a semi-static balance-sheet growth was assumed, with growth equal to the GDP growth of the scenario, when positive, and null otherwise.

57. Other operational income and expenses, as well as administrative costs are kept constant in the adverse scenario and grow at the same rate of the balance sheet in the baseline scenario. Extraordinary items and minority interest are assumed to be equal to zero.

[31] C33.00.a is reported twice per year, Q2 and Q4.

[32] These are: sovereign domestic, euro area (EA) sovereign non-domestic, GB sovereign, US sovereign, BR sovereign, MX sovereign, other.

[33] These are: below three months, between three months and one year, between one and two years, between two and three years, between three and five years, between five and ten years, above five years.

[34] The breakdown considers: Asset management, Insurance, Loans, Payment, Securities, Other.

58. The tax rate is set at the bank-specific median effective tax rate across the past five years for the whole stress testing horizon in case of positive net income and zero otherwise. For banks, whose historical tax rate appeared significantly below peers, due to the use of Deferred Tax Assets, a floor of 29 percent was applied. The bank levy of 4.8 percent on NII and NFCI, regardless of net profit being negative or positive, which was extended for 2024, was also applied in both scenarios.

59. Dividend payouts are payable out of the current year's profit where these are positive and set at zero otherwise and share buy-backs are excluded. Dividends are assumed to be paid out of current period net income after taxes by banks in compliance with supervisory capital requirements. The dividend payout ratio is determined from the bank-specific median dividend payout ratio over the past five years (dividends over net income after taxes, F 46.00), with a floor at 45 percent. If net income is negative, it is assumed that there is no dividend payout. It is assumed that banks do not issue new shares or make repurchases during the stress test horizon.

60. Minimum capital requirements used as hurdle rates were consistent with the Spanish capital regulatory standards that reflect Basel III capital requirements. The assessment criteria ("hurdle rate") includes the capital standards implemented via the Capital Requirements Regulation (CRR) and the phased-in buffers. The hurdle rates applied in the stress test are set at the Maximum Distributable Amount (MDA), which accounts for Common Equity Tier 1 (CET1) regulatory minimum of a 4.5 percent Pillar 1 requirement, bank-specific Pillar 2 requirements, and Capital Conservation Buffer (CCoB) of 2.5 percent, O-SII / G-SIB buffers, while CCyB is kept at zero for both baseline and adverse. This led to a CET1 hurdle rate around 8.4 for the system. For the leverage ratio the hurdle rate of Pillar 1 requirement was considered, corresponding to 3 percent.

Results

61. SIs perform well in the baseline scenario (Figure 24). The aggregate CET1 capital ratio exhibits an upward trajectory, reaching 15.4 percent at the end of 2026, from a starting point of 12.6 percent in Q3-2023. This salutary performance is due to the interest income generating capacity of banks' loan portfolios, the relatively low cost of retail funding, and stable loan loss provisioning. These results could overestimate bank capitalization to the extent that current pace of share buy-backs continue for some time as do ongoing trends in the migration of sight to term deposits.

62. SIs display resilience in the aggregate under the adverse stress test scenario, albeit with significant credit deleveraging and evidence of a weak tail of SIs. At an aggregate level, the CET1 ratio of the 10 SIs declines up to 3 percentage points, to 9.6 percent at end-2025, and recovers to just over 10 percent by end-2026. SIs record losses in all three years, with a peak in the second year and more contained losses in the last year. The CET1 ratio recovery in the last year is due to a slight decline in RWAs. The CET1 capital of two SIs fall below their Maximum Distributable Amount (MDA) trigger, with one breaching the leverage ratio requirement. To a significant degree, this outcome reflects the substantial deleveraging undertaken by banks in the scenario without which solvency of more banks would likely have been threatened. The overall macroeconomic costs of most SIs' maintaining adherence to minimum capital requirements under the adverse scenario are

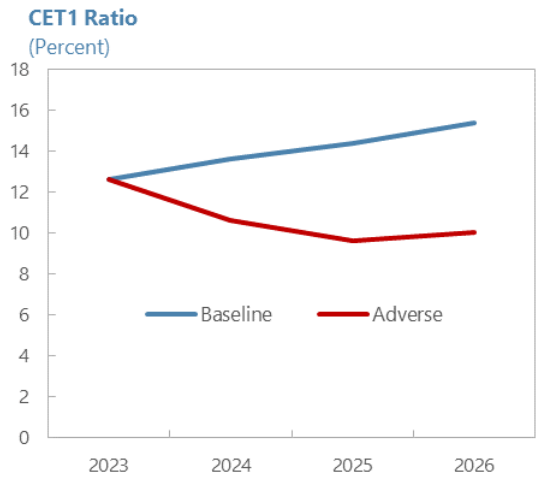
pushed up by them pruning their balance-sheets to absorb losses, which puts them in a poor position to meet credit demand.

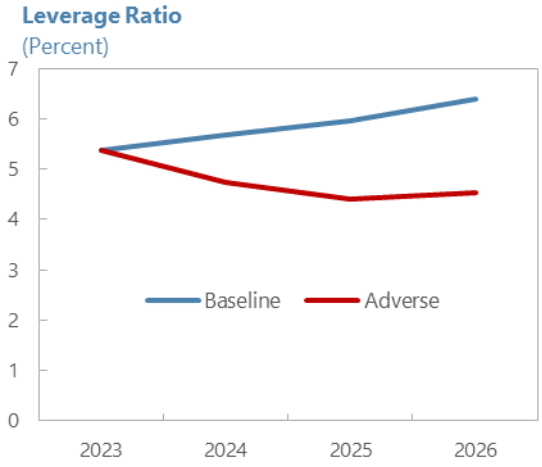
63. The increase in loan loss provisions (LLP) is the key factor underpinning reduction in bank profitability in the adverse scenario (Figures 24, 25). Three-year cumulative credit impairments are 135 percent of starting CET1 capital by end-2026. Under the baseline scenario, cumulative three-year impairments are 54 percent of starting capital. The majority of credit impairments are recorded in foreign portfolios. Given the global and synchronized shocks embedded in the adverse scenario, banks lose the geographical diversification advantage, which typically support profits.

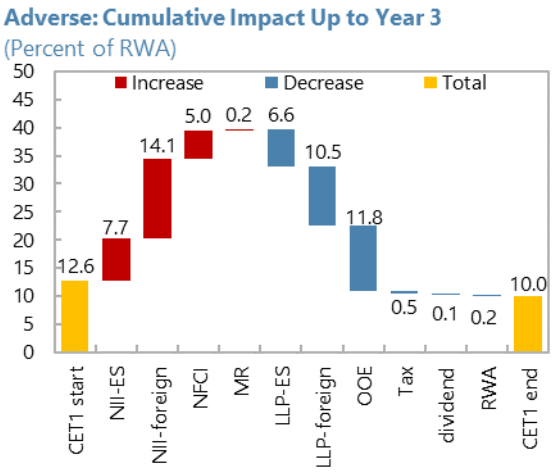
64. The increase in the interest rates in the adverse scenario allows banks to initially attenuate the impact of credit losses with higher net interest income (NII), but this mitigant wanes during the last two years (Figure 24). NII grows in the first year of the adverse scenario due to the interest rate pass-through differential between assets and liabilities, especially on domestic exposures, as price effects dominate volume effects. Subsequently, the attenuative effect of NII decreases as volume effects start to dominate due to protracted negative credit growth in Spain and increasing nonperforming exposures in both domestic and foreign loan books.

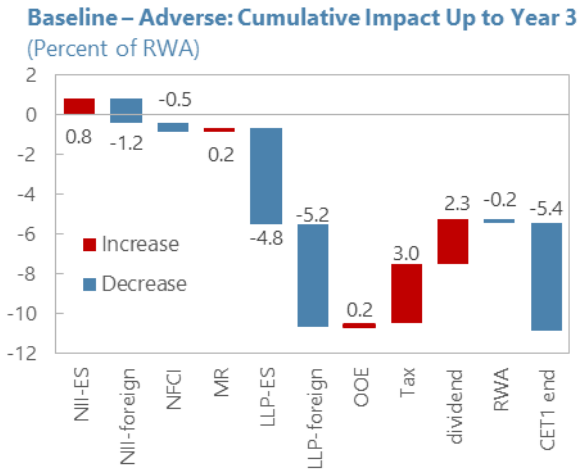
65. Market risk losses are material only in the first year of the adverse scenario, and they contribute positively to earnings in the outer years as rates start to normalize (Figure 25). While they contribute negatively to profitability and capital in the first year, they are not the main drivers of the results of the solvency analysis. The reasons for this limited impact are twofold. First, Spanish banks, on aggregate hold 60 percent of their bond portfolios at amortized cost, with a peak at 96 percent, and so the change in their market valuation does not get reflected in banks' earnings. Second, the negative impact of market risk in the first year is more than compensated by gains in the subsequent years of the scenario, when interest rates fall. Stressed net fee and commission income, a growing component of Spanish banks' income, is lower than in baseline, but it remains positive.

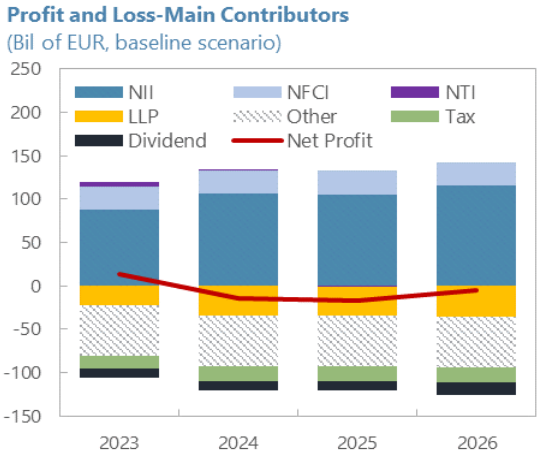
Figure 24. Spain: Solvency Stress Test Results

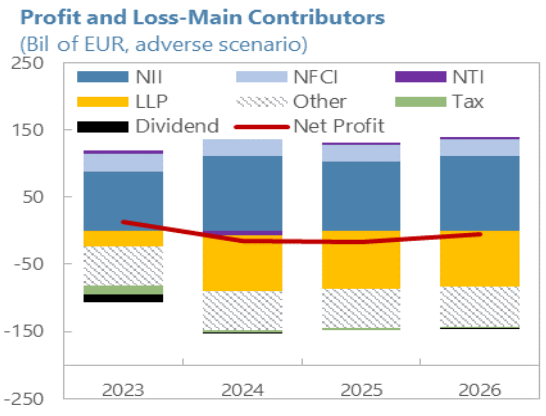












Sources: BdE, ECB, and IMF Staff calculations.

Figure 25. Spain: Solvency Stress Test Results

Sources: BdE, ECB, Moody's, IMF staff calculations

Sensitivity Analyses

Banks' Pass-Through Rates

66. The FSAP considered a series of alternative calibration of pass-through for domestic loans and deposits. These were obtained in different ways:

a. doubling the pass-through on loans and deposits separately ("2x-Deposit"and "2x-Assets").").

b. BdE estimates of pass-through on loans and deposits as of June 2023 ("BdE- Assets", "BdE-deposits" (Figure 9).

c. long-run estimates of pass-through using an ARDL model;[35]

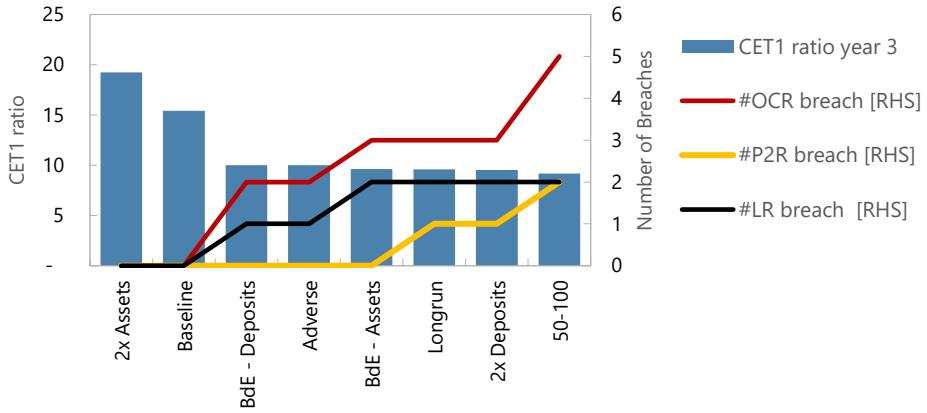
d. a stylized calibration with 50 percent pass-through on sight deposits and 100 percent on term deposits ("50-100")

All the calibrations assume a cap of 100 percent for the pass-through and pertain to the adverse scenario. Table 1 in Appendix V provides an overview of the alternative calibrations.

67. Results are robust to alternative pass-through rates (Figure 26). We compare calibrations against several metrics. The two scenarios at the opposite sides of the spectrum "2x-Assets" and "50-100", as expected, show an extreme picture: doubling the pass-through on assets, which imply having 100 percent rate on the domestic loan portfolio, boosts the NII significantly, owing to the high interest rates embedded in the scenario; on other end, increasing the cost of deposit funding to an unprecedented levels brings about three more capital breaches and further erodes the capital buffers of banks that were already in breach of overall capital requirements in the adverse scenario. The intermediate calibrations present a more balanced picture: lowering pass-through to assets or increasing them for deposits—under any of the alternative approaches—causes one CET1 breach, for a bank already close to the threshold under the adverse scenario, while a milder pass-through on deposits does not affect the results. In all the intermediate cases the capital ratio does not vary materially at banking system level.

Figure 26. Spain: Sensitivity Analysis on Interest Rate Pass-Through

End-2026 Results, by Scenario
(Percent, unit)



Sources: Bde; ECB; and IMF staff calculation.

Unrealized Losses on Amortized Cost Securities

68. Securities valued at amortized cost represent close to 60 percent of the bond portfolio. Of these, 60 percent are issued by the Spanish government, 20 percent by other euro area sovereign (rest of EA) and the rest 20 percent by a mix of advanced and emerging economies (RoW), in line with the international footprint of Spanish SIs. The level of encumbrance ranges between 29 and 82

[35] See also October 2023 GFSR Chapter 2. New Look at Global Banks Highlights Risks From Higher-for-Longer Interest Rates (imf.org)

percent, with higher encumbrance for shorter maturities and domestic bonds, on average (Table 7). Besides being held for liquidity purposes, the majority classified as HQLA, Spanish banks also invest into sovereign securities to increase the duration of their domestic assets, as the loans portfolio is largely at variable rate (63 percent for household loans and 57 percent for NFC loans).

Table 7. Spain: Level of Encumbrance for AC Portfolio, by Maturity and Geography

	Spain	Rest of EA	RoW
Less than 3 months	38	43	82
3 months to 1 year	43	35	52
1 to 2 years	49	69	35
2 to 3 years	58	45	36
3 to 5 years	53	47	43
5 to 10 years	49	48	46
over 10 years	48	42	29

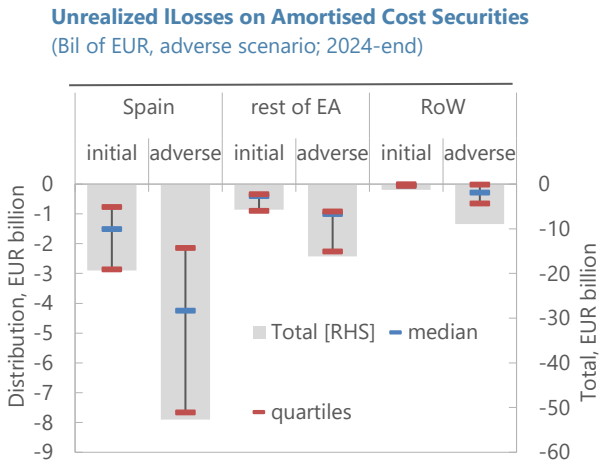
Note: percent of carrying amount.

69. Supervisory data on sovereign exposures available to the FSAP had some limitations, which make the loss estimates an upper bound. Bank-by bank stocks of exposures were based on prudential data (C33.00.a) and for Spain they include loans to local and central government. Prudential data alone does not allow distinguishing between bonds and loans, at a level of granularity sufficient to estimate unrealized losses. The BdE provided additional aggregate information on bond exposures, based on granular security-level data, including their market value, weighted average haircuts for unrealized losses up to June 2023, and weighted average haircuts for losses deriving from the baseline and adverse scenarios, up to the first year, by maturity and geography. Based on these additional data, the FSAP estimates loans exposures to represent, between 10 to 67 percent of the carrying amount for a given maturity bucket, with higher concentration on shorter maturities. Given this approximation, and the additional lack of data on hedges, all results presented in the following are to be considered upper bounds.

70. Unrealized losses would triple in the adverse scenario (Figure 27). Unrealized losses amounted to EUR 26 billion as of June 2023,[36] and they would reach EUR 78 billion in the adverse scenario. Individual banks' unrealized losses are heterogeneous because of size, geographical and maturity profile of banks portfolios. At individual bank level, the median unrealized loss stood at EUR 2 billion for exposures to Spanish sovereign (the largest contributor to the total losses, due to the size of the initial exposure), reaching EUR 4 billion in the adverse scenario.

[36] Based on self-reported estimates provided by banks in the context of the latest EBA stress test, Spanish banks' unrealized losses, including hedges, amounted to EUR 18 billion as of February 2023. See: Overall amount of unrealized losses in euro area banks' bond portfolios contained (europa.eu)

Figure 27. Spain: Unrealized Losses on Bond Portfolio



Sources: BdE; ECB, and IMF Staff calculations.

C. Liquidity Stress Tests

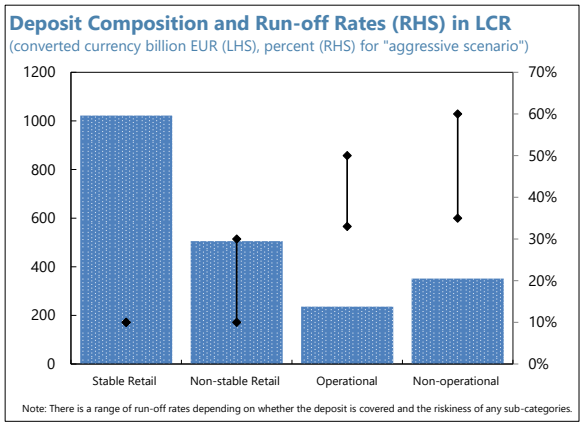
Overview

71. Structural liquidity analyses assess the Spanish banking sector's resilience to funding shocks and market driven stress. This comprises a LCR test (one-month horizon) and the NSFR (1 year). The team conducted a more granular cash-flow based (CF) analysis to evaluate the liquidity shortfall of banks across a range of scenario severities for one-week and three-month horizons. This included a reverse-stress test based on a "Distance to Liquidity Stress Indicator (DLSI)"[37] that measures the required stress factor that must be applied for the bank to reach the point where it becomes illiquid (surpluses turn into shortfalls). All these bank-level tests use August 2023 regulatory data from COREP and FINREP that provide detailed information on individual bank balance sheets, liquid assets, inflows and outflows, maturity ladder, and funding sources and maturities for the set of significant institutions.

72. The LCR analysis is based on four scenarios while the CF analysis considers a grid with 25 levels of scenario severities. The scenario severity in both cases ranges from European transposition of the Basel III scenario to an "aggressive" adverse stress scenario simultaneously stressing the market value of liquid assets, inflows, and outflows, calibrated based on relevant historical episodes (as further detailed below), recent banking turmoil in March-2023 and concurrent FSAPs. Two intermediate scenarios considering the effects from only "market stress" and "funding stress" help to decompose the underlying drivers of financial risk for banks' liquidity. Sensitivity analysis is also performed for a range of "funding stress" scenarios with increasing runoff rates on outflows for LCR. CF analysis further includes a reverse stress test indicator for each bank.

[37] The DLSI is a reverse stress-testing metric and was introduced in "A Liquidity Shortfall Analysis Framework for the European Banking Sector" by Laliotis and others (2020) published in *Mathematics*.

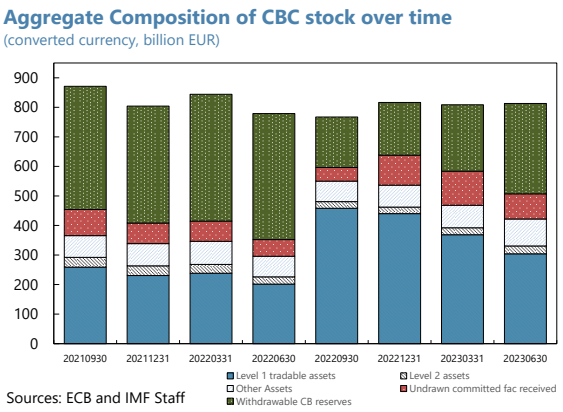
73. Spanish SIs primarily rely on deposits for funding (77 percent of bank liabilities in June 2023). While stable retail funding accounts for 48 percent of the Spanish banks' deposit mix subject to low run-off rates, the remaining 52 percent is a combination of non-stable retail, operational and non-operational wholesale deposits. Depending on the risk profile of such deposits, they are subject to varied haircuts depending on counterparty risk, coverage from deposit insurance, and maturity profile (text chart).

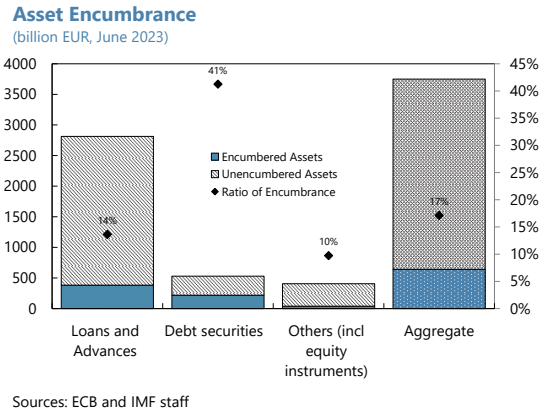


74. The counter-balancing capacity (CBC) across the 10 SIs has been stable since monetary policy normalization started (Figure 28, left panel). Majority of the CBC comprises of central bank reserves (31 percent) and level 1 assets (32 percent). The Spanish banks repaid over 90 percent of their TLTRO in 2022-23, largely by reducing central bank reserves, and partially by issuing secured and unsecured debt, to maintain a comfortable buffer in terms of deposit at central banks. In combination with relatively low loan-to-deposit ratio, the outflow resulting from TLTRO repayment did not cause concern for Spain. This further resulted in a relatively lower asset encumbrance in Spain at 17 percent in 2023-Q2 compared to 23 percent at the end of 2021.

75. The adverse scenarios used in liquidity stress testing are based on historical data. First, in June 2017, Banco Popular suffered a deposit run episode that resulted in the resolution of the bank, against the backdrop of uncertainty in asset quality and hence capital position, change in management and market reaction. Second, in 2017, Caixabank's deposits experienced short-lived and contained volatility whereafter pro-active, coordinated, and timely action led to an orderly handling of the outflows. The adverse scenarios used in liquidity stress testing take these two episodes as a benchmark, along with the recent banking turmoil in March-2023 and concurrent IMF-FSAPs to calibrate the degree of scenario severity.

Figure 28. Spain: Counterbalancing Capacity and Asset Encumbrance Across SIs





LCR and NSFR

76. The LCR test measures a bank's ability to meet its liquidity needs in a 30-day stress scenario by using its stock of unencumbered high-quality liquid assets (HQLA). Basel III LCR (called the baseline scenario) promotes the short-term resilience of banks' liquidity profile by requiring that in normal times banks hold a stock of cash or unencumbered HQLA (the numerator of the ratio) at least as large as the expected total net cash outflows (the denominator) over a period of significant liquidity stress lasting 30 calendar days. Due to the global footprint of some large SIs, the analysis considers other significant currencies—EUR, BRL, MXN, USD, GBP, TRY, and CLP.[38]

77. Adverse scenarios capture market driven stress and funding pressures via higher haircuts on HQLA and higher run-off rates on outflows respectively (Table 8). The scenarios' severity ranges from European transposition of the Basel III scenario to an "aggressive" adverse stress scenario simultaneously stressing the market value of liquid assets, inflows, and outflows. Two additional scenarios consider the effects from only "market stress" and "funding stress" to decompose the underlying drivers of financial risk for banks' liquidity. The FSAP calibrated scenarios severity based on relevant historical episodes in Spain, recent global banking turmoil in March-2023 and concurrent FSAPs. In addition, a set of general principles guide the choice of run-off rates for the computation of the LCR. First, more informed, and sophisticated depositors withdraw funding more rapidly than less informed ones. That is why run-off rates applied to wholesale funding sources are higher than those applied to retail funding sources. Second, run-off rates on insured funding sources are lower than those applied to uninsured funding sources. The FSAP also considered intermediate scenarios of increasing funding stress severity as a sensitivity analysis over the "Outflow" scenario.[39]

[38] The result will be published for EUR exposure only to comply with the confidentiality guidelines whereby among the banks contributing to the aggregate figure there are at least three banks, and no single bank contributes more than 85 percent of the aggregate figure.

[39]There are 3 intermediate scenarios prepared as a weighted sum of the factors (haircuts, run-off rates, roll-off rates) attributed to the "Basel III" and "Outflow scenario"- with weights as 75-25, 50-50 and 25-75 percent -called "Outflow_25", "Outflow_50" and "Outflow_75" respectively.

Table 8. Spain: LCR Scenario Summary				
LCR Stressed factors, rates, and haircuts	**Scenario**			
	Basel	Market	Outflow	Aggressive
Haircuts on liquidity buffers				
Roll-off rates on inflows				
Run-off rates on Outflows				
Note: A green cell indicates regulatory weights, red cell indicates "stressed" weights. The weight calibrations ensure internal consistency between inflows rates and haircuts within a scenario to satisfy the assumption that in a reverse repo transaction the inflow rates = 1- haircut for the underlying asset collateral.				

78. While banks appear to be resilient to market-driven stress, the aggregate LCR for the 10 SIs falls below 100 percent under the "outflow" and "aggressive" scenario. Four out of 10 SIs have LCR above the regulatory hurdle rate of 100 percent for the "outflow" scenario, and three SIs have LCR above 100 percent for the "aggressive" scenario (Figure 29).

Spain: Number of Banks Falling Below the Regulatory Hurdle for Each Scenario

Scenario	Basel III	Market	25% Outflow	50% Outflow	75% Outflow	100% Outflow	Aggressive
#Banks	0	0	0	1	2	6	7
Note: x% Outflow scenarios are weighted sum of Basel & Outflow scenario with weights (1-x)% Basel + x% Outflow.							

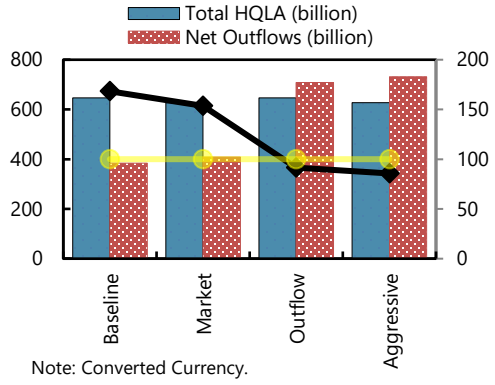
79. The second test is based on the Net Stable Funding Ratio (NSFR). The NSFR provides a useful complementary view of banks' funding profile in relation to the composition of their assets and off-balance sheet activities at a one-year horizon. It is based on the ratio of available versus required amounts of stable funding and informs the ability of banks to support long term funding of illiquid assets. The aggregate NSFR for the 10 significant institutions has been well above the hurdle rate for last two years. The most recent NSFR for June 2023 was 129 percent, well above the regulatory threshold (Figure 29).

Figure 29. Spain: LCR and NSFR Analysis for 10 SI

The LCR falls below the hurdle rate for the "outflow" and "aggressive" stress scenarios, however…

Aggregate HQLA, Net Outflows and LCR (RHS)

(Billion EUR, percent (RHS))



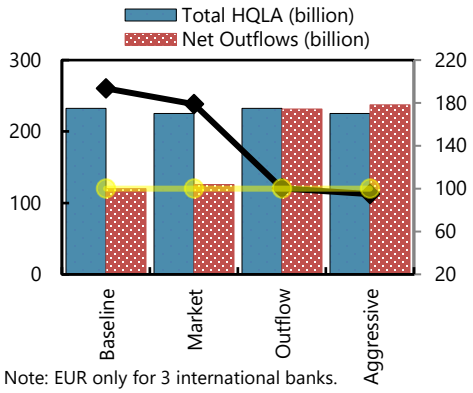
Note: Converted Currency.

Sources: ECB and IMF Staff.

Currency-specific LCR for exposures in EUR performs better under all stress scenarios for the three international banks.

Aggregate HQLA, Net Outflows and LCR (RHS)

(Billion EUR, percent (RHS))



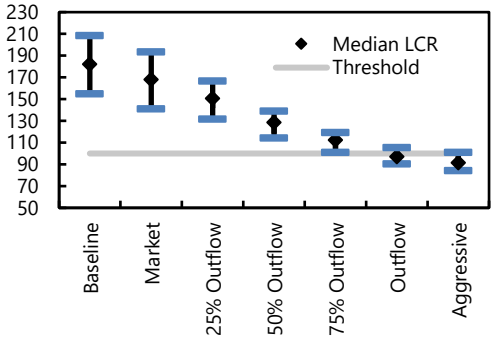
Note: EUR only for 3 international banks.

Sources: ECB and IMF Staff.

If 75 percent of the run-off rates considered under the "outflow" scenario were to materialize, SIs in aggregate would still exceed the hurdle rate.

LCR across SI - Median and Inter-Quartile Range

(Converted currency, August 2023)



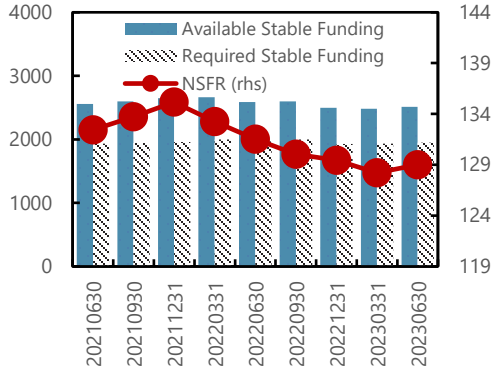
Note: x% Outflow is a weighted sum of (1-x)%Basel + x%. O

Source: IMF Staff.

The aggregate NSFR for the 10 significant institutions has been well above the hurdle rate for last two years.

Time Series of Net Stable Funding Ratio across SI

(Bil of EUR)



Sources: ECB and IMF Staff.

CF and Reverse Stress Test Analysis

80. The cash flow stress test evaluates the liquidity risk of the banks using two key indicators—bank's cumulated net funding gap and their counterbalancing capacity. Cash flow stress tests are conducted using supervisory data on contractual cash flows by maturity buckets (COREP C66) for one-week and three-months horizon. The net-funding gap is the difference between inflows and outflows in each time bucket and defined as the sum of these differences across buckets within a horizon. The counterbalancing capacity is defined as the cumulated value of liquid assets that banks can monetize under stress at reasonable prices across time buckets. A "liquidity shortfall" arises when the bank exhausts its counterbalancing capacity to fulfill the net-funding gap. Such an analysis provides a more granular balance sheet approach to assess banks' liquidity position vis-à-vis LCR, and helps to better identify the tipping points, thus informing policy discussions.

81. The CF analysis considers a range of 25 scenarios affecting asset values, inflows, and outflows uniformly across different maturity buckets. These scenarios are based on a linear grid of scenario severities across all factors (haircuts, run-off rates and roll-off rates) spanning also the "Basel III" and "aggressive" scenario analogues of the LCR[40] applied to bank level liquidity flows over one-week and three-month horizons. The analysis is based on the August-2023 data vintage and done for the entire set of significant currencies as before (only EUR exposure results are presented). Results are robust to different choice of data vintages.

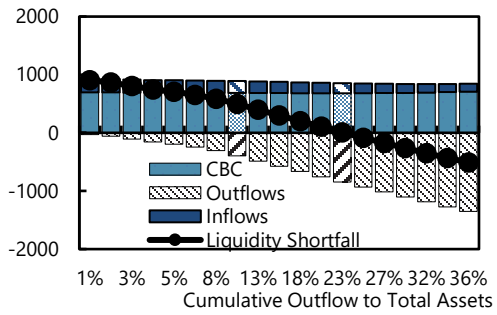
82. On aggregate, SIs would maintain a marginal liquidity surplus under the aggressive scenario over a one-week horizon while having a small shortfall over the three-month period. However, there is some heterogeneity, with three banks experiencing a marginal liquidity shortfall in the one-week cash flow at the "aggressive" scenario severity while this number increases to four banks for the three-month horizon. When considering only exposures in EUR, banks again appear to be more resilient. The key drivers of CBC depletion are wholesale deposit outflows and credit lines presented using a waterfall-decomposition of the three-month CF analysis along with all the results in Figure 30.

83. The distance to liquidity stress indicator (d) measures the degree of resilience to the "aggressive" liquidity stress conditions. It measures the gap in the ratio of "cumulative outflows to total assets" between the "aggressive scenario" and the "first shortfall scenario" (i.e., the first scenario severity for which the bank liquidity surplus turns to shortfall) for each of the 10 SIs. Hence, it measures the amount of additional stress the banks can withhold if the stress scenario were to entail additional "d" percent of cumulative outflows to total assets relative to the "aggressive" scenario. Only two banks have a negative DLSI for one-week horizon, while one bank has a negative DLSI for three-month horizon. This is partly explained by the inclusion of contingent outflows due to committed credit lines in the aggregation of outflows for the CF exercise.

Figure 30. Spain: Cash Flow and Reverse Stress Test Analysis for 10 SIs

SIs would maintain a marginal liquidity surplus under the aggressive scenario over a one-week horizon…

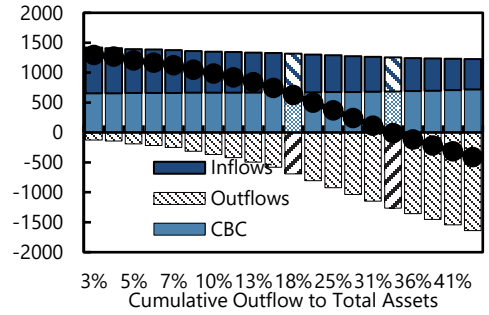
CF Analysis for One Week
(Billion EUR, converted currency, August 2023)



Source: IMF Staff.

…while having a marginal shortfall under the aggressive scenario persisting for three months.

CF Analysis for Three Months
(Billion EUR, converted currency, August 2023)



Source: IMF Staff.

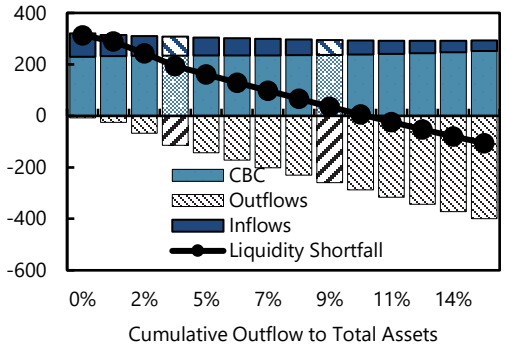
[40] The analogue to LCR entails the same run-off rates, roll-off rates and haircuts uniformly applied across outflows, inflows, and counterbalancing capacity respectively for each maturity bucket within each time-horizon.

Figure 30. Spain: Cash Flow and Reverse Stress Test Analysis for 10 SIs (concluded)

When considering EUR exposures, the largest banks maintain higher liquidity buffers over a one-week horizon…

…as well as over a three-month horizon.

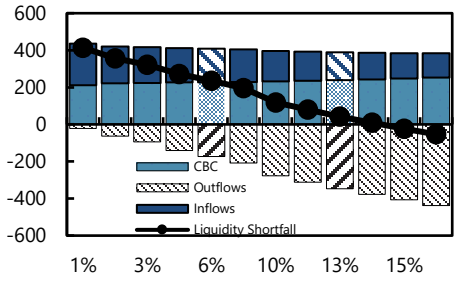
CF Analysis for One Week
(Billion EUR, only EUR for Three International SI, August 2023)



Note: x-axis is cumulative outflows scaled by total assets of the three international banks

Source: IMF Staff.

CF Analysis for Three Months
(Billion EUR, only EUR for Three International SI, August 2023)



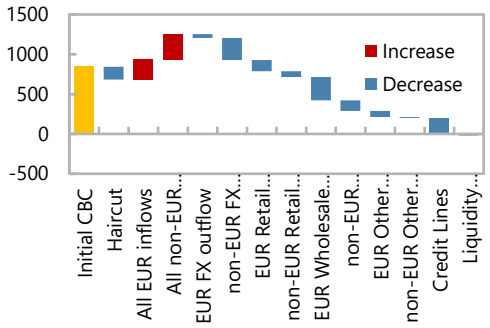
Note: x-axis is cumulative outflows scaled by total assets of the three international banks

Source: IMF Staff.

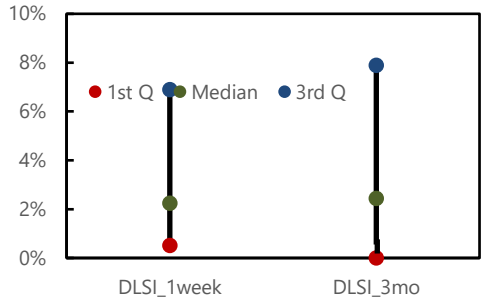
The depletion of CBC is primarily due to outflows from wholesale deposits and credit lines.

The DLSI (distance to liquidity stress indicator) measures the additional stress that would deem a bank from liquidity surplus to shortfall.

Waterfall-Decomposition of CF Analysis
(Three months, billion EUR, August 2023)



Distribution of DLSI across SI for One Week and Three Months
(Converted currency, August 2023)



Sources: ECB and IMF Staff.

Note: The CF analysis considers a range of stress scenarios (more than 20) affecting runoff rates and rollover rates of maturing obligations (i.e., the stress factors) with increasing severity. The scenarios are scaled using a simple linear grid of weighted sums between the assumptions underlying the Basel LCR in terms of run-off rates and the "aggressive" scenario. The x-axis summarizes the scenario severity in terms of aggregate outflows to total assets in each scenario, with the Basel and Aggressive scenarios highlighted in the grid.

D. Liquidity-Solvency Interaction

84. For banks which do not comply with LCR requirements in the outflow scenario, liquidity stress could potentially also impact banks' solvency. If a breach of LCR results in further funding outflows, then banks may eventually be unable to access the ECB standing liquidity facility. If, in addition, BdE emergency liquidity assistance (ELA) is unavailable to them in such circumstances, they may need to sell securities, e.g., government bonds held at amortized cost in the open market.

85. Sale loss estimates focus on unencumbered securities issued by EA sovereigns (including Spain). These amount to EUR 105 billion in total, or 39 percent of the whole bond portfolio for the subset of banks in scope. The team excluded securities issued from outside the EA, firstly, because a severe outflow event is unlikely to happen simultaneously on several markets globally, and secondly, because in the subsidiaries-based business model of the Spanish banks, liquidity is managed locally. When estimating the losses, any provision related to sovereign exposures is deducted, but the effect is negligible. Data limitation described earlier, apply also to these estimates, which are to be considered upper bounds.

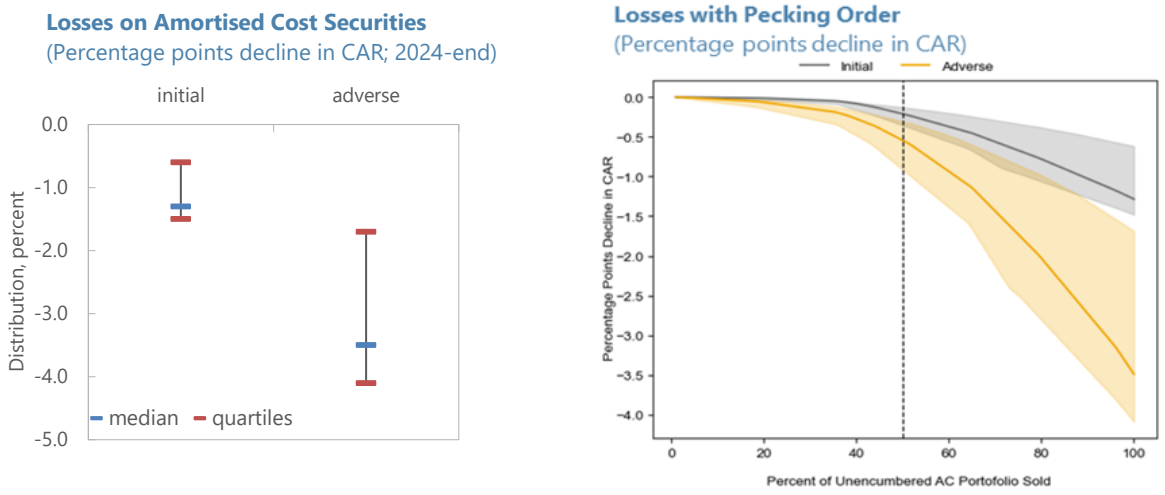
86. Potential sale losses from the liquidation of securities in the open market are estimated to induce a median decline in CET1 ratio between 1.3 and 3.5 percentage points (pp) (Figure 31). The lower bound of the range considers only unrealized losses up to June 2023 (the "initial" scenario), while the upper bound considers the peak losses from the adverse scenario, which occur at the end of the first year. In the adverse scenario, the first quartile corresponds to a decline of 4.1 pp, while the third quartile corresponds to a decline of 1.7 pp in CET1 ratio.

87. Moreover, by prioritizing sale of bonds with lower maturity, banks could liquidate half of their portfolio with less than one quarter of these loss estimates. As the scenario of liquidating the entire bond portfolio is extremely unlikely, the FSAP considered a range of liquidation rates reflecting potential different liquidity needs. A partial liquidation also entails a pecking order during the sale, where shorter maturity bonds are sold first, to minimize losses. For example, if the banks would sell half of their portfolio, losses entail a median CET1 ratio decline of 0.2 pp and 0.5 pp in the initial and adverse scenario, respectively.

88. Several factors render the scenario of forced bond sales an extreme event. First, a breach of the LCR requirement does not automatically preclude access to the Eurosystem (ECB's) standing facilities, as a grace period may be granted. Second, even in the absence of central bank access, EA sovereign bonds can also be used as collateral in cleared repo, where counterparties maintain anonymity, albeit at a cost of higher haircuts; given the ample inventory of these HQLA bonds, banks would still be able to raise significant liquidity even if less effectively then in business-as-usual conditions. Third, any sale of amortized cost securities would be most likely preceded by the liquidation of the part of the portfolio that is already marked-to-market, which, for the sample considered would generate in total EUR 38 billion, when accounting only for the unencumbered part and under adverse scenario haircuts. Fourth, several banks can generate liquidity through other sources, e.g., by issuing covered bonds backed by their mortgage loan portfolio—this option is particularly viable for banks with regular market issuance. Finally, given the

degree of economic adversity, assuming away simultaneously standing facility and ELA access is likely unreasonable.

Figure 31. Spain: Potential Losses from Forced Liquidation of Amortized Cost Bonds



Sources: BdE; ECB, and IMF Staff calculations.
Caveat: results are un upper bound. Stock of exposures includes loans to local and central Spanish government and there is no data on hedges

INTERCONNECTEDNESS ANALYSIS

A. Overview

89. The analysis of systemic risk and interconnectedness enhances understanding of risk transmission across the financial system. This section seeks to integrate these findings by examining the financial system's interdependencies. It starts with an exploration of the international contagion risks from Spanish international banking partners. It then moves to evaluate how banks might affect each other through their domestic direct financial exposures. Finally, it evaluates the implications of sovereign-bank financial linkages through banks' significant sovereign debt holdings.

B. Cross-Border Interconnectedness

90. The analysis of financial interconnectedness employs the network model developed by Espinosa-Vega and Solé (2011).[41] This model relies on data on the matrix of bilateral interbank gross credit exposures. Its application in this FSAP encompasses banks that represent Spanish SIs' largest banking counterparties at the domestic banking sector level, i.e., exposures from both the asset and liability perspectives of each country's aggregate banking system to Spanish banks. From the asset side, the analysis investigates the impact of pure contagion, where a given country's banks failure to meet their obligations imply direct credit losses for other banks within the network. On the

[41] For details, please see Appendix X.

funding side, the model's simulations rely on forced liquidations or "fire sales" triggered by funding shocks, reflecting situations where distress in another country's banking sector could precipitate liquidity strains in the Spanish banking market due to an abrupt loss of financing from the other country's banks. Under such circumstances, impacted banks may be compelled to liquidate other assets at reduced prices to meet demand for liquidity on the funding side.[42]

91. The analysis encompasses 11 banking centers, predominantly within Europe, that maintain the largest direct banking exposures with Spain. Using the BIS consolidated banking statistics up to the second quarter of 2023, the exercise models the effects of simultaneous credit and funding shocks. It hypothesizes a 50 percent loss on unsecured asset claims following a counterparty's default and a 30 percent loss for the portion of secured lending with collateral. Due to data scarcity, it is assumed that half of the bilateral exposures are collateralized. Moreover, it posits a 35 percent reduction in interbank funding reflecting a 65 percent roll-over rate, and a 30 percent discount on assets forced into liquidation due to funding shortfalls. The analysis assumes that part of the exposure is collateralized, meaning a higher recovery rate in case of default of the counterparty. For this exercise, the collateralized portion is assumed to be 50 percent, of which 70 percent is recoverable in an event of default. The analysis explores the implications of: (i) a credit shock alone, and (ii) both credit and funding shocks. It highlights the repercussions for the capitalization of Spanish banks of defaults on exposures of a range of EA and non-EA foreign banks.

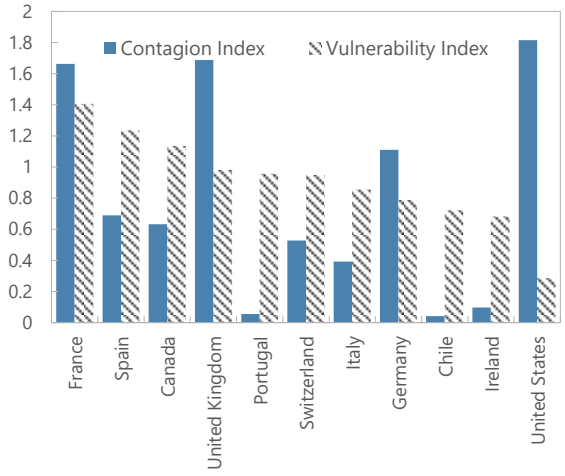
92. The analysis reveals that Spanish banks' vulnerability to contagion from distress in foreign banking systems via direct exposures to be modest given that the bulk of cross-border claims of these banks is to sectors other than banking (Figure 32). Spanish banks remain exposed to banks from the same set of countries from both credit and funding channels. The low level of interbank exposures on Spanish banks' balance-sheets limits the potential for systemic, cross-border interbank contagion risk in both directions (Figure 30).[43] The vulnerability index indicates that Spanish banks could face, on average across all in-sample counterpart countries, a loss of approximately 1.2 percent of their current total capital, if banks were forced to forfeit their cross-border banking claims under the recovery assumptions in the previous paragraph. The losses due to a banking distress in some individual European countries could reach up to 4 percent of bank capital in Spain. Notwithstanding this, the post-shock capital adequacy ratio even in such cases remains above 14 percent (Figure 30).

[42] The model's implementation follows an iterative process, wherein an initial default or distress within the (international) banking network yields a further cascade of distress or defaults through credit and funding channels and ends when no further distress is triggered.

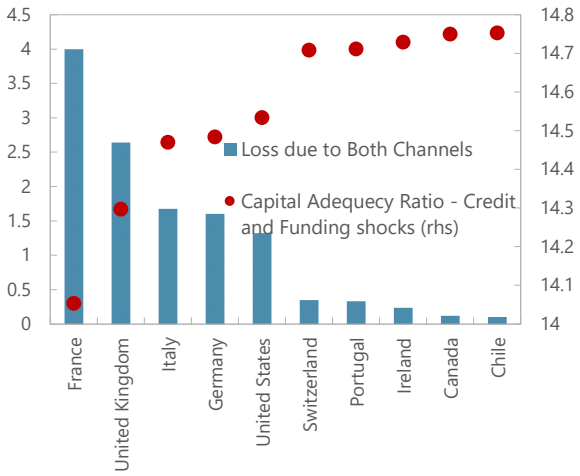
[43] The *contagion index* represents the outward spillover reflecting the percentage of capital loss in other countries due the failure of a banking system in each country. The *vulnerability index* represents the inward spillover reflecting the percentage of capital loss of a given country's banks due to shocks from the banks in corresponding countries.

Figure 32. Spain: Cross-Border Contagion Analysis Results

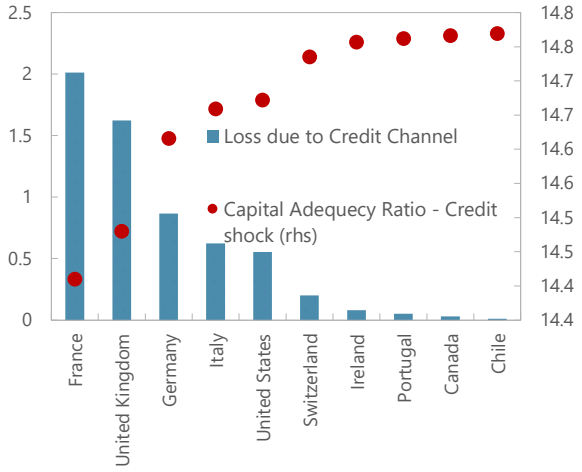
Contagion and Vulnerability indices (in percent of total capital)



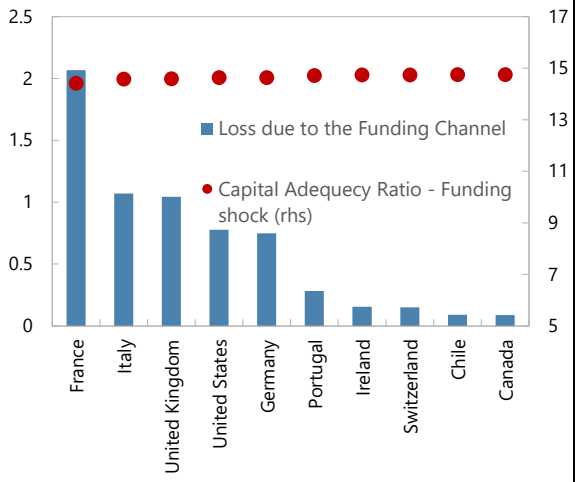
Capital loss due to credit and funding channels (in percent of total capita)



Capital loss due to the credit channel (in percent of total capita)



Capital loss due to the funding channel (in percent of total capita)



Sources: BIS, FSI, and IMF staff calculations.

Note: Index of contagion (or index of outward spillover risks): the average loss of other banks due to the failure of a bank i. The index is computed as $\mathrm{Cont_i} = 100 * \frac{1}{N-1}\sum_{j=1,j\neq i}^{N}\frac{L_{ji}}{K_j}$, where K_j is the capital of bank j and L_{ji} is the loss to bank j due to the default of bank i. The outward spillover reflects the percentage of capital loss in other countries due the failure of banking system in Spain.

Index of vulnerability (or index of inward spillover risks): the average loss of a bank i due to the failure of all other banks. The index is computed as $\mathrm{Vuln_i} = 100 * \frac{1}{N-1}\sum_{j=1,j\neq i}^{N}\frac{L_{ij}}{K_I}$, where K_I is the capital of bank i and L_{ij} is the loss to bank i due to the default of bank j. The inward spillover reflects the percentage of capital loss of Spanish banks due to shocks from the banks in corresponding countries.

C. Domestic Interbank Linkages

93. The analysis of domestic interconnectedness explored the scope for, and implications of, interbank contagion within Spain, on a network covering SIs, 6 LSIs and two Spanish subsidiaries of foreign banks. The analytical framework relied once more on the model of Espinosa-Vega and Solé (2011).[44] The data is derived from the domestic interbank exposure network at the group level, sourced from the Spanish credit registry maintained by the BdE. Interbank exposures encompass various instruments.[45] Information regarding collateralization levels was not precisely available and alternative assumptions of 30 percent and 50 percent were made.

94. Domestic interbank contagion risk is concentrated within the sub-system of SIs (Table 9). The losses within this sub-system account for over 72 percent of total losses.[46] The analysis also shows that foreign subsidiaries are more vulnerable through their exposures to LSIs compared to SIs. The analysis also reveals that the credit channel is significantly more impactful in terms of interbank loss contagion compared to the funding channel. The credit channel is responsible for ¾ of total losses with the remaining being due to funding shock losses.

D. The Financial Sector's Sovereign Exposures

Table 9. Spain: Contagion Losses by Type of Trigger Bank/Recipient Bank

		Recipient of the shock		
	(In percent of total losses)	SIs	LSIs	Foreign Subs.
Source of the Shock	SIs	72.3	4.6	3.5
	LSIs	5.4	0.7	8
	Foreign Subs.	1.3	4.2	0

Sources: BdE and IMF staff calculations.
Note: Percentage of losses in the system due to interbank exposure, classified by the originator and recipient segments of banks.

95. The financial sector in Spain has significant exposures to sovereign debt obligations.

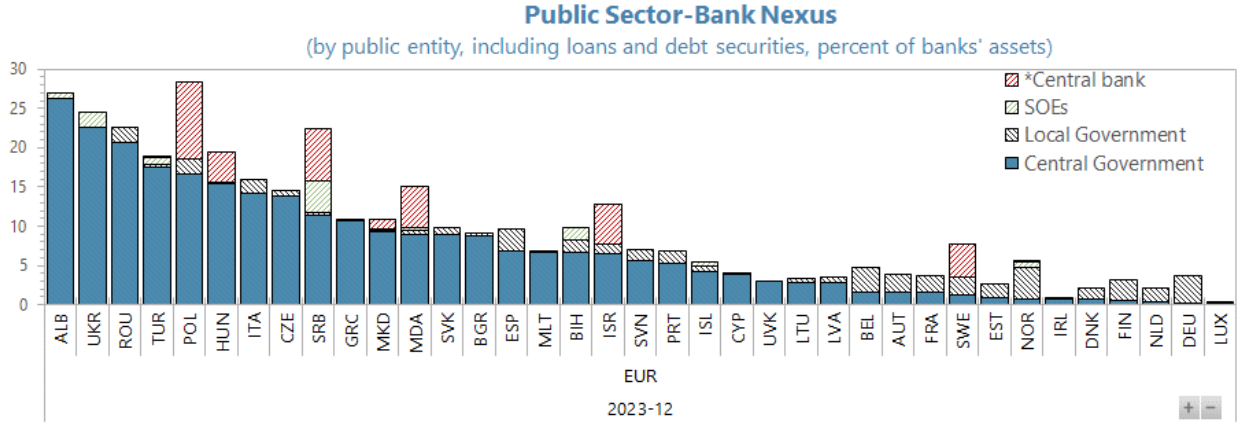
- **Government debt securities comprised approximately 80 percent of Spanish banks' debt securities holdings, maintaining a relatively stable share over the past few years**. As of 2023-H1, Spanish banks' debt securities holdings were valued at €590 billion, making up around 14.8 percent of their total assets, a sharp annual increase of 8.6 percent. Since June 2019, the cumulative growth in debt holdings has exceeded 15 percent, outpacing the growth in total

[44] The parameter values are similar to those used for the cross-border analysis, explained in paragraph 92.
[45] Temporary Asset Acquisition, Fixed-Income Securities, Financial Credit, Securities Loans, Non-Recourse Factoring with Investment, Leasing Operations, Commercial Credit, and Overdue and Uncollected Products from Doubtful Assets are included in the interbank exposure.

[46] This is to be expected, given that SIs account for the majority of the Spanish banking system in terms of assets. Furthermore, since SIs are well capitalized, and they also account for the majority of the capital in the system, losses within the SIs are unlikely to represent a real risk for the system.

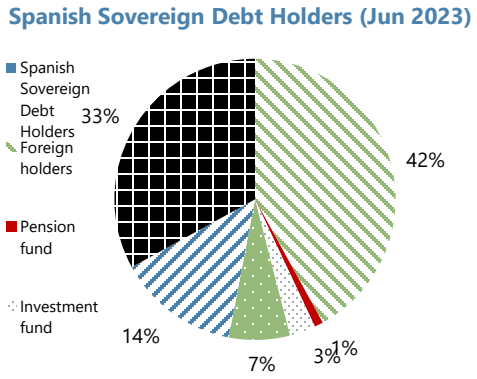
assets by 2.3 percentage points during this period. Nonetheless, the exposure of Spanish banks to the public sector as a share of their assets have been stable over the past couple of years and similarly the share of local government debt holding remains stable at around 30 percent of total exposure to the public sector.

- **Among advanced European countries, Spanish banks are among the most exposed to sovereign risk in Europe relative to both assets and capital (text chart)**. Indeed, among the larger EA economies, only Italian banks are more exposed to their public sector compared to Spain. In such a context, adverse macro-financial implications could be more important if market sentiment shifts against highly indebted EA countries due to global and idiosyncratic factors.



- **While banks and open-ended investment funds have increased their asset allocation towards sovereign debt in recent years, pension funds and insurance companies have gone in the opposite direction; (Figure 33).** Consequently, the share of banks and funds in the domestic financial sector's sovereign exposures has risen and that of pension and insurance has fallen (Figure 33). Banks and insurance companies show a clear home bias in their holdings of sovereign debt in contrast with investment funds (Figure 33). Finally, while funds offer investors exposure to intermediate duration assets with larger exposure to medium-term bonds, insurance companies tend to hold longer duration assets through long-term bonds (Figure 32).

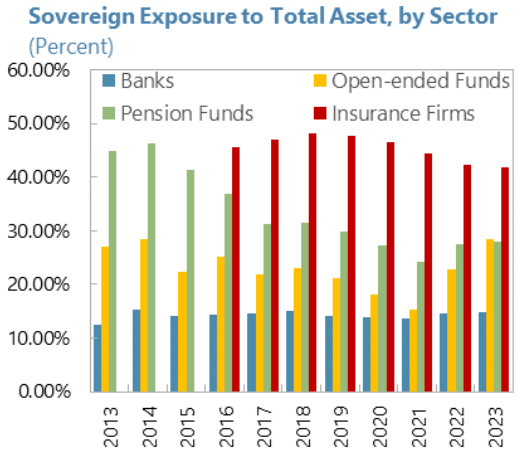
96. While the public sector is the primary counterparty for all banks, SIs have greater exposure to the public sector outside Spain, whereas exposures of LSIs are concentrated in the domestic market. Excluding BdE's holdings, as of June 2023, Spanish resident banks hold the largest share, of 14 percent, of outstanding Spanish sovereign securities, with the domestic NBFI sector holding 11 percent. Foreign entities have a significant share, accounting for 42 percent of the outstanding volume of Spanish sovereign debt.



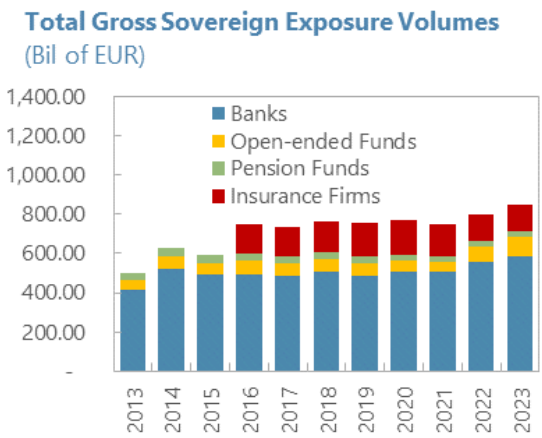
Source: BdE.

Figure 33. Spain: Financial Sector's Exposure to Sovereign Debt

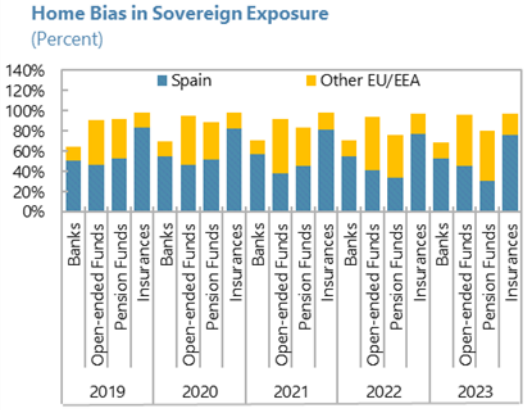
While pension funds and insurance firms have reduced their exposure to sovereign debt, they remain are the most exposed in their portfolios.



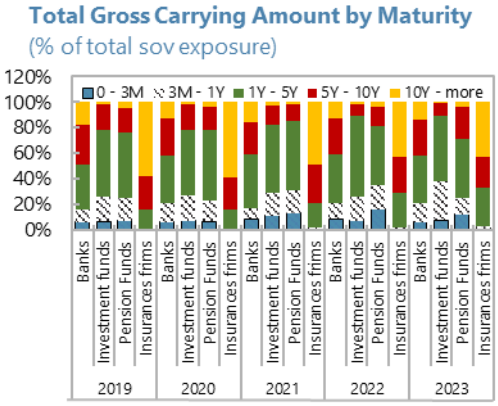
Share of banks and open-ended funds in total sovereign debt holding has increased in recent years.



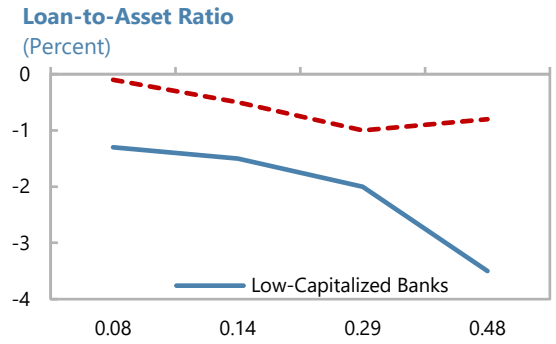
Banks and insurances have home biases in sovereign debt holdings, in contrast to funds.



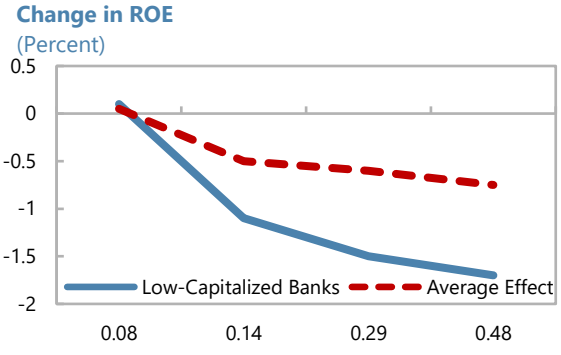
Funds prefer medium-term maturity bonds, while insurance hold long-term bonds.



In sovereign distress, banks with greater exposure to government debt, tend to reduce their lending



Banks with larger government debt holdings are more likely to experience reduced net interest income and profitability

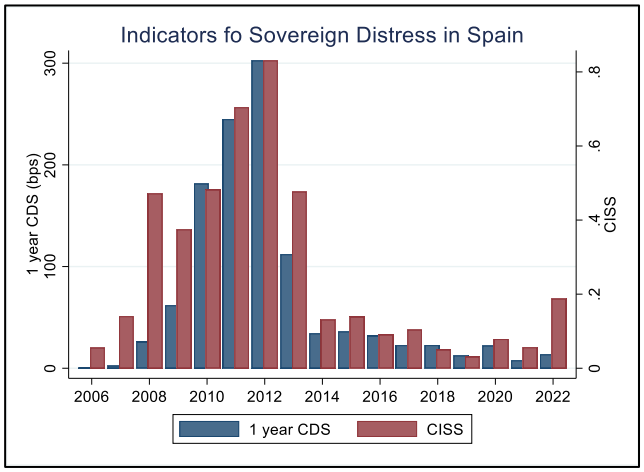


Sources: Bank of Spain, CNMV, ECB SHSS, and IMF staff calculations.

Sovereign-Bank Distress Linkages

97. The sovereign-bank distress channel stems from the direct exposure of banks to sovereign risk through their holdings of government debt. A rise in sovereign distress could reduce the market value of government debt that banks hold and use as collateral to secure financing. When this happens within the context of an adverse macroeconomic scenario, higher bank exposure to distressed sovereign debt can contribute materially to the tightening of banks' capital constraints and, in turn, to tighter lending standards and volumes. The relatively high exposure of Spanish banks to the public sector could potentially reinforce the link between banking stability and public finances during downturns or when large exogenous shocks occur.

98. The FSAP analyzed potential implications of sovereign distress on bank lending and earnings. Model identification was achieved through cross-sectional variation in outcome variables (i.e., loans-to-assets and NII) across banks with different debt holdings. Sovereign distress was defined as periods with values higher than specific thresholds of– (1) the one-year sovereign CDS for Spain, and (2) the ECB's composite indicator of sovereign stress (CISS).[47] These thresholds primarily encompass the years 2009-2013 as being in sovereign distress which coincides with the European sovereign debt crisis (text figure). Sovereign exposure is measured using the share of government debt securities in total assets in the previous year (to ensure exogeneity in the exposure variable). The analysis includes bank and time fixed effects with standard errors clustered at the bank level.[48]



99. FSAP findings associate banks with greater exposure to sovereign debt with greater reduction in lending and as likelier to experience reduced NII in the aftermath of sovereign distress (Figure 33). Reduced lending may be driven by banks' response to loss-induced-tightening of capital constraints or crowding out, albeit the analysis cannot assign relative quantitative important to alternative factors. On NII, the results associate banks with initial government-debt-holdings-to-total-assets 10 percentage points higher with a decline of 0.7 percentage points in their ROE following an increase in sovereign distress, defined as the CISS exceeding the third quartile of its historical distribution (the rightmost point on the horizontal axes of Figure 33, i.e., CISS ≥ 0.48). This effect is more pronounced for banks whose capitalization is below the median of the sampled banks ("less capitalized banks" in Figure 33).[49]

[47] The CISS includes 15 raw, mainly market-based financial stress measures that are split equally into five categories, namely the financial intermediaries' sector, money markets, equity markets, bond markets and foreign exchange markets.

[48] For more details, see appendix XI.

[49] Banks with capital ratios less than the median of the banks sample in each year.

Appendix I. FSAP Risk Assessment Matrix (RAM)

Table 1. Spain: Risk Assessment Matrix

Risk	Overall Level of Concern	
	Relative Likelihood	Expected Impact of Risks
Intensification of regional conflict(s) and geo-economic fragmentation Escalation of Russia's war in Ukraine or other regional conflicts and resulting economic sanctions disrupt trade (e.g., energy, food, tourism, and/or critical supply chain components), remittances, refugee flows, FDI and financial flows, and payment systems.	**High**	**Medium** • Trade disruptions weigh on domestic activity. • Shortages in critical supply chain components and rising energy and food prices further raise inflation. • Intensification of conflicts in the Middle East and Africa leads to disorderly migration into Europe further deepening political division within the EU.
Abrupt global slowdown or recession that may trigger systemic financial instability Global and idiosyncratic risk factors combine to cause a synchronized sharp growth downturn, with recessions in some countries, adverse spillovers through trade and financial channels, and markets fragmentation. Sharp swings in real interest rates and risk premia could occur amid the economic slowdown. In Europe, intensifying fallout from the war in Ukraine, recurrent energy crisis and supply disruptions, and monetary tightening exacerbate economic downturns, and housing and commercial real estate market corrections. Policy errors could also act as an amplifier.	**Medium**	**High** • Tighter financial conditions in anticipation of a recession and weaker consumer confidence weigh on domestic activity. • Slower growth by trading partners reduces external demand for Spanish exports through trade channels. • The significant cross border presence of Spanish banks leads to adverse cross border spillovers through financial channels. • Disorderly tightening of financial conditions leads to abrupt and significant bond repricing and housing market corrections. This, together with higher financing costs result in sharp deterioration of financial conditions of firms and households due to high share of floating rate debt in Spain. The associated adverse impact on banks' asset quality results in an erosion of banks' capital buffers, adversely affecting credit availability and economic activity. • Adverse economic impact will be amplified if social tensions around economic adjustments emerge and erode trust in policy makers. The resulting political instability will challenge achieving political consensus on policies, including fighting inflation, thereby amplifying the impact of the domestic shocks.

Table 1. Spain: Risk Assessment Matrix (continued)		
Risk	**Overall Level of Concern**	
	Relative Likelihood	**Expected Impact of Risks**
		• Adverse economic impact will be amplified if social tensions around economic adjustments emerge and erode trust in policy makers. The resulting political instability will challenge achieving political consensus on policies, including fighting inflation, thereby amplifying the impact of the domestic shocks.
Commodity price volatility A succession of supply disruptions (e.g., due to conflicts, uncertainty, and export restrictions) and demand fluctuations causes recurrent commodity price volatility, external and fiscal pressures in EMDEs, contagion effects, and social and economic instability.	**High**	**Medium** • Higher energy prices fuel inflation pressure and further raise inflation expectations. Export competitiveness of Spanish firms is adversely affected, which slows down activity. • High energy prices have an adverse impact on vulnerable households, leading to lower domestic demand.
Monetary policy miscalibration Amid high economic uncertainty and financial sector fragility, major central banks pause monetary policy tightening or pivot to loosen policy stance prematurely, de-anchoring inflation expectations, triggering a wage-price spiral and spillovers to financial markets.	**Medium**	**High** • A cycle of higher inflation feeds into higher inflation expectations which then feeds back to higher inflation. Equity markets are affected as expectations suddenly shift, and inflation risk premia rises.
Weak implementation of fiscal commitments, delays in EU funded projects or reassessment of sovereign risk Lack of or reversal of reforms in Spain. Shift in market perception in the EA undermines high-debt countries' ability to roll over and service debt.	**Medium**	**High** • Uncertainty about medium-term fiscal commitments in Spain or a shift in market sentiment against highly indebted EA countries weaken confidence and cause an increase in the sovereign risk premium which worsens public debt dynamics. • Timely implementation of EU funded projects is seen as critical to safeguarding near-to-medium term growth. • Increased sovereign yield spreads reduce the value of fixed-income assets, putting pressure on financial sector balance sheets and reducing the value of banks' liquid assets.

Table 1. Spain: Risk Assessment Matrix (concluded)

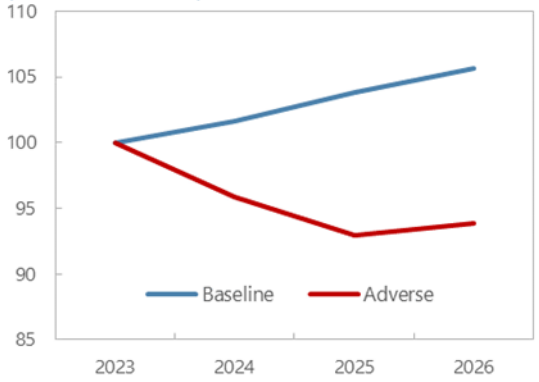
Risk	Overall Level of Concern	
	Relative Likelihood	Expected Impact of Risks
Extreme climate events Extreme climate events driven by rising temperatures cause loss of human lives, severe damage to infrastructure, supply disruptions, lower growth, and financial instability.	**Medium**	**Medium** • The occurrence of climate-related events (e.g., droughts, heatwaves, wildfires) disrupts banks and other financial institutions and infrastructures' operations, impairs borrowers' ability to repay debt or reduces the value of assets that are collateralizing debt. • Climate-related events amplify supply chain disruptions and inflationary pressures, with additional negative effects on the economy due to second-round effects.
Cyberthreats Cyberattacks on physical or digital infrastructure (including digital currency and crypto assets ecosystems) or misuse of AI technologies.	**Medium**	**High** • Cyber-attacks trigger financial and economic instability.

Source: IMF staff.

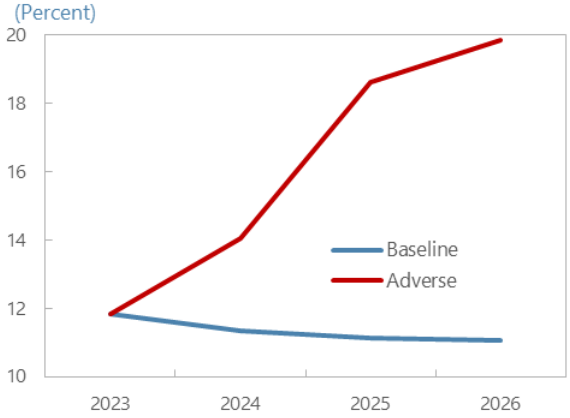
Appendix II. Macro Scenarios

Figure 1. Spain: Stress Test Scenarios: Baseline and Adverse

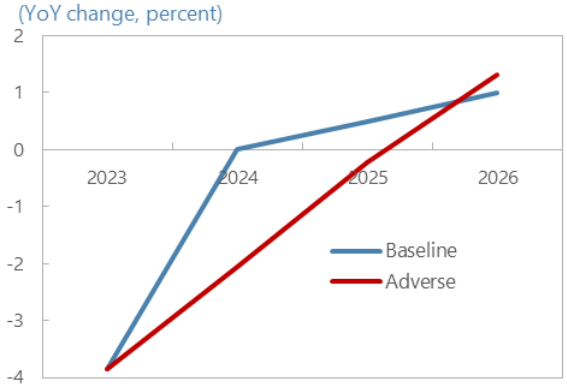
Output
(Indexed, 2023=100)



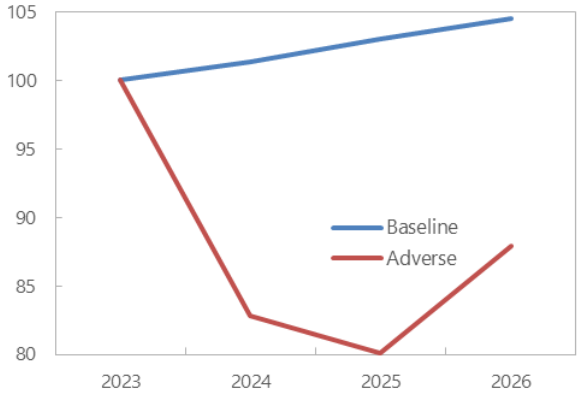
Unemployment
(Percent)



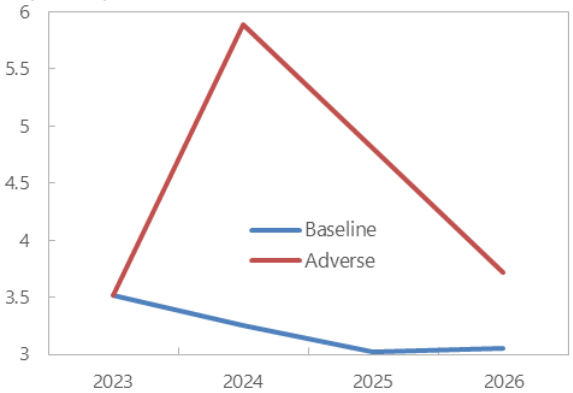
Credit Growth
(YoY change, percent)



Price of Housing
(Indexed, 2023=100)



Short Term Sovereign Yield
(Percent)



Long Term Sovereign Yield
(Percent)

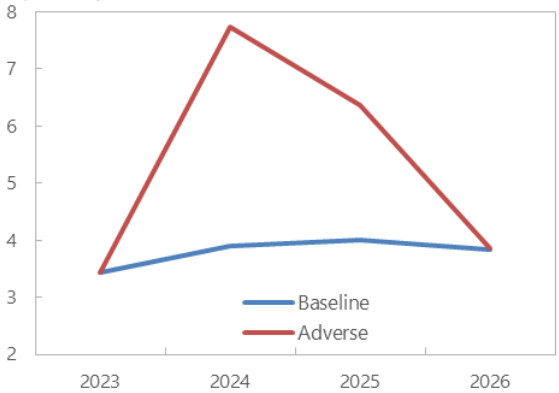
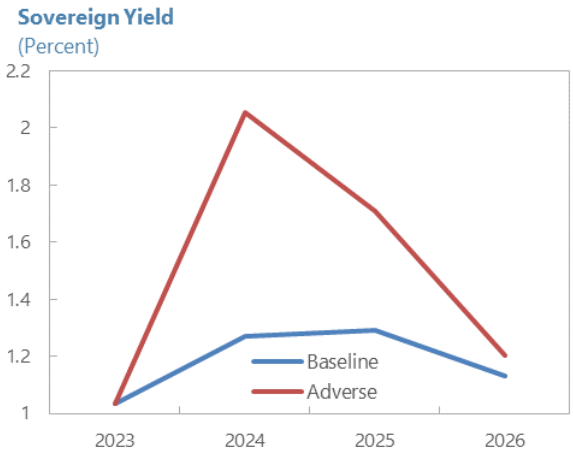
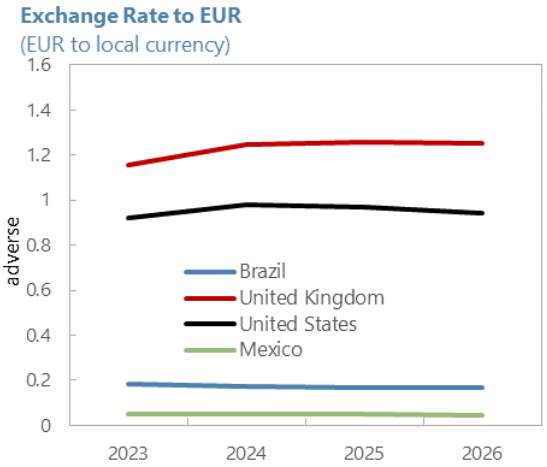
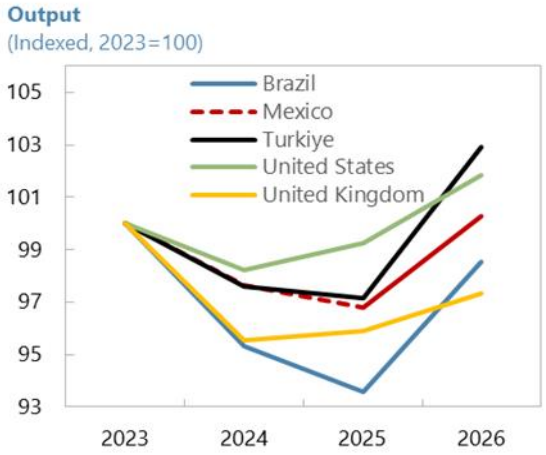
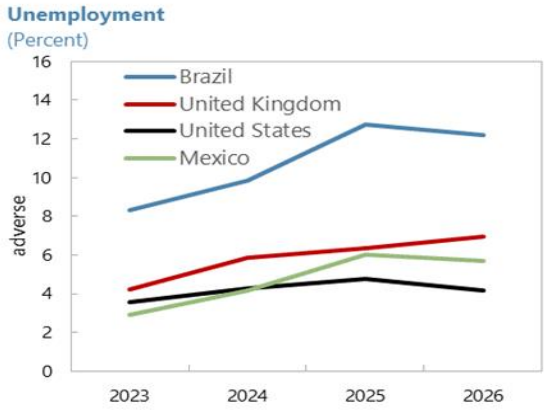


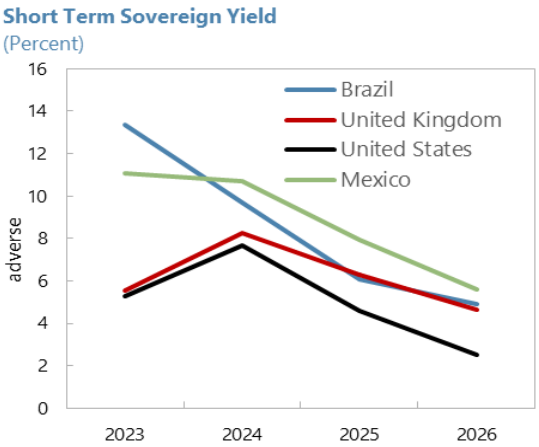
Figure 1. Spain: Stress Test Scenarios: Baseline and Adverse (concluded)

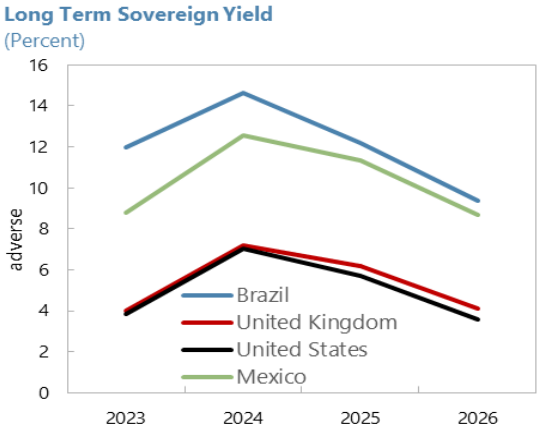












Source: IMF staff calculations.
Note: For foreign markets, only adverse is shown.

Table 1. Spain: Adverse Macro Scenario (Percent change unless otherwise indicated)			
	2024	**2025**	**2026**
Spain			
Real GDP growth	-4.09	-3.10	1.00
Core Inflation	6.77	2.46	0.86
Unemployment	14.03	18.61	19.84
Short term sovereign yield	5.89	4.80	3.71
Long term sovereign yield	7.73	6.35	3.85
Sovereign spread over Germany	2.06	1.71	1.20
House Price	-17.16	-3.29	9.70
Credit Growth	-2.06	-0.22	1.32
Brazil			
Exchange rate to EUR	0.17	0.17	0.17
Real GDP growth	-4.68	-1.83	5.29
Core Inflation	5.67	4.55	4.07
Long term sovereign yield	14.65	12.21	9.39
Short term sovereign yield	9.69	6.08	4.89
Unemployment	9.86	12.72	12.22
Mexico			
Exchange rate to EUR	0.05	0.05	0.05
Real GDP growth	-2.37	-0.86	3.62
Core Inflation	5.32	5.40	4.82
Long term sovereign yield	12.58	11.33	8.68
Short term sovereign yield	10.72	7.96	5.62
Unemployment	4.16	6.01	5.69
Other Euro area			
Real GDP growth	-2.74	0.20	1.43
Core Inflation	6.20	3.47	1.74
Long term sovereign yield	6.69	5.61	3.38
Short term sovereign yield	5.99	4.71	3.32
Unemployment	6.19	7.07	7.34
Türkiye			
Exchange rate to EUR	0.03	0.02	0.01
Real GDP growth	-2.42	-0.46	5.94
Core Inflation	63.88	54.43	49.60
Long term sovereign yield	46.74	47.00	45.30
Short term sovereign yield	43.26	43.48	43.63
Unemployment	11.52	14.15	13.89
United Kingdom			
Exchange rate to EUR	1.25	1.26	1.25

Table 1. Spain: Adverse Macro Scenario (concluded)			
	2024	**2025**	**2026**
Real GDP growth	-4.45	0.35	1.50
Core Inflation	5.81	4.87	2.40
Long term sovereign yield	7.22	6.16	4.12
Short term sovereign yield	8.23	6.29	4.62
Unemployment	5.87	6.38	6.96
United States			
Exchange rate to EUR	0.98	0.97	0.94
Real GDP growth	-1.77	1.04	2.59
Core Inflation	4.96	4.67	2.80
Long term sovereign yield	7.02	5.71	3.59
Short term sovereign yield	7.66	4.60	2.50
Unemployment	4.28	4.77	4.16

Appendix III. Stress Test Matrix (STeM)

Table 1. Spain: Stress Test Matrix (STeM)		
Banking Sector: Solvency Stress Test		
Top-down by IMF		
1. Institutional Perimeter	Institutions included	• Ten SI banks, of which one G-SIB
	Market share	• Almost 95 percent of the banking sector assets
	Data and baseline date	• Multiple data vintages: 2023 Q3 (starting point for PL (annualized), balance sheet and capital), time series 2015 Q1-2023 Q3 (net fee and commission income) • Supervisory data: Bank balance sheet and supervisory statistics (including FINREP and COREP), information on interest rate risk in the banking book (IRRBB), provided by the authorities and the ECB. Expected Default Frequency sourced from Moody's. Further supervisory information on probability of defaults by credit portfolios for domestic exposures. • Market and confidential data on banks on funding and lending rates by type of asset and funding portfolios. • Scope of consolidation: banking activities of the consolidated banking group for banks having their headquarters in Spain. • Coverage of sovereign and non-sovereign securities exposures: debt securities measured through fair value (FVPL and FVOCI) and amortized cost (AC) account.
2. Channels of Risk Propagation	Methodology	• FSAP team satellite models and methodologies. • Balance-sheet regulatory approach. • Provisioning for IRB and SA are modeled using IFRS9 transition matrix approach. • Traded risk impact from the revaluation of trading assets (FVPL) and securities classified as fair value thorough other comprehensive income (FVOCI) securities assessed using a modified duration approach. • Structural model of bank NII, based on repricing ladder and estimated betas.
	Satellite models for macro-financial linkages	• Models for credit losses (PD and LGD by portfolio), funding costs, lending rates, net fee and commission income and risk weights • For internally modelled exposures (IRB), projection of PiT and TTC PDs, LGD, EAD, and RWA. For SA exposures, projection of new flows of defaulted exposures. Provisioning for IRB and SA modeled using IFRS9 transition matrix approach. • Funding costs to be projected at the portfolio level using funding structure by product (retail and wholesale • deposits, secured and unsecured debt securities, repo, etc.) and maturity bucket (overnight vs. term).

Table 1. Spain: Stress Test Matrix (STeM) (continued)		
Banking Sector: Solvency Stress Test		
Top-down by IMF		
3. Tail Shocks	Stress test horizon	• 2023 Q3– 2026 Q4 (three years, one quarter)
	Scenario	• Two Scenarios: • A baseline scenario drawn from the October 2023 WEO macroeconomic projections. • An adverse scenario that captures the key risks in the RAM. This scenario relies on GFM, a structural macro-econometric model of the world economy, disaggregated into forty national economies, documented in Vitek (2018).
	Sensitivity Analysis	• Estimation of unrealized losses of held-to-maturity securities as interest rates rise, separating domestic and foreign sovereign securities. Banks not fulfilling LCR requirement in the outflow scenario of LCR test will be considered separately, to identify potential liquidity – solvency spillover. • Estimation of NII impact of a range of deposit Beta. • Alternative paths for Spain sovereign spreads will be considered.
4. Risks and Buffers	Risk Covered	• Risks covered include credit (on loans and debt securities), market (valuation impact of debt instruments through repricing and credit spread risk as well as the P&L impact of net open positions in market risk factors such as foreign exchange risks) and interest rate risk on the banking book (IRRBB).
	Behavioral Adjustment	• For the growth of the banks' balance sheet over the stress-test horizon, whereas the balance sheet grows in line with the nominal GDP paths, floored at 0, except for domestic loans exposures where, as shown in Figure 1 in Appendix II, credit growth in Spain is negative for 2024 and 2025. • In projecting RWAs, standardized and IRB portfolios are differentiated. For the standardized portfolios, RWAs changed due to the balance sheet growth, new inflows of non-performing loans, new provisions for credit losses, exchange rate movements, and the conversion of a portion of off-balance sheet items (undisbursed credit lines and guarantees) to on-balance sheet items. For the IRB portfolios, through-the-cycle-PDs, downturn LGDs and EAD for each asset class/industry are used to project risk weights. • Interest income from nonperforming loan is not accrued. • Dividends are paid out by banks that remain adequately capitalized throughout the stress.

Table 1. Spain: Stress Test Matrix (STeM) (continued)		
Banking Sector: Solvency Stress Test		
Top-down by IMF		
5. Regulatory and Market-Based Standards and Parameters		• National regulatory framework Basel III regulatory minima on CET1 (4.5 percent) and include any requirements due to macroprudential buffers for other systemically important institution (O-SII). Leverage ratio during the stress test horizon against the 3 percent Basel III minimum requirement.
6. Reporting Form for Results	Output Presentation	• System-wide capital shortfall • Number of banks and percentage of banking assets in the system that fall below regulatory minima. • Outputs also include information on impact of different result drivers, including profit components.
Banking Sector: Liquidity Stress Test		
Top-down by IMF		
7. Institutional Perimeter	Institutions Included	• Ten banks, of which one G-SIB
	Market Share	• Total coverage is about 95 percent of the banking sector
	Data and Baseline Date	• Latest data: August 2023 • Source: supervisory data (including FINREP and COREP) • Scope of consolidation: banking activities of the consolidated banking group for banks having their headquarters in Spain.
	Methodology	• Structural Liquidity Analysis: Basel III LCR (30-day horizon), NSFR (1 year horizon) and cash-flow based liquidity stress test using maturity buckets (1 week and 3-month horizon) by banks, incorporating both contractual and behavioral (where available) assumption about combined interaction of funding and market liquidity and different level of central bank support. • Liquidity test in EUR, USD, GBP, MXN, BRL, TRY, CLP.
8. Channels of Risk Propagation	Risks	• Funding liquidity • Market liquidity
9. Risks and Buffers	Buffers	• The counterbalancing capacity, including liquidity obtained from markets and/or the central bank's facilities. Expected cash inflows are also included in the cash-flow based and LCR-based analysis.

Table 1. Spain: Stress Test Matrix (STeM) (concluded)		
Banking Sector: Liquidity Stress Test		
Top-down by IMF		
10. Tail Shocks	Size of the Shock	• The run-off rates are calibrated to reflect scenarios of system-wide deposit runs and dry-up of unsecured wholesale and retail funding, with additional run-off for non-resident deposits on top of the retail and wholesale run-off, which is calibrated following historical events, recent international experience in liquidity crisis and IMF expert judgment. • The haircuts of high-quality liquid assets (HQLA) are calibrated against ECB haircuts, past EA FSAPs, and market shock for investment securities and money market instruments in the solvency stress test
11. Regulatory and Market-Based Standards and Parameters	Regulatory Standards	• Consistent with Basel III regulatory framework (LCR). • Liquidity shortfall by bank.
12. Reporting Format for Results	Output Presentation	• Liquidity ratio or shortfall by groups of banks and systemwide. • Number of banks that still can meet or fail their obligations. • Distribution of the distance to liquidity stress indicator for banks and systemwide.
Interconnectedness and Contagion Analysis[1]		
Institutional Perimeter		• Banks and NBFIs, data permitting
Methodology		• Network-based contagion analysis based on three potentially mutually reinforcing contagion channels: • Price channel: selling of assets by institutions in distress affects other institutions' balance sheet through the price channel. The change of asset price will be a function of market depth, which depends on authorities' data provision. • Credit contagion: default of institutions can cause other institutions to default in turn.
		• Funding contagion: refusal of institutions to rollover funding can cause other institutions to sell assets or stop rolling over funding in turn.

[1] This analysis is not part of the stress testing work but is included in the systemic risk analysis.

Appendix IV. Credit Risk

PD

1. Domestic PD paths, were estimated via panel BMA, obtaining bank-specific paths.

Table 1. Domestic PDs: BMA Output

		Real GDP_-YoY	CPI – YoY	UR[3]	UR - YoY	FX	HPI[4] - YoY	Short term rate	Term Spr.[5]	Sov. Spr.[5] 10Y
NFC	LRM[1]	-0.00	0.00	0.03	0.22	-0.00	0.21	0.00	0.50	0.54
	PIP[2]	0.00	0.00	0.07	0.58	0.01	0.40	0.00	1.00	0.92
MORTGAGE	LRM	-0.00	0.05	0.76	0.03	-0.00	0.00	0.31	0.29	0.00
	PIP	0.00	0.08	1.00	0.06	0.01	0.00	0.93	0.93	0.00
CONSUMPTION	LRM	-0.02	0.07	0.02	1.11	0.00	0.09	0.00	0.02	0.39
	PIP	0.04	0.23	0.09	0.88	0.05	0.09	0.04	0.16	0.85

Notes: 1. Long-Run Multiplier, normalized by standard deviation; 2 Posterior Inclusion Probability ;3. Unemployment Rate; 4. House Price Index; 5 Spread. Results refer to BMA with sign constraints.

2. Foreign PD paths, were estimated on aggregate level, and they were adapted to bank specific PDs by anchoring to bank-specific starting point in distance-to-default space. For each bank i and sector k:

$$PD_{i,t}^{k} = \Phi\left(\Phi^{-1}\left(PD_{i,0}^{k}\right) + \Phi^{-1}\left(PD_{t}^{k}\right)\right) - \Phi^{-1}\left(PD_{0}^{k}\right)$$

where, Φ standard normal is the cumulative distribution function.

Table 2. Foreign PDs: BMA Output

		FX	REAL GDP - YOY	REAL GDP - QOQ	LONGTERM RATE	SHORTTERM RATE	CPI - FIRST DIFF.	CPI - YOY	CPI - QOQ	UR[3]	UR - YOY	UR - QOQ
BR	LRM[1]	-	-	-								
		0.01	0.09	0.43	0.00		0.01	0.60	0.22	0.00	0.00	0.00
	PIP[2]											
		0.07	0.33	0.79	0.00		0.08	0.74	0.40	0.00	0.06	0.05
MX	LRM		-	-								
		0.02	0.11	1.79	0.00	0.00	0.43	0.02	0.06	0.00	0.01	
	PIP											
		0.08	0.19	0.98	0.00	0.04	0.63	0.09	0.11	0.00	0.02	
TR	LRM	-		-								
		0.29	-	0.81	-		0.03	0.06	0.19	-	0.00	0.00
	PIP											
		0.26	-	0.81	-		0.19	0.16	0.21	-	0.02	0.00
UK	LRM	-		-								
		0.00	-	0.00	0.25	0.00	-	0.03	0.00	0.02	0.61	
	PIP											
		0.00	-	0.00	0.81	0.00	0.00	0.13	0.02	0.06	0.98	
US	LRM		-	-			-					
			0.01	0.00	0.27	0.00	0.00	0.26	0.12	0.00	0.50	0.00
	PIP											
			0.01	0.01	0.92	0.00	0.01	0.68	0.32	0.02	0.98	0.01

Notes: 1. Long-Run Multiplier, normalized by standard deviation; 2 Posterior Inclusion Probability ;3. Unemployment Rate. Results refer to BMA with sign constraints.

LGD

3. For domestic mortgages, the LGD are computed with a structural model based on Loan-to-value updated with the scenario.

$$\text{LGD}_t = (1 - \text{TM}_{32}) \cdot \max\left(\frac{\text{LTV}_t - \text{SR}}{LTV_t}, 0\right)$$

$$\text{LTV}_t = \text{LTV}_0 \frac{\text{HP}_0}{\text{HP}_t}$$

Where TM_{32} indicates the transition probability from Stage 2 to Stage 3, LTV is the loan-to-value, HP is the house price and SR is sale revenue.

4. For portfolios other than domestic mortgages, a link of LGDs to PDs was established through a Vašíček equation in the advanced economies. The equation is derived based on the premise that there is an inherent link, a positive association, between PDs and LGDs.

5. 1 The LGD is expressed as a function of PDs as follows:

$$\mathrm{LGD}_{\mathrm{b,t0+h}} = \Phi\left(\Phi^{-1}\left(\mathrm{PD}_{\mathrm{b,t0+h}}\right) - \mathrm{k}\right)\mathrm{PD}_{\mathrm{b,t0+h}}$$

where additional subscripting for different portfolios (here: corporate, consumer credit) is omitted for brevity, Φ and Φ^{-1} denote a Normal and inverse Normal, and *k* is a bank-portfolio specific parameter computed at the outset and kept fixed thereafter, involving a correlation coefficient ρ (to set judgmentally).

$$\mathrm{k} = \frac{\Phi^{-1}(\mathrm{PD_{t0}})\Phi^{-1} - (\mathrm{PD_{t0}} \cdot \mathrm{LGD_{t0}} \cdot \mathrm{f})}{\sqrt{1-\rho}}$$

The factor *f* in the equation was set (implied) at the outset for the two equations to imply an LGD that matches the bank-portfolio specific observed LGDs.

For exposures in emerging market LGD are kept constant.

IFRS9

6. Performing and nonperforming exposure stocks were projected based on the transition matrix-implied flows, while allowing for write-offs and asset sales. The equations employed to simulate the stocks of Stage 2 and 3 exposures forward in time are the following:

$$\mathrm{S2_t} = \mathrm{S2_{t-1}} + \mathrm{TM_t^{12}S1_{t-1}} + \mathrm{TM_t^{32}\,S3_{t-1}} - \mathrm{TM_t^{21}\,S2_{t-1}} - \mathrm{TM_t^{23}\,S2_{t-1}} - \mathrm{M_t^2\,S2_{t-1}}$$

$$\mathrm{S3_t} = \mathrm{S3_{t-1}} + \mathrm{TM_t^{13}S1_{t-1}} + \mathrm{TM_t^{23}\,S2_{t-1}} - \mathrm{TM_t^{31}\,S3_{t-1}} - \mathrm{TM_t^{32}\,S3_{t-1}} - \mathrm{WRO_tS3_{t-1}}$$

The stock of Stage 1 is implied by gross loan growth, while new business flows and repayment remain implicit:

$$\mathrm{S_t} = \mathrm{S1_t} + \mathrm{S2_t} + \mathrm{S3_t} = (1 + \mathrm{g_t})\mathrm{S_{t-1}}$$

$$\mathrm{S1_t} = \max(0, \mathrm{S_t} - \mathrm{S2_t} - \mathrm{S3_t})$$

The write-off rate and asset sales rates ($\mathrm{WRO_t}$) were assumed to remain constant at end-sample observed values at the observed bank-portfolio specific levels.

[1] Details can be found in Frye and Jacobs (2012).

7. Transition matrix (TM) TM_t^{ij} entries are updated simultaneously with the stocks S_t^i , in four steps:

a. $TM_t^{13}$and TM_t^{23} derived from PD_t path, which is the weighted average of the two

$$\mathrm{TM}_\mathrm{t}^{23} = \Phi\left(\Phi^{-1}(\mathrm{TM}_0^{23}) + \left(\Phi^{-1}(\mathrm{PD_t}) - \Phi^{-1}(\mathrm{PD}_0)\right)\right)$$

$$\mathrm{TM}_\mathrm{t}^{13} = \min\left(1, \max\left(0, \frac{\mathrm{PD_t} \cdot (\mathrm{S}_{\mathrm{t}-1}^1 + \mathrm{S}_{\mathrm{t}-1}^2) - \mathrm{TM}_\mathrm{t}^{23} \cdot \mathrm{S}_{\mathrm{t}-1}^2}{\mathrm{S}_{\mathrm{t}-1}^1}\right)\right)$$

b. Project other TM_t^{ij}, $\mathrm{i} \neq j$ based on sensitivity to shock in distance-to-default space

$$TM_t^{ij} = \Phi\left(\Phi^{-1}\left(TM_0^{ij}\right) + \mathrm{DD_{ij}}\left(\Phi^{-1}\left(TM_t^{i3}\right) - \Phi^{-1}\left(TM_0^{i3}\right)\right)\right), \quad \mathrm{i} \neq 3$$

$$TM_t^{3j} = \Phi\left(\Phi^{-1}\left(TM_0^{3j}\right) + \mathrm{DD_{3j}}\left(\Phi^{-1}(TM_t^{23}) - \Phi^{-1}(TM_0^{23})\right)\right)$$

c. Derive diagonal terms TM_t^{ii} to have rows summing up to 1

8. ECL are computed by stage

$$PROV_t^{S1} = \mathrm{TM}_\mathrm{t}^{13} \cdot \mathrm{LGD_t} \cdot \mathrm{S1}_{\mathrm{t}-1}$$

$$PROV_t^{S2} = \sum_{\mathrm{s=t+1}}^{\mathrm{L}} \frac{\mathrm{TM}_\mathrm{s}^{23,*} \cdot \mathrm{LGD_s} \cdot \mathrm{S2}_{\mathrm{s}-1}}{(1+\mathrm{r})^{\mathrm{s}}}$$

$$PROV_t^{S3} = \mathrm{LGD_t} \cdot \mathrm{S3}_{\mathrm{t}-1}$$

$$PROV_t^k = PROV_t^{S1} + PROV_t^{S2} + PROV_t^{S3}$$

RWA

9. STA – Performing: Densities at the cut-off point are assumed constant over the scenario horizon.

RWA densities per portfolio/segment 'e'

$$\rho_e^{PE}[0] = \frac{RWA(STA)_e^{PE}[0]}{EAD(STA)_e^{PE}[0] - PROV(STA)_e^{PE}[0]}$$

RWA

$$RWA(STA)_e^{PE}[t] = \rho_e^{PE}[0] * (EAD(STA)_e^{PE}[t] - PROV(STA)_e^{PE}[t])$$

10. STA - Nonperforming: Densities at the cut-off point are assumed constant over the scenario horizon.

RWA densities per portfolio/segment 'e'

$$\rho_e^{NPE}[0] = \frac{RWA(STA)_e^{NPE}[0]}{EAD(STA)_e^{NPE}[0] - PROV(STA)_e^{NPE}[0]}$$

RWA

$$RWA(STA)_e^{NPE}[t] = \rho_e^{NPE}[0] * (EAD(STA)_e^{NPE}[t] - PROV(STA)_e^{NPE}[t])$$

11. IRB: Performing: Use of Basel formulas. PD TTC and LGD DT are projected as follows:

a. PD TTC

i. Option A: If historical information on PD PiT is available for a period equal to $\text{TTC Window} - 1$; then PD TTC is calculated based on the moving average of PD PiT, with an adjustment made with respect to the cut-off point. The adjustment accounts for the difference between the true PD TTC and the estimated one at the cut-off point.

$$\text{PD TTC}[t] = \frac{\sum_{k=0}^{k=TTC\ Window} PDPiT[t-k]}{TTC\ Window} + \left(PD\ TTC[T_0] - \frac{\sum_{k=0}^{k=TTC\ Window} PDPiT[T_0-k]}{TTC\ Window} \right)$$

ii. Option B: If no historical information on PD PiT is available, but PD PiT and PD TTC are known at the cut-off point, then a formula that mimics a moving average is used instead.

$$\text{PD TTC}[t] = \frac{\big(TTC\ Window - (t+1)\big) * \frac{PD\ TTC[T_0] * TTC\ Window - PD\ PiT[T_0]}{TTC\ Window - 1} + \sum_{k=0}^{k=t} PDPiT[k]}{TTC\ Window}$$

Main caveat in both options is the implicit assumption that TTC is a simple cycle average which ignores any conservatism when banks do not update downwards PD TTCs during boom cycles.

b. LGD DT

$$LGD\ T_e[\text{t}] = \max(LGD\ PiT_e[t], LGD\ DT_e[T_0])$$

12. IRB: Nonperforming:

$$RWA(IRB)_e^{NPE}[t] = EAD(IRB)_e^{NPE}[t] * (LGD\,T_e[t] - ELBE_e[T_0]) * 12.5 RWA(IRB)_e^{NPE}[t]$$
$$= EAD(IRB)_e^{NPE}[t] * (ELBE_e[T_0] - LGD\,T_e[t]) * 12.5$$

Appendix V. Interest Income

Notation

1. Denote as E_t the total loans outstanding at time t, and as $E_t^{[T,T+1]}$ the loans in bucket $[T, T+1]$. These are loans that at the end of period t have between T and $T+1$ years left until repricing.

2. Denote the fraction of loans in each bucket at time t as $\theta_t^{[T,T+1]} = \frac{E_t^{[T,T+1]}}{E_t}$,

Assumptions

3. Assume the following:

i. The total stock of loans grows at an exogenous rate g_t

ii. [1]. That is, $E_{t+1} = (1 + g_{t+1})E_t$.

iii. Let r_t^L be the interest on new loans. Loans pay a fixed nominal rate, and the principal is not inflation-adjusted.

iv. The model assumes there is no refinancing of loans.

v. $\theta_t^{[T,T+1]}$ are kept constant at the cut-off date.

vi. $r_0^{[k-1,k]} = r_0 \; \forall k$

4. The total interest income in period t is calculated as

$$\widetilde{\Pi_t} = \sum_{k=1}^{3} r_{t-1}^{[k,k+1]} E_{t-1}^{[k,k+1]} + \frac{1}{2} r_{t-1}^{[0,1]} E_{t-1}^{[0,1]} + \frac{1}{2} r_t^{E,nb} \left(\sum_{k=0}^{5} I_t^{[k,k+1]} \right)$$

Where the three terms account for

i. interest income from the exposures that at the end of year-(t-1) had at least 1 year left until repricing;

ii. income from the exposures that at the end of year-(t-1) had less than 1 year left until repricing;

iii. newly issued/repriced loans.

And:

[1] This is growth rate of the gross loans, that is, including NPLs.

$$I_t^{[k-1,k]} = E_{t-1}^{[k,k+1]}\left(1 + r_{t-1}^{[k,k+1]}\right) - E_t^{[k-1,k]}$$

$$r_t^{[k-1,k]} = \frac{E_{t-1}^{[k,k+1]}\left(1 + r_{t-1}^{[k,k+1]}\right)}{E_t^{[k-1,k]}} \cdot r_{t-1}^{[k,k+1]} + \frac{I_t^{[k-1,k]}}{E_t^{[k-1,k]}} \cdot r_t^{[E,nb]}$$

$$E_t = (1 + g_t^E)E_{t-1}$$

$$\mathrm{E}_{\mathrm{t}}^{[\mathrm{k},\mathrm{k}+1]} = \theta_0^{[\mathrm{k},\mathrm{k}+1]} \cdot \mathrm{E}_{\mathrm{t}}$$

5. Finally, income is adjusted to account for nonperforming exposures:

$$\mathrm{II}_{\mathrm{t}} = \frac{\mathrm{av}\{(1 - \mathrm{NPEr}_{\mathrm{t}})\mathrm{E}_{\mathrm{t}}\,;\,(1 - \mathrm{NPEr}_{\mathrm{t-1}})\mathrm{E}_{\mathrm{t-1}}\}}{\mathrm{av}\{\mathrm{E}_{\mathrm{t}};\mathrm{E}_{\mathrm{t-1}}\}} \cdot \widetilde{\mathrm{II}}_{\mathrm{t}}$$

Table 1. Spain: Alternative calibration considered for deposit and loans beta

Sector	Item	Type	PECM	2x Assets	2x Deposits	BdE - Assets	BdE - Deposits	Long run (ARDL)	50-100
HH	Deposit	Sight	6	6	12	6	2	11	50
		Term	49	49	98	49	31	100	100
	Loans	Mortgages	78	100	78	53	78	91	78
		Consumption	60	100	60	35	60	81	60
NFC	Deposit	Sight	27	27	54	27	10	36	50
		Term	48	48	96	48	44	100	100
	Loans	all	73	100	73	53	73	100	73

Note: Shaded cells indicate a deviation from central calibration (PECM).

Appendix VI. Market Risk

1. The fair value of debt securities can change due to 1) risk free rates (r) and 2) sovereign spread (s). The loss is the result of multiplying the modified duration of the position/portfolio by the changes in benchmark risk free rate/credit spread and portfolio valuation. Securities are partitioned according to duration/maturity and the relevant interest rate is considered for the shock:

$$MD_t \sim \frac{MD_{t-1}}{1 + \Delta s_t + \Delta r_t}$$

$$FV_t = FV_{t-1}(1 - MD_t \cdot \Delta s_t - MD_t \cdot \Delta r_t)$$

Appendix VII. Liquidity Stress Test Scenario Specification

Table 1. Spain: Liquidity Stress Test Scenario Weights (percent)

	Basel III	Market	Outflow	Aggressive
Outflows				
Retail Deposits				
Stable Demand Deposits	5	5	10	10
Less Stable Demand Deposits	10	10	26.3	26.3
Term Deposits, residual maturity > 30 days	0	0	19.2	19.2
Unsecured Wholesale Funding				
Demand and Term deposit, small business, residual maturity <30 days				
Stable Deposits	5	5	10	10
Less Stable Deposits	10	10	33	33
Operational deposits due by clearing, custody and cash mgt activities	25	25	50	50
Portion covered by deposit insurance	5	5	10	10
Cooperative banks in an institutional network	25	25	35	35
NFCs, sovereigns, central banks, multilateral development banks, PSEs				
Fully covered by deposit insurance	20	20	35	35
Not fully covered by deposit insurance	40	40	60	60
Other legal entity customers	100	100	100	100
Secured Funding				
Secured funding with a central bank, or backed by Level 1 assets	0	0	5	5
Secured funding backed by Level 2A assets	15	15	30	30
Secured funding backed by non-Level1 or non-Level2A asset, with dom. sovereign, multilateral dev banks, or domestic PSEs as a counterparty	25	25	40	40
Funding backed by RMBS eligible for Level 2B	25	25	40	40
Funding backed by other Level 2B assets	50	50	60	60
Other secured funding transactions	100	100	100	100
Additional Requirements				
Valuation changes non-Level 1 posted collateral securing derivatives	20	20	35	35
Excess collateral held by bank related to derivate transactions that could be called anytime	100	100	100	100
Liquidity needs related to collateral contractually due on derivatives transactions	100	100	100	100

Increased liquidity needs related to derivative transactions allowing collateral substitution	100	100	100	100
ABCP, SIVs, conduits, SPVs, or similar				
Liabilities from maturing	100	100	100	100
Asset backed securities	100	100	100	100
Undrawn but committed credit and liquidity facilities				
Retail and small business	5	5	10	10
NFCs, sovereigns, CBs, multilateral dev banks, PSEs				
Credit facilities	10	10	30	30
Liquidity facilities	30	30	50	50
Supervised banks	40	40	50	50
Other financial institutions				
Credit facilities	40	40	50	50
Liquidity facilities	100	100	100	100
Other legal entity customers, credit, and liquidity facilities	100	100	100	100
Other contingent funding liabilities				
Trade finance	5	5	10	10
Customer short positions covered by customers' collateral	50	50	75	75
Other products and services	10	10	10	10
Additional contractual outflows	100	100	100	100
Net derivate cash outflows (including planned)	100	100	100	100
Any other contractual cash outflows (not listed above)	100	100	100	100
Inflows				
Level 1 assets	0	0	0	0
Level 1 assets (extremely liquid)	7	15	7	15
Level 2a assets	15	15	15	15
Level 2b assets				
Eligible Residential Mortgage-Backed Securities (RMBS)	25	50	25	50
Other	50	70	50	70
Margin lending backed by all other collateral	50	100	50	100
All other assets	100	80	100	80
Credit or liquidity facilities	0	0	0	0
Operational deposits held at other financial institutions	0	0	0	0
Other inflows, by counterparty				
Retail counterparties	50	35	50	35
Nonfinancial wholesale counterparties, transactions not listed above	50	35	50	35
Other inflows from NFCs, non-principal repayment	100	80	100	80
Financial institutions and central banks, transactions not listed above	100	80	100	80
Loans with an undefined contractual end date	20	10	20	10
Net derivative cash inflows	100	100	100	100

Other (contractual) cash inflows	100	80	100	80
Assets				
Level 1 assets				
Cash	100	100	100	100
Qualifying marketable securities (sovereign, CB, PSEs, MBDs)	100	95	100	95
Qualifying CB reserves	100	100	100	100
Domestic Sovereign or CB debt for non-zero risk weighted entities	100	95	100	95
Level 1 extremely high-quality covered bonds	93	85	93	85
Level 2A assets				
Qualifying marketable securities form sovereigns, central banks, PSEs, and multilateral development banks (with 20% risk weighting)	85	85	85	85
Qualifying corporate debt securities rated AA- or higher	85	85	85	85
Qualifying covered bonds rated AA- or better	85	85	85	85
Level 2B assets				
Qualifying Mortgage-Backed Securities	75	50	75	50
Qualifying corporate debt securities rated between A+ and BBB-	50	30	50	30
Qualifying common equity shares	50	30	50	30

Appendix VIII. Household Vulnerability Analysis Methodology

Data and General Approach

1. The household vulnerability analysis uses micro data from BdE's 2020 Survey of Household Finances to conduct simulations of macroeconomic shocks to household balance sheet. The analysis then computes under different scenarios, household vulnerability measures based on DSTI and essential consumption on food, utilities, and rents.

2. The analysis also divides households into five income quintiles and study the heterogeneity across different income groups.

Definition of Household Vulnerability

3. Two definitions of household vulnerability are considered: DSTI greater than or equal to 40, and debt service plus consumption of food, utilities, and rents exceeding 70 percent of household income (debt-service-and-essential-consumption-to-income-ratio, DSECTI>=70).

Application of Macroeconomic Shocks

4. Given the latest survey of household finances were conducted in 2020 and households' liabilities and consumption patterns could have changed in the recovery from the pandemic, we apply the cumulative changes in the macroeconomic conditions from 2020 to 2024 and from 2020 to 2026 to assess the health of household balance sheet in the two years. The application of each macroeconomic variable to individual household balance sheet follows Valderrama et al. (2023):

- **Income.** From 2020 to 2022, we extrapolate each household's income growth using the cumulative growth in disposable income per capita. For 2023 onwards, we use projected wage growth to proxy for household income growth. The same growth rate is applied to each household.
- **Debt.** Updating household debt is more challenging as some households may offset principal repayment since 2020 with new borrowing, while others may fully amortize debt and be replaced by new borrowers. Moreover, as interest rate increases, households with sufficient financial assets may choose to repay their variable-rate loans early. For simplification, we apply the save ratio of debt growth to all households following the sectoral wide growth rate.
- **Interest payments.** For simulations up to 2022, we assume that adjustable-rate loans had not been repriced. For 2024 onwards, interest rate changes are assumed to be fully passed through to variable-rate loans and fixed-rate loans are not affected.
- **Consumption.** We assume no change to the structure of the real consumption basket.

- **Prices.** Changes in the price of food and energy follow global wholesale prices sourced from IMF's WEO while the value of rents, non-essential goods, and services is adjusted by core inflation.

- **Unemployment rate.** We assume that changes of unemployment rate can apply evenly to anyone who is currently in the labor force. When a worker changes from employed to unemployed, its wage income will become the average social benefits available to unemployed (unemployment benefit, unemployment assistance, private insurance, and ERTE). Similarly, when an unemployed worker becomes employed, it will lose all the unemployment-related social benefits but started to earn an average wage income.

Summary Table for Key Assumptions

5. The table below shows the assumptions on the evolvement of key macroeconomic variables used in the simulation. Changes for household income, prices, and household debt are shown in percent differences relative to 2020 levels; changes for unemployment rate and interest rates are shown in percentage points differences relative to 2020 rates.

Table 1. Spain: Key Macroeconomic Variables Assumptions Summary Table

	2022	2024, baseline	2024, adverse	2026, baseline	2026, adverse
Income	+8.1	+16.4	+16.4	+22.8	+20.5
Unemployment rate	-2.7	-3.9	+2.7	-4.5	+5.1
Mortgage interest rate	0	+4.3	+6.9	+4.1	+5
Other household loan interest rate	0	+2.6	+4.5	+2.5	+2.8
Food price	+36.7	+24.7	+37.9	+24.9	+47.1
Energy price	+226.6	+91.7	+131.5	+74.1	+136.8
CPI	+11.4	+18.7	+21.7	+22.5	+25.8
Household debt	+2.6	+0.3	-1.7	+0.9	-6.4

Computing Household Vulnerability

Denoting $\boldsymbol{\Delta i_{T-t,j}}$ as the interest rate shock from time

$$\boldsymbol{DSTI^{h}_{T,j} = \frac{\sum_{k=1}^{N}\left(P^{h}_{t,k} + O^{h}_{t,k} \times i^{h}_{t,k}\right) + \sum_{s=1}^{M}\left(O^{h}_{t,s} \times \Delta i^{s}_{T-t,j} \,|s = variable\right)}{I^{h}_{t} \times \left(1 + \Delta inc_{T-t,j}\right)} \times gD_{T-t,j}}$$

$$\boldsymbol{DSECTI^{h}_{T,j} = DSTI^{h}_{T,j} + \frac{food^{h}_{t} \times \left(1 + \Delta CPI^{food}_{T-t,j}\right) + utilities^{h}_{t}\left(1 + \Delta CPI^{energy}_{T-t,j}\right) + rent^{h}_{t} \times \left(1 + \Delta CPI_{T-t,j}\right)}{I^{h}_{t} \times \left(1 + \Delta inc_{T-t,j}\right)}}$$

Appendix IX. Housing Price Valuation Methodology

1. The exercise uses a linear regression model (IMF Real Estate Market Module) with changes in CPI-deflated real house prices as the dependent variable. The baseline model has mainly demand-side variables as explanatory variables, while supply is assumed to be relatively inelastic in the short run but has an impact on house prices in the long run. The regression takes the following form:

$$\begin{aligned}&\Delta\, real\ house\ price\ growth_t\\&= C + \theta\ affordability_{t-1} + \beta_1\ income\ growth_t + \beta_2\ short\ term\ rate_t\\&+ \beta_3\ long\ term\ rate_t + \beta_4\ stock\ price\ growth_t + \beta_5\ working\ age\ population\ growth_t\\&+ \beta_6\ GFC\ dummy_t + \beta_7\ Euro\ Crisis\ dummy_t + \beta_8\ COVID\ dummy_t + \epsilon_t\end{aligned}$$

2. Income is proxied using GDP per capita and house prices to income (proxied by GDP per capita) ratio is used to measure affordability. The short-term rate is the mortgage benchmark rate—12-month Euribor and the long-term rate uses 10-year Spanish treasury yield in the secondary market. In two alternative models, explanatory variables further include credit growth, and credit growth together with supply-side variables (construction cost index, new building permits) to capture additional possible drivers of house prices.

3. The levels of house prices in years from 2015 to 2018 are used as alternative base levels from which the fitted values of the house price increases are accrued. The misalignment then is calculated as the average over these base years.

The table below summarizes the variables used in the house price valuation model:

Table 1. Spain: Variables and Data Sources for the House Price Valuation Model

Variables	Data Source	Frequency
General Housing Price Index excluding State-Subsidized Housing	BdE	Quarterly
CPI	INE	Monthly -> Quarterly
GDP	INE	Quarterly
Working Age Population, 16+ years of age	INE	Quarterly
Outstanding Loans to HH/NPISH and NFCs	BdE	Monthly -> Quarterly
12-Month Deposits [EURIBOR]	ECB	Monthly -> Quarterly
10-year Government Bond Yields, Secondary Market	BdE	Monthly -> Quarterly
Ibex35	Bolsa de Madrid	Monthly -> Quarterly
Construction Cost Index: Residential Buildings ex Community Residences	Eurostat	Monthly -> Quarterly
Building Permits: Residential Buildings ex Community Residences	Eurostat	Monthly -> Quarterly

Appendix X. NFC Stress Testing Methodology

1. The methodology proposed by Tressel and Ding (2021) employs a series of firm-level indicators to evaluate firms' financial health, specifically focusing on their debt servicing capacity (ICR), external borrowing requirements based on cash balances, and overall solvency. This approach integrates scenario-based stress testing with a comprehensive set of firm-level regressions, which can be augmented by accounting principles. It particularly utilizes dynamic regressions to analyze return on assets (ROA) and leverage ratios, alongside Probit models for assessing cash balances and the ICR.

2. The OLS regression models target ROA and leverage as dependent variables, while the Probit models use binary indicators—flagging an ICR below one or a non-positive cash balance—as dependent variables. These models dynamically forecast based on prior year firm-level data, incorporating both changing and constant structural features, as well as macro-financial factors.

3. At its core, the firm-level regression framework is structured around dynamic OLS regression, incorporating industry-specific fixed effects to account for sectoral variations.

4. $$Y_{i,s,t} = \alpha \cdot Y_{\{i,s,t-1\}} + \beta\{firm\_char\}_{\{i,t\}} + \Phi\{MacroVar\}_t + d_s + \nu_{i,s,t}$$

5. In the methodology, $\boldsymbol{Y_{\{i,s,t\}}}$ represents the variable forecasted for firm i, in industry s and year t, where $\boldsymbol{firm\ char_{\{i,t-1\}}}$ includes firm-specific explanatory variables from the previous year, $\boldsymbol{Macro\ var_t}$ encompasses macroeconomic variables, $\boldsymbol{d_s}$ are industry-specific fixed effects, and $\boldsymbol{\nu_{\{i,s,t\}}}$ is the error term, clustered by industry and year to account for within-group correlation.

6. Explanatory variables at the firm level are taken from one period prior and encompass measures such as profitability (using the return on assets metric), leverage (represented by the debt-to-asset ratio), size (determined by total assets), asset tangibility (calculated as the ratio of fixed assets to total assets), and cash flow generation capacity (expressed as the ratio of sales to total assets). These metrics are widely recognized as key factors influencing a firm's level of indebtedness and the composition of its debt maturity.

7. To forecast firm-level outcomes for the dependent variables, some explanatory factors are categorized as reflecting the structural attributes of firms, treating them as time-invariant. Specifically, the size of the firm and asset tangibility are considered stable and are thus fixed at their values from 2022 (last observation). In contrast, other variables, such as return on assets (ROA) and leverage, are dynamically projected to change over time in response to various macroeconomic scenarios. The macro-financial variables influencing firm-level profitability and leverage include annual real GDP growth and interest rates. The estimations are done based on the following equation:

$$Y_{i,s,T} = \alpha \cdot \hat{Y}_{\{i,s,T-1\}} + \hat{\beta}\left\{Struc\ Char_{\{i,s,2022\}}, other\ firm\_char_{\{i,s,T-1\}}\right\} + \hat{\Phi}\{MacroVar\}_T + \hat{d}_s$$

8. Based on the projection of ROA and leverage, the model uses accounting identities to construct other variables.

- **Interest expenses** reflects incremental macro shocks to interest rates in each scenario, and firm level base effects reflecting each firm's 2022 effective interest rates and debt levels in each period. Specifically, they are projected according to the equation:

  Interest expense(i,t) = {2019 effective interest rate(i) + [LTD/TD(i) * Δscenario LT rate(t) + STD/TD(i)*Δscenario ST rate(t)]}× TD(i,t-1).

  where: "2022 effective interest rate(i)" is the effective interest rate paid by firm *i* on its stock of debt in 2022, "TD(i,t)" is the firms' debt stock in period t, "LTD/TD(i)" is the firm's 2022 ratio of long-term debt to total debt in 2022, "STD/TD(i)" is the 2022 ratio of short-term debt to total debt, "Δscenario LT rate(t)" is the change in the long-term interest rate for corporates in the scenario considered between 2022 and year t, and "Δscenario ST rate(t)" is the change in the short-term interest rates for corporates between 2019 and period t.

- **EBIT** is related to ROA = (EBIT-taxes)/Total Assets.

- **Cash/borrowing needs** are given by: EBIT – Taxes – Interest Expense + Initial Cash and eq. under the assumption that firms do not pay dividends and invest to maintain the existing stock of capital (depreciation+amortization=CAPEX). A negative value means that the firm has to increase its indebtedness to be able to honor cash outflows.

- **The change in debt** is defined as "minus" borrowing needs.

The results are presented in Figure 20.

Appendix XI. Interconnectedness Models

Network Analysis Framework (Espinosa-Vega and Solé, 2010)

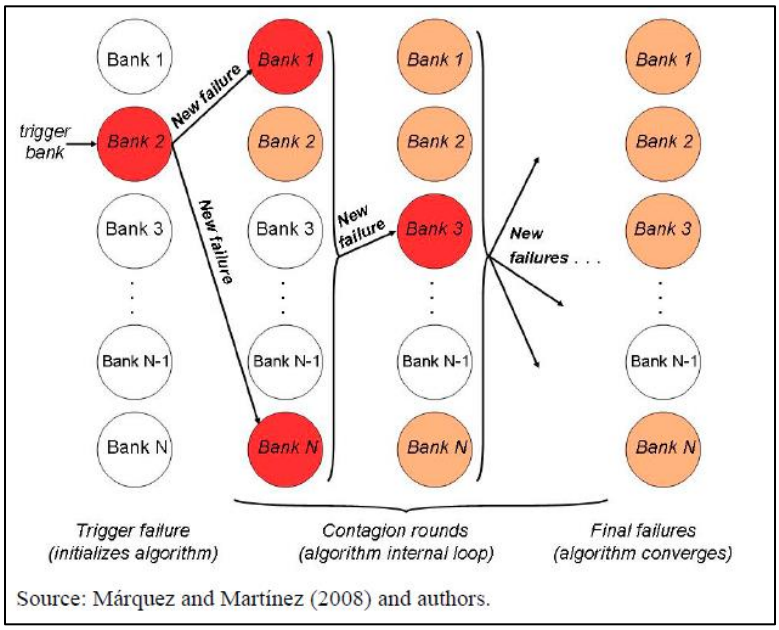
1. To evaluate contagion risks and interconnectedness, the analysis uses the framework developed by Espinosa-Vega and Sole (2010), focusing on the analysis of cross-border bank exposures and the potential for contagion within the interbank market.

2. Credit shock: The "failure" of banking system A would lead to credit losses for system B, which holds claims against A. The severity of these losses is governed by the assumed credit loss rate, with a loss given default rate of 50 percent used to illustrate the impact of a severe credit shock.

3. Funding shock: The "failure" of banking system A compels system B (which has claims against A) to seek alternative funding sources. This could necessitate system B's fire sale of liquid assets to cover the funding shortfall. It's assumed that 35 percent of the funding loss cannot be replaced (with a 65 percent rollover rate), and assets sold under duress are subject to a 30 percent discount ratio due to fire sale.

4. For instance, in the case of the cross-border interconnectedness, an initial adverse credit or funding shock within a country's financial system can spread across international borders through a network of bilateral claims, as recorded in the BIS consolidated banking statistics. This network propagation can distress banking systems in other countries, amplifying the direct losses from the original shocks.

5. A banking system is considered to have "failed" if it incurs losses exceeding its total Tier 1 or regulatory capital. Such a failure might lead to the failure of another banking system, setting off a chain reaction. This domino effect signifies how the collapse of one entity in a financial network can precipitate failures across other connected banking systems**.**



Source: Márquez and Martínez (2008) and authors.

6. In addition to the loss incurred by each institution in the model, the model gives two outputs as follow:

Index of contagion: the average loss of other banks due to the failure of a bank i:

$$Cont_i = 100 \times 1/(N-1) \sum_{\{j=1, j \neq i\}}^{N} L_{\{ji\}} / K_j$$

Index of vulnerability: the average loss of a bank i due to the failure of all other banks:

$$Cont_i = 100 \times 1/(N-1) \sum_{\{j=1, j \neq i\}}^{N} L_{\{ij\}} / K_i$$

Appendix XII. Sovereign-Bank Model

1. The analysis investigates the potential direct impact of sovereign distress on banks' balance sheets by analyzing mark-to-market losses related to their exposures to sovereign debt. The following empirical model is estimated:

$$\begin{aligned}\left[Y_{\{i,t\}} = \beta_1 Sovereign\ Exposure_{\{i,t-1\}} \times Sovereign\ \ Distress_{\{i,t\}} \times Capital\ Ratio_{\{i,t-1\}}\right.\\ \left. + \beta_2 Sovereign\ Exposure_{\{i,t-1\}} \times Sovereign\ \ Distress_{\{i,t\}}\right]\\ +\ \beta_3\ Sovereign\ Exposure_{\{i,t-1\}} \times Capital\ Ratio_{\{i,t-1\}} + \beta_4\ \ Sovereign\ Exposure_{\{i,t-1\}}\\ + \beta_5 Sovereign\ \ Distress_{\{i,t\}} + \beta_6\ Capital\ Ratio\_\{i,c,t-1\}\ ]\end{aligned}$$

$$\left[+ \Gamma\ X_{\{i,t-1\}}\ +\ \gamma_i\ + \epsilon_{\{i,t\}}\ \right]$$

2. The independent variable $Y_{i,t}$ represents i) the change in the change in the total gross loans-to-total assets ratio (ii), denotes the change in pre-tax profits divided by lagged total equity for bank i from the end of year t-1 to the end of year t. These variables have been extracted from the annual consolidated financial statements of the banks.

3. The variable $Sovereign\ Exposure_{t-1}$ represents the ratio of total government bond holdings to total assets at the end of the previous year, t-1. $Sovereign\ Distress_{t-1}$ is an indicator variable that takes the value of 1 if there is sovereign distress in year t. Specifically, it is set to 1 if, during year t, the sovereign CDS spread exceeds a certain and otherwise, it is set to 0. Alternatively, we consider ECB's composite indicator of sovereign stress (CISS) which includes 15 raw, mainly market-based financial stress measures that are split equally into five categories, namely the financial intermediaries' sector, money markets, equity markets, bond markets and foreign exchange markets.

4. To examine potential non-linearities in this relationship, we consider various thresholds for the sovereign CDS spread, which range from 50 to 200 basis points which happened during the height of the European debt crisis. This approach follows the methodology of Pescatori and Sy (2007).

5. The variable $Capital\ Ratio_{i,t-1}$ is defined as the ratio of total equity to total assets at the end of the previous year, t-1. $X_{i,t-1}$ represents the set of bank controls at the end of year t-1, which includes various factors such as size (measured as the logarithm of total assets), capital **ratio, liquidity (non-cash assets-to-total assets ratio), profitability (return on assets), total exposure to the central bank divided by total assets, interbank balances (interest-earning balances with central and other banks divided by total assets), and loans outstanding divided by total assets.** These control variables are based on the methodology established by Deghi et al. (2022) and are lagged by one year to address potential concerns related to endogeneity.

6. In this analysis, we are primarily concerned with a one-year time horizon, which allows us to assess the impact at the end of year t following a sovereign stress event in year t. This is

because sovereign stress can rapidly transmit to banks within a relatively short period of time, and we are interested in capturing the effects within that timeframe. The identification in the analysis is achieved by leveraging cross-sectional variations in outcome variables among banks with differing levels of government debt holdings during a specific year. The model incorporates bank fixed effects (denoted as γ_i) to absorb any time-invariant entity-dependent specific characteristics. Our assumption is that these fixed effects, in combination with an extensive array of bank-level controls, are sufficient to account for variations across banks that could potentially explain differences in bank-level outcomes following a sovereign distress event, beyond their exposure to sovereign debt. We estimate the model using ordinary least squares, and standard errors are clustered at the bank level for robustness.

7. The primary hypotheses to test are as follows: first, whether banks with higher holdings of sovereign debt experience adverse outcomes in the aftermath of a sovereign stress event, and second, whether banks with lower capital ratios are more susceptible to amplified effects. To estimate the effect of sovereign exposure on banks' credit to private sector during periods of heightened sovereign stress, the analysis first estimates the impact for all banks and then, it compares these results with those specific to banks where the capital ratio falls below the median level. To assess the impact of higher government exposures on ROE, we estimate the effect at the mean capital ratio, meaning we compute "$\beta 1$* capital ratio" at the mean capital ratio when the sovereign is under distress. We then compare this effect to that of banks with a capital ratio half standard deviation lower than the mean.

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