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TECHNICAL NOTE

SYSTEMIC RISK ANALYSIS AND STRESS TESTING OF THE BANKING AND CORPORATE SECTORS

Prepared By
Monetary and Capital Markets Department

This Technical Note was prepared by IMF staff in the context of the Financial Sector Assessment Program in Italy. 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

AE	Asset Encumbrance
AFS	Available for sale
ASF	Available Stable Funding
BDI	Banca d'Italia
BIS	Bank for International Settlements
BMA	Bayesian Model Averaging
BPS	Basis Points
CAR	Capital adequacy ratio
CCB	Capital Conservation Buffer
CET1	Core Equity Tier 1
CFLST	Cash Flow-based Liquidity Stress Test
EA	Euro Area
EAD	Exposure at default
EBA	European Banking Authority
ECB	European Central Bank
EU	European Union
FSAP	Financial Sector Assessment Program
FV	Fair Value
FVOCI	Fair Value through Other Comprehensive Income
FVTPL	Fair Value through Profit and Loss
FX	Foreign Exchange
GDP	Gross domestic product
GFC	Global Financial Crisis
GFSR	Global Financial Stability Report
HQLA	High-quality liquid assets
IRB	Internal ratings-based (approach)
IRRBB	Interest Rate Risk in the Banking Book
LCR	Liquidity coverage ratio
LGD	Loss-given default
NFC	Non-Financial Corporate
NII	Net interest income
NIM	Net interest margin
NPL	Nonperforming loan
NSFR	Net-Stable Funding Ratio
OSII	Other Systemically Important Institution
PD	Probability of default
PiT	Point-in-time
RAM	Risk Assessment Matrix
ROA	Return on assets

ROE	Return on equity
RSF	Required Stable Funding
RWA	Risk-weighted assets
SMEs	Small- and Medium-Sized Enterprises
STE	Short-term exercise
STeM	Stress test matrix (for FSAP stress tests)
TD	Top-down (stress test)
TLTRO	Targeted Longer-Term Refinancing Operations
TTC	Through-the-cycle
WEO	World Economic Outlook

EXECUTIVE SUMMARY[1]

The Financial Sector Assessment Program (FSAP) took place against the backdrop of an ongoing recovery of the financial system. Since the global financial crisis (GFC), financial regulation has been substantially enhanced by the implementation of euro area-wide (EA-wide) regulatory and supervisory frameworks. Furthermore, the Italian authorities have implemented important measures that improved governance, facilitated capitalization, raised prudential requirements, and improved asset quality. In response, Italian banks have made substantial progress tackling legacy non-performing loans (NPLs) and improving solvency ratios.

The banking sector nonetheless is still vulnerable and faces a challenging baseline outlook. Italian banks are the largest users of the ECB's TLTRO, which provides substantial support to banks' liquidity and profitability. Despite progress in recent years, many banks still suffer from relatively low capital levels and low profitability and asset quality. The average capital ratio of Italian banks remains below the euro area. NPL ratios are still among the highest in the EU; the FSAP estimates that shortfalls of loan loss provisions are about €5 billion based on internal workouts, mostly related to loans identified as unlikely to pay, and an additional €7½ billion will be needed for banks to halve their NPLs through market sales. In addition, the relatively high operating costs of segments of the Italian banking system and corporate governance weaknesses continue to weigh on profitability, which will be further impacted by the full implementation of International Financial Reporting Standard 9 (IFRS 9) and the Minimum Requirement for Own Funds and Eligible Liabilities (MREL). Italian banks' exposure to the sovereign and the leverage in the corporate sector increase the vulnerability to downside shocks. Furthermore, fiscal vulnerabilities increase the risk of a substantial economic contraction and rising credit spreads, which would have strong negative repercussions for the financial sector.

The FSAP conducted a comprehensive set of stress tests and interconnectedness analyses to assess the resilience and vulnerabilities of the Italian financial banking system. The scenario-based solvency stress test focuses on the reemergence of sovereign stresses in Italy, which was assumed to be primarily driven by Italy-specific factors. Under the scenario, the interaction of sovereign and banking sector stress generates heightened risk aversion, fiscal consolidation reactions and confidence losses. The exercise covered 9 significant institutions (SIs), representing 68 percent of total banking assets, while sensitivity-based analysis covered both SIs and 62 less significant institutions (LSIs).[2] In addition to solvency stress tests, a suite of liquidity stress tests was conducted based on several approaches and a variety of scenarios. A contagion analysis explored interlinkages within Italy and across borders and corporate sector stress tests analyzed the resilience

[1] Prepared by Maral Shamloo, Irman Pardede, Purva Khera, Nour Tawk, Xiaodan Ding and Mindaugas Leika, from the IMF Monetary and Capital Markets Department, and Alvar Kangur from the IMF European Department for the 2020 Italy FSAP.

[2] The FSAP did not stress test the cooperative banking sector since it was undergoing consolidation into two groups and a joint protection scheme in early January 2019.

of this sector to adverse profit and interest rate shocks. The above was supplemented by profitability analysis of the banking system.

Solvency stress tests indicate that banks still face important challenges:

- Under the **baseline scenario**, the aggregate common equity tier 1 (CET1) ratio of sample banks would decline by 56 basis points (bps) from 11.9 percent to 11.4 percent. The unfavorable macroeconomic outlook under the baseline scenario, i.e., elevated sovereign spreads and weak growth prospects, raises credit risk. Furthermore, FSAP assumptions used on loss-given default (LGD) also increase the provisions needed during the three-year scenario horizon.[3] With no additional NPL disposal assumed, one bank falls below the T1 threshold and another bank falls below the capital adequacy ratio (CAR) threshold. When including NPL disposal targets, the first bank would fall short of the three capital thresholds. The aggregate CET1 ratio declines by 102 bps to 10.9 percent with a resulting shortfall in capital of about 0.05 percent of gross domestic product (GDP). Credit risk is the main contributor to the decline in capital ratios.

- The **adverse scenario,** which is based on severe but plausible assumptions, has a significant impact on banks' capital ratios. The average fully loaded CET1 capital ratio declines from 11.9 percent in 2018 to 8.2 percent in 2021. Three banks would see their capital ratios drop below capital minimum requirements. While the resulting capital shortfall against the capital thresholds is small at about 0.2 percent of GDP, capital needs to bring the CET1 ratio of the 9 SIs included in the stress scenario back to the end-2018 level of 12 percent is about 2.2 percent of the GDP. Again, credit risk was the largest contributor to the decline in capital ratios, amounting to about 5.3 percentage points of the decline. The increase in sovereign yields also has an important impact through valuation losses (1.2 percentage point decline in CET1) so do net interest income (NII) losses related to higher funding costs (0.9 percentage points). Heightened credit risk, valuation effects in foreign exchange exposures, and the projected increase in lending for some banks, contribute to an expansion of risk weighted assets (RWAs), thereby lowering CET1 by 1.2 percentage point across the sample banks. The pre-provision revenue, including mainly aggregate NII, non-interest income, and non-interest expenses, increases the aggregate CET1 ratio by 4.7 percentage points relative to the starting point.

- **The sensitivity analysis using single-factor shocks indicates important vulnerabilities among the LSIs.** Results show that banks are vulnerable to NPL shocks and mark-to-market losses arising from an increase in the yield of Italian government bond holdings. An increase in Italian sovereign yields by 230 bps would cause the capital of almost a quarter of the sample of LSIs by assets (10 banks) to fall below the 7 percent CET1 ratio threshold. Under an

[3] If applicable, the FSAP applies a gradual provisioning increase over the three-year baseline horizon on existing stock of NPLs to benchmark loss rates estimated by the FSAP for various portfolios. When including NPL disposal target in an alternate baseline scenario, the FSAP assumes market discount rates on NPLs that are targeted to be disposed through market sales as opposed to internal workouts.

NPL shock, 14 LSIs (35 percent of the sample's assets) would see their CET1 ratio fall below 7 percent. The tests indicate that SIs are resilient to concentration risk; specifically, SIs can withstand the simultaneous default of the five largest borrowers of their non-financial corporate exposures.

Three different liquidity stress tests were conducted to assess the resilience of the banking sector against funding and market liquidity shocks. The FSAP conducted Liquidity Coverage Ratio (LCR), Net Stable Funding Ratio (NSFR), and cashflow-based analyses for the full list of SIs (11 banks) and 61 LSIs. While the results indicate relatively comfortable positions, the tests highlight that the concentration of liquid assets in Italian government securities renders banks' liquidity susceptible to adverse market valuations of these securities. Diversification by issuers and maturity and type of asset would help increase banks' resilience to adverse shocks. Furthermore, aggregate liquidity is boosted by the extensive reliance on the TLTRO. At close to € 250 bn and representing on average about 10 percent of banks' total liabilities, Italian banks are the largest utilizers of this facility in the EA.

The non-financial corporate stress test indicates that the sector remains sensitive to macroeconomic shocks. In the adverse macroeconomic scenario, combined profit and interest rate shocks would move the median interest coverage ratio and the share of firms-at-risk close to the levels of the 2008–09 and 2012 crises. The results indicate that the bulk of the improvement in corporates' debt servicing capacity has been driven by the historically low interest rates and structural improvements in profitability have been insufficient. These results are consistent with the outcome of the banking sector solvency stress tests, where the majority of losses emanate from corporate credit risk.

Domestic interbank contagion is limited, but the exposure of Italy's financial sector to the government and nonfinancial corporate sector produces high cross-sectoral contagion risk. The network analysis of interbank interconnectedness suggests very limited risk of contagion within the banking system owing to small interbank exposures. However, the flow-of-funds analysis indicates significant cross-sectoral contagion risk owing to: (i) growing cross-sectoral exposures; (ii) the significant exposure of banks, nonbanks (particularly insurance firms) and foreign investors to the government bond market; (iii) indirect links of households to sovereign risk intermediated through the financial system; and (iv) important direct links of banks, households and nonresidents to corporate debt.

Cross-border linkages for Italy are high, and shocks originating externally are becoming increasingly relevant to the Italian financial system. Italy's banking system affects and is affected by financial conditions in other countries, particularly European ones. While Italian stock markets, bank returns, and sovereign CDS spreads have historically been net shock transmitters of stress to other countries, their importance as net shock originators declined since May 2018. In addition, they have become more sensitivity to external shock. This is a result of the fact that, in recent years, foreign investors have been selling Italian securities while domestic residents have continued to build their net foreign asset position, thus exposing Italy relatively more to external shocks.

Table 1. Italy: Recommendations from Stress Testing and Risk Assessment	
Recommendations	**Time**
Further enhance banks' capital levels, as appropriate, to ensure all banks maintain adequate capital ratios under stress scenarios. (ECB, BdI)	NT
Incentivize banks to diversify bond holdings included in their counterbalancing capacity to limit market/liquidity risks. (ECB, BdI)	NT

Time Frame: C = continuous; I (immediate) = within one year; NT (near term) = 1–3 years; MT (medium term) = 3–5 years.

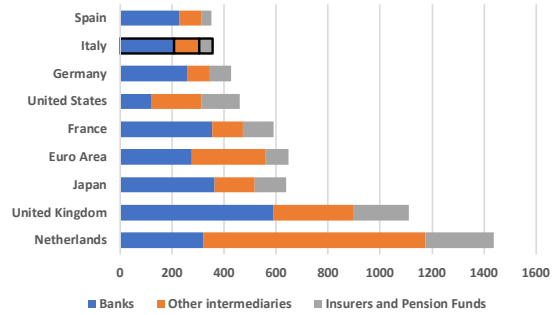
INTRODUCTION

1. Banks continue to dominate the Italian financial system despite the significant growth of insurance firms and investment funds in recent years (Figure 1). While the banking sector has consolidated in recent years, the number of small mutual, cooperative, and regional banks remains relatively high. In January 2019, about 240 of the 280 mutual banks were merged into two new banking groups, which have been classified as SIs; the remaining mutual banks will enter into an institutional protection scheme (IPS). These consolidations reduced the number of banks in the financial system to about 170 (as of June 2019). The insurance sector is the fourth largest in Europe and the eighth largest in the world by premium income. The industry has consolidated significantly in the past decade through mergers and takeovers, reducing the number of insurers from 162 in 2007 to 100 as of June 2018. While relatively small, the share of assets of investment funds and other financial intermediaries in the financial system has grown since 2011 from 15 percent to 18 percent.

Figure 1. Financial System Structure

The Italian financial system is large, but relatively smaller than the euro area average.

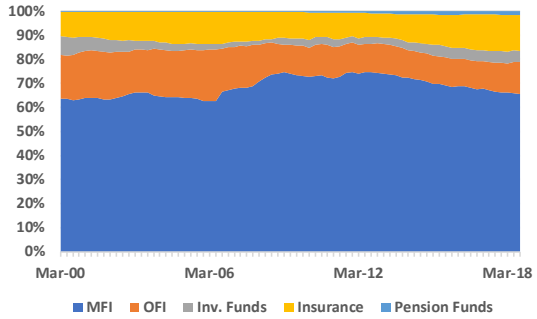
Total assets of financial institutions
(in percentage of GDP, Dec. 2017)



Sources: Financial Stability Board and IMF staff calculations.

Banks continue to dominate the system despite the recent growth of other financial institutions.

Total financial assets of intermediaries
(in percentage of total financial assets of the system)



Sources: Banca d'Italia and IMF staff calculations.

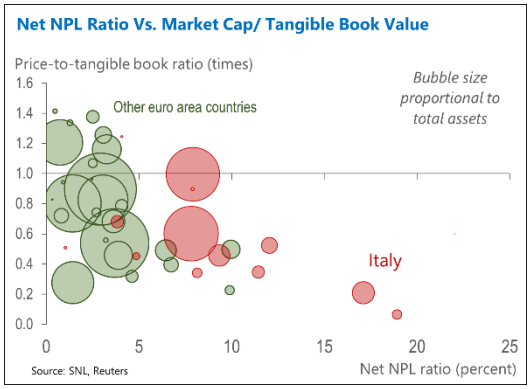
2. Notable progress has been made tackling problem assets. The NPLs ratio of the banking sector fell from 16.5 percent in 2015 to about 8.7 percent in December 2018, achieved mainly through close to €130 billion of private NPL sales. This is a substantial reduction by any standard, though NPLs remain well above the 3.2 percent average of the main European Union (EU) banks.

The SIs are planning to further reduce NPLs to 7 percent by end-2020. New NPL formation has fallen to pre-crisis levels. Provisioning coverage increased by 2 percentage points in 2018 to 53 percent, placing Italy at 8 percentage points above the average of the main EU banks. [4]

3. Notwithstanding the significant improvements in recent years, vulnerabilities remain in the banking sector and the baseline outlook is challenging (Figure 2). The banking sector continues to receive notable support. At close to € 250 billion, Italian banks are the largest users of TLTRO, which substantially boosts banks' liquidity and profitability. In December 2018, the sample of SIs reported a fully-loaded CET1 ratio of 11.9 percent; the ratio reflects a 0.3 percentage point increase in the last two years but is still significantly below the average of their EU peers (by 2.6 percentage points). While significant reductions in NPL ratios were achieved thus far, more needs to be done as NPL ratios are still among the highest in the EU. In addition, the relatively high operating costs of Italian banks, particularly for medium- and small-sized banks, and corporate governance weaknesses in some segments of the banking system continue to weigh on profitability, which might be further impacted by the ECB's eventual monetary policy normalization and the phase-in of the bail-inable liabilities requirements (MREL). Italian banks' exposure to the sovereign and the high leverage in the corporate sector increase the vulnerability of banks to downside shocks.

4. NPL reductions have been facilitated by IFRS 9 transitional arrangements, which allowed banks to increase NPL provisions while deferring the impact on capital. The transitional arrangements, which will be gradually phased out by 2022, have dampened the impact of IFRS 9 implementation on banks' capital ratios, with the total impact estimated at around 104 bps for SIs and 138 bps for LSIs. This has enhanced banks' ability to reduce NPLs through securitizations or outright sales of portfolios. Further disposals of NPLs, as currently envisaged, may result in additional costs and could impact banks' capital levels.

5. Market-adjusted measures of bank capitalization reflect a sizeable market discount. In the EA, and in Italy in particular, bank aggregate price-to-book ratios are less than one. If market valuations were used to calculated capital ratios, as opposed to the accounting value of capital, the Italian banking sector would have their capital ratios reduced by about 45 percent. In Italy, this seems to reflect to some extent the uncertainty related to asset quality in addition to broad profitability concerns.



[4] The ratio varies substantially across individual banks. Also, if banks were to rely fully on market-based NPL disposal, additional provisioning will still be needed on average.

6. Bank profitability has started to recover. Following large fluctuations during the past years, the banking sector's profitability rebounded in 2017–18.[5] However, the recent rebound in profitability has been largely driven by the group of large and small banks, with the profitability of medium banks lagging behind.

7. The large exposure of Italian banks to the sovereign increases their vulnerability to a sovereign shock. At over 11 percent of total assets, banks' exposures to the domestic sovereign is high and introduces linkages via the capital and liquidity fronts (Figure 3). The link between sovereign spreads and bank capital has been tempered by new accounting strategies but is still high. [6] Banks are moving a large share of their sovereign bonds from the fair-value to amortized-cost (AC) accounting category. The strategy is seen as a "stop-loss" approach, where most banks recognized market losses up to 2018:Q2. Banks are also reducing the duration of their sovereign holdings. Notwithstanding the accounting treatment, the high concentration of sovereign debt renders banks' capital and liquidity vulnerable to adverse market valuations of these securities and impacts banks' equity prices and funding costs.

8. Against this backdrop, the objective of the FSAP risk analysis is to assess the capacity of the banking system to withstand severe but plausible macroeconomic shocks. The tests are meant to explore potential weaknesses in the financial system and the channels through which adverse shocks could propagate. The FSAP stress tests can help identify priorities for policy actions, such as those aiming at reducing specific exposures or building capital and liquidity buffers. The FSAP stress testing process can also help the authorities identify informational and methodological gaps and assess their preparedness to deal with financial distress.

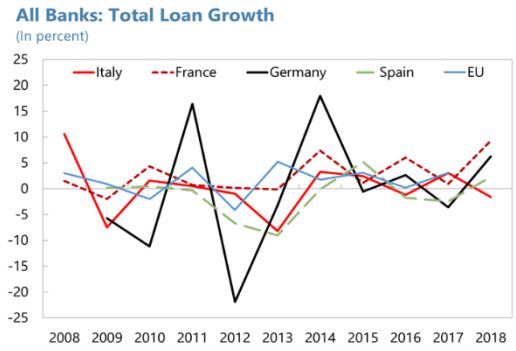
9. Stress tests are important tools for analyzing vulnerabilities in a financial system, but the results must be interpreted with caution. FSAP stress tests are macroprudential in nature, as they are intended to help identify key sources of systemic risk in the financial system. Another caveat is that the FSAP credit loss estimates and solvency projections in the adverse scenario are subject to data and methodological limitations. Adverse stress testing scenarios should not be interpreted as macroeconomic "forecasts", as they capture a combination of external and domestic shocks that are considered "tail" events based on historical distribution.

[5] Large banks refer to those with balance sheets larger than 30 bn euros; mid-sized banks have balance sheets between 30 bn euros and 4 bn euros; the small-sized banks are those with balance sheets smaller than 4 bn euros. The sector's ROA reached 0.6 percent and 0.5 percent in 2017 and 2018, respectively.

[6] The BdI estimates that an upward shift of 100 bps in the government yield curve would reduce banks' CET1 ratio by 40 bps.

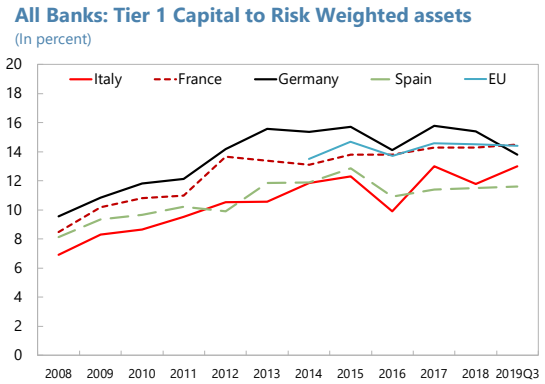
Figure 2. Banking Sector Developments

Lending growth has been weak.



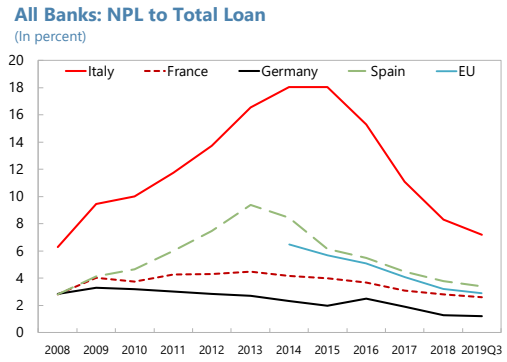
Source: ECB and IMF staff calculation.

Capital ratio has shown meaningful improvement but is still below the EU average.



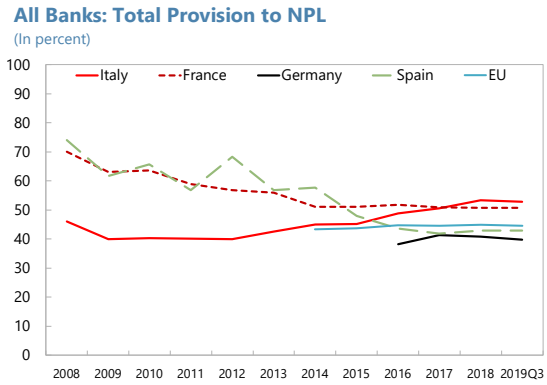
Sources: FSI database, EBA risk dashboard.

Non-performing loan ratio has declined notably but is still high.



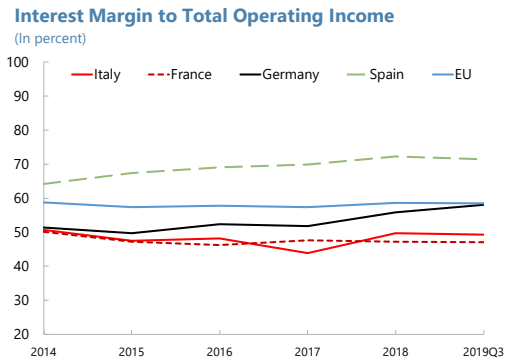
Source: FSI database and EBA risk dashboard.

Provision coverage ratio has improved gradually and is above EU average.



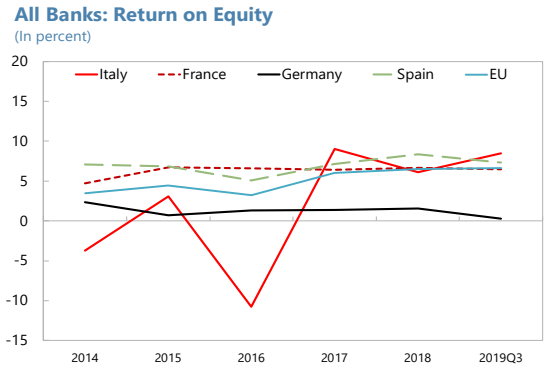
Source: FSI database, EBA risk dashboard, and IMF staff calculation.

Low interest margin challenges banks profitability….



Source: EBA risk dashboard.

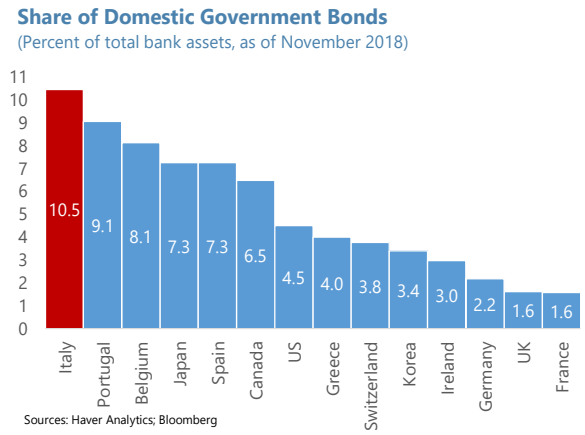
…and, combined with provisioning needs, dampened the return on equity for banks.



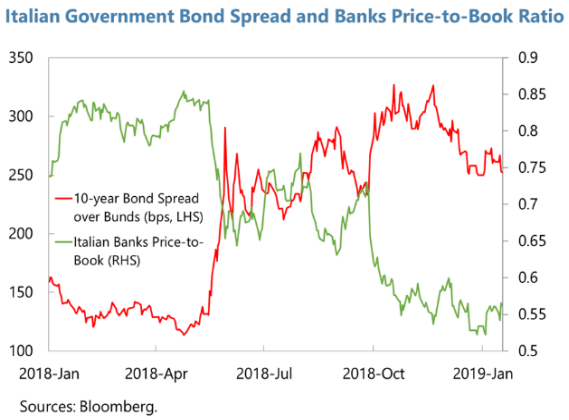
Source: EBA risk dashboard.

Figure 3. Sovereign-Bank Nexus[1]

Exposures of banks to the sovereign is high…



…contributing to the reemergence of the sovereign bank nexus.



10. The stress tests of the banking sector in the FSAP covered solvency, liquidity and contagion risks (Figure 4).

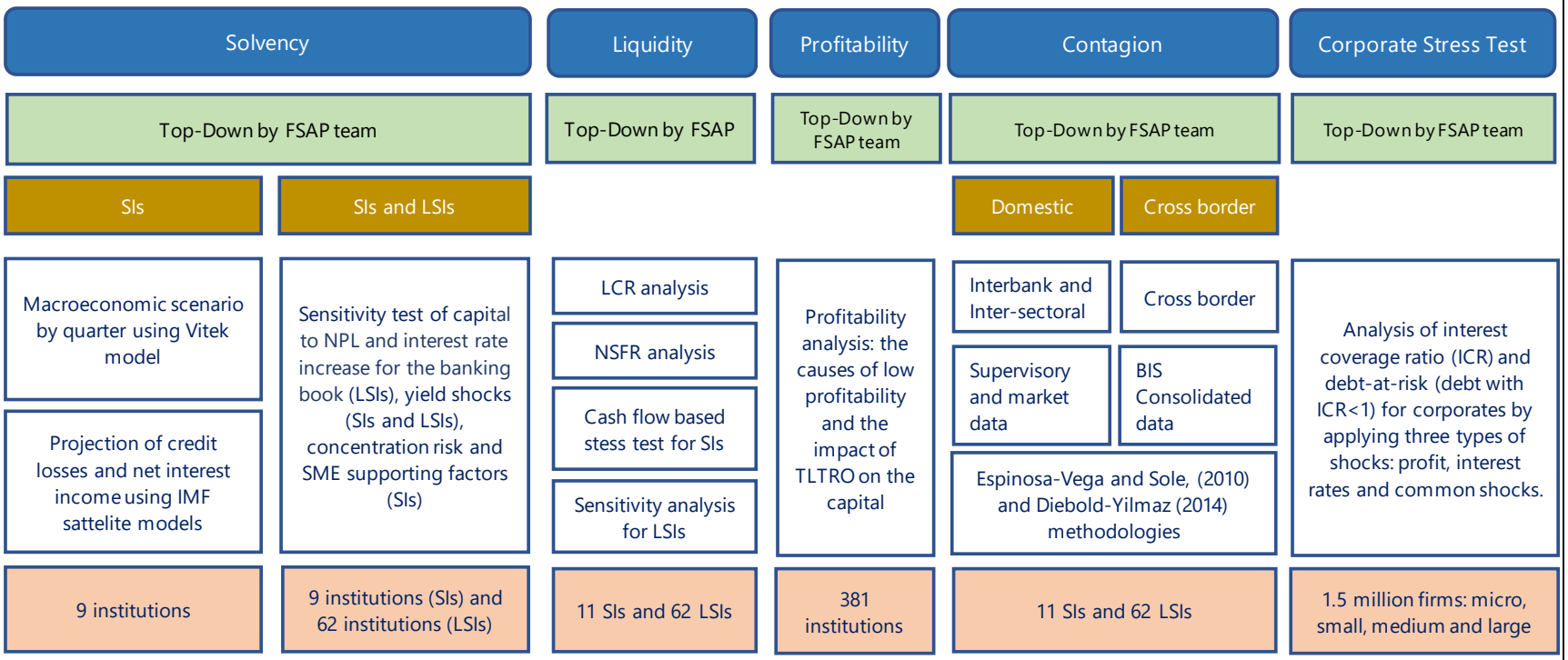
- The solvency tests assessed the impact on banks of severe but plausible shocks to the economy over a three-year horizon, from 2018:Q4 to 2021:Q4. The estimated transmission of these shocks to the banking system was based on satellite models and methodologies developed by the IMF. In addition to the scenario-based test, single factor tests were also conducted to assess the resilience of the banking system to individual shocks.

- The liquidity stress tests were conducted using several approaches. Regulatory based approaches include Liquidity Coverage Ratio (LCR) and Net-Stable Funding Ratio (NSFR), in which the first approach focused on short-term liquidity mismatch, while the latter focused on the longer-term structure of liquidity. A cashflow-based approach was also used to assess the liquidity resilience to large withdrawals of funding, using the maturity ladder.

- The contagion analysis examined domestic interbank and inter-sectoral financial linkages as well as cross-border spillovers.

11. The stress tests above were supplemented by profitability analysis of the banking sector and non-financial corporate sector stress tests. The FSAP analyzed the drivers of and prospects for banks' profitability. The corporate sector stress test assessed firms' debt servicing capacity in the face of profit and interest rate shocks.

Figure 4. Summary of Risk Analysis



Source: IMF staff calculations.

12. The top-down (TD) stress test for solvency and liquidity are based on supervisory and additional data provided by the Banca d'Italia (BdI). The main sources of data were European Banking Authority's (EBA's) Implementing Technical Standards (ITS) templates, which cover financial reporting information (FINREP) and common reporting templates (COREP), with end-2018 as a starting point. This was complemented by BdI historical data of aggregate historical default rates and are based on the BdI Credit Register. Other public data sources included Bloomberg, Haver Analytics, Moody's KMV, Fitch, and the World Economic Outlook (WEO).

13. The vulnerability analysis covering the SIs and LSIs indicate vulnerabilities that need to be addressed. Solvency stress tests indicate that the system still faces important challenges as many banks with material aggregate total asset share continue to be vulnerable to an adverse scenario. Liquidity stress tests suggest relatively comfortable positions, albeit boosted by the significant use of TLTRO and with a high concentration of liquid assets in Italian government securities, increasing vulnerability to sovereign risk. In this context, it would be advisable that the authorities adopt measures that build further resilience. The FSAP recommends enhancements to banks' capital levels to ensure all banks maintain adequate capital ratios under stress scenarios. Furthermore, a thorough supervisory review of banks' business models and governance can provide the basis for supervisory action to address balance sheet weaknesses, utilizing the full gamut of the supervisory toolkit to affect improvements or achieve consolidation or orderly winddowns, as needed.

14. FSAP stress tests may differ from stress tests conducted by other institutions, including EBA and the ECB. In addition to potential differences in the methodology, the FSAP used a larger sample of banks and used different macro scenarios, data input and parameters. The FSAP tests were carried out in close cooperation with the ECB and the BdI.

TOP DOWN SOLVENCY STRESS TESTS OF BANKS

15. The FSAP solvency stress test covered 9 bank (SIs), accounting for 68 percent of the banking sector assets. The Italian banking sector includes 11 SIs that account for about 74 percent of the banking sector assets. Two SIs comprising about 6 percent of the banking sector assets were under restructuring programs and therefore were excluded from the stress testing exercise. The nine SIs included in the stress tests include one Global Systemically Important Bank (GSIB) and two Domestic Systemically Important Banks (DSIBs). The three systemic banks are subject to additional capital buffers set by the Italian authorities.

16. The solvency stress tests reveal vulnerabilities in the SI sector. The SI sample is affected substantially by the solvency stress tests, with the total CET1 ratio for the group declining by 370 bps, from 11.9 percent to 8.2 percent. Furthermore, 2 SIs would fall below the minimum capital requirement thresholds under the baseline scenario; and 3 banks (comprising about 8.5 percent of the banking system's assets) fall below the thresholds under the stress scenario. While the resulting capital shortfall against the capital thresholds is small at about 0.2 percent of GDP, capital needs to bring the CET1 ratio of the 9 SIs included in the stress scenario back to the end-2018 level of 12 percent is about 2.2 percent of the GDP.

A. Macroeconomic Scenarios[7]

17. The solvency stress test for the SIs includes a baseline and an adverse scenario, covering a 3-year span, from 2019–21. The baseline corresponds to the April 2019 WEO projections, which projects a slowdown in real GDP growth rate relative to recent years and continued elevated sovereign yield levels.[8] The adverse scenario is simulated using the Global Macrofinancial Model, a structural macroeconometric model of the world economy, disaggregated into forty national economies, documented in Vitek (2018).[9] The simulation is based on a narrative that captures the risks discussed in the Risk Assessment Matrix (Appendix I), with attention paid to the main vulnerabilities of Italian banks and borrowers. The reference date for the stress test is end-2018.

18. The main feature of the adverse scenario is a reemergence of sovereign stresses in Italy, resulting in a sharp rise in risk premia. The mission's work builds on the stress test results undertaken in the context of the recent EA FSAP and the EBA stress testing exercises. The two exercises were centered on the main external risks featured in the RAM. Accordingly, the FSAP focused its stress testing scenario on risks emanating domestically. The stresses are assumed to be primarily driven by Italy-specific factors, with limited spillovers to EA periphery countries.[10] The scenario assumes a 180 bps rise in Italy's long-term risk premium shock (the peak increase relative to the baseline), whereas safe-haven capital inflows reduce term premia by 70 bps in the EA core, and by 40 bps in other advanced economies.

19. The trigger for the scenario is assumed to be a loss of investor confidence. Concerns about rolling back of reforms, less market-friendly policies, and budget proposals which are expansionary relative to Italy's European commitments could lead investors to leave the Italian bond market. The increase in sovereign risk implies a sharp drop in investment and output in Italy. Furthermore, the recession has an adverse impact on the primary fiscal balance due to lower tax receipts. Lower revenues and higher sovereign borrowing costs force a tightening of the fiscal position, which exacerbates the downturn. In addition, corporates are affected by the resulting higher borrowing rates, and sharply reduce investment expenditure. The resulting drop in aggregate demand exacerbates their balance sheet position through the impact on profits.

20. The scenario leads to a sharp decline in output and worsening of macrofinancial conditions (Tables 2 and 3 and Figure 5). The peak to trough decline in GDP throughout the horizon is 5.1 percent. This represents a fall of 7.2 percent relative to baseline by 2021, reflecting a

[7] Please also refer to the Risk Assessment Matrix (RAM) in Appendix I.

[8] It should be noted that the Italian Sovereign yield have declined significantly since mid-2019, after the FSAP stress testing work was concluded. This decline is expected to have a positive impact on the stress test results, both under the baseline and adverse scenarios.

[9] Vitek, F. (2018), The Global Macrofinancial Model, *International Monetary Fund Working Paper*, 81.

[10] In the adverse scenario, the macro variables of other countries do not deviate much from the baseline, which followed the April 2019 WEO projections.

6.9 percent fall in consumption and a 22.3 percent fall in investment. The deviation of growth relative to the baseline is equivalent to a 2.1 standard deviations shock to GDP growth in the second year of a three-year horizon (U-shaped profile).[11]

21. The financial implications of the scenario are equally severe. The long-term yields increase by 180 bps in the second year (relative to the baseline). Spreads relative to German long-term Bunds (a measure of risk premia) reach 580 bps in the second year of the scenario before narrowing to 560 bps, partly due to the declining German Bund yield under the scenario.[12] Furthermore, heightened risk aversion reduces equity prices by 45 percent in Italy over two years, relative to the baseline.[13]

B. Methodology

22. The TD exercise for the banks is based on the IMF's internally developed solvency stress testing framework. This stress test includes a comprehensive set of risks, including credit risk associated with all exposures, market risks (equity, exchange and interest rate risks), sovereign risk, and interest rate risk on the banking book. By contrast, the derivatives book was not considered, due to lack of access to granular enough information to stress the derivatives portfolio in a meaningful way (see the Stress Testing Matrix (STeM) in Appendix II for more details).

Balance Sheet and Income Projections

23. A quasi-static approach was used for the growth of banks' balance sheet over the stress-test horizon. Asset allocation and the composition of funding remain the same, whereas the balance sheets, which are based on total net assets, grow in line with the nominal GDP path specified in the stress test scenario. However, to prevent banks from deleveraging, a floor on the rate of change of balance sheets was set at zero percent. This constraint was binding in the adverse scenario. The balance sheet growth was estimated for each individual bank, using the weighted average GDP growth of all countries where the bank had a significant exposure. Other factors affecting balance sheet growth are the revaluation of assets and liabilities in accordance with foreign exchange movements and the conversion of a portion of off-balance sheet items (i.e., credit lines and guarantees) to the balance sheet.

24. In projecting RWAs, standardized (STA) and internal ratings-based (IRB) portfolios were differentiated. For the standardized portfolios, RWAs changed due to the balance sheet

[11] The shock is also broadly consistent with a 5 percent growth-at-risk measure. As mentioned, given that the baseline scenario has already captured a weak macroeconomic environment, an increase in sovereign spreads up to 180 bps from the baseline resulted in a high Italian sovereign yields level, reaching up to 550 bps. This level is above the yield used in the EBA 2017 stress test exercise by 150 bps.

[12] The spread vis-à-vis the Bund reached 550 bps during the sovereign debt crisis.

[13] As discussed further in the note, the parameters for the market risk are calibrated separately and applied as an "instantaneous" shock. As such, the evolution of financial variables in the macro scenario will not be used for the calculation of market risk.

growth, new provisions for credit losses, exchange rate movements, and the triggered portion of off-balance sheet items.[14] For the IRB portfolios, the projected through-the-cycle (TTC) probabilities of default (PDs) for each asset class/industry were used to calculate new average risk weights.[15] Similarly with the standardized portfolio, the projection of exposure at default (EAD) was driven by balance sheet assumptions, structural foreign exchange (FX) risk in foreign currencies, and triggered portion of off-balance sheet items. Specifically, changes to EAD in the IRB portfolio were governed by:

$$EAD_{i,t}^{c,j} = EAD_{i,t-1}^{c,j} \cdot \left(1 + g_t^c + f_i^c \cdot \Delta FX_t^c\right) \cdot \left(1 - PD_{i,t-1}^{c,j}\right) + \Delta L_{i,t}^{c,j} \cdot UCL_{i,t-1}^{c,j}$$

where *i* denotes the bank, *j* denotes the portfolio, *c* denotes the country of exposure, g_t^c is credit growth in country *c* (where demand effects are incorporated but supply effects are disallowed), f_i^c is the fraction of foreign currency loans, ΔFX_t^c is the depreciation of the foreign currency relative to the euro, $\left(1 - PD_{i,t-1}^{j}\right)$ represents the non-defaulted portfolio, $\Delta L_{i,t}^{j}$ is the shock to triggered credit lines and guarantees, and $UCL_{i,t-1}^{j}$ is the amount of undrawn credit line and guarantees.

Table 2. Italy: Adverse Scenario Calibration

Deviation from the baseline (in percentage points; unless specified otherwise)

	Adverse Scenario		
	2019	2020	2021
Real GDP	-3.4	-6.9	-7.2
Policy interest rates	0.1	0.1	0.0
Short-term money market rate	0.8	1.1	0.9
Spread of short-term money market rate	0.7	1.0	0.9
Long-term government bond yield	1.3	1.8	1.5
Real effective exchange rate appreciation (-)/depreciation (+)	8.0	12.7	12.3
Nominal exchange rate appreciation (-)/depreciation (+)	7.7	11.5	10.4
Inflation rate (CPI)	-0.3	-1.2	-0.9
Unemployment rate	1.1	3.4	4.5
Memo:			
Baseline Real GDP growth (in percent)	0.0	0.9	0.7
(Adverse) Real GDP growth (in percent)	-3.3	-2.7	0.3
Cumulative real GDP growth (from 2018)	-3.3	-6.0	-5.7
Severity: deviation of growth from baseline in multiples of standard deviation of historical growth volatility	**1.9**	**2.1**	**1.6**

Source: IMF staff calculations.

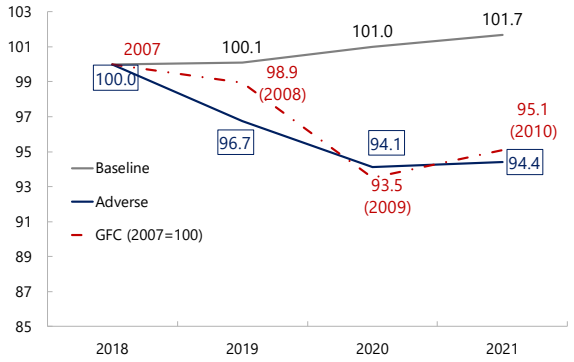
[14] The triggered portion was assumed to be 0 percent and 2.5 percent of the off-balance sheet items for baseline and adverse scenarios, respectively.

[15] Note that point-in-time (PiT) PDs were used for the calculation of credit losses.

Figure 5. Adverse and Baseline Scenario

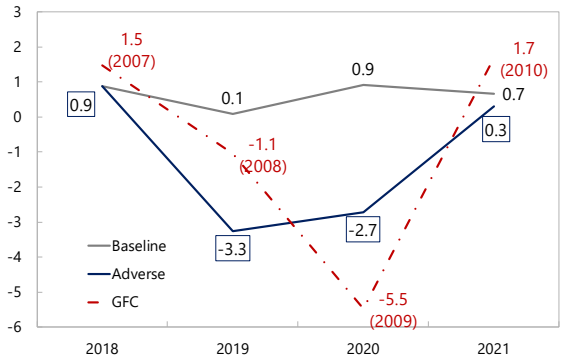
The overall loss of output is similar to what was experienced during the GFC…

Real GDP under Stress Scenarios, 2018-21
(2018 = 100)



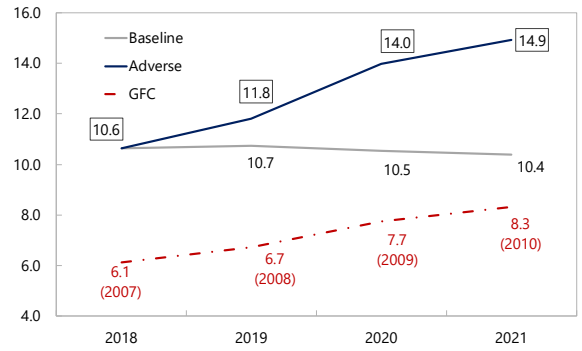
…however, the adverse scenario is less V-shaped.

Real GDP Growth under Stress Scenarios, 2018-21
(In percent)



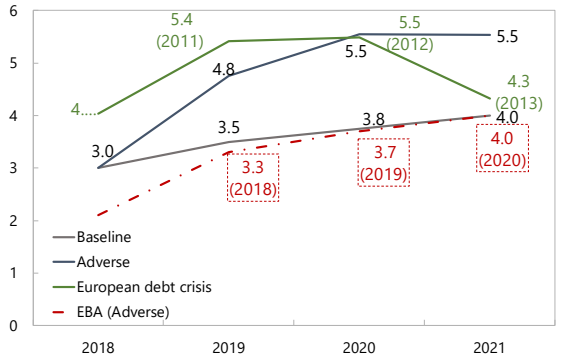
Unemployment starting point higher than prior to the GFC.

Unemployment Rate under Stress Scenarios, 2018-21
(In percent)



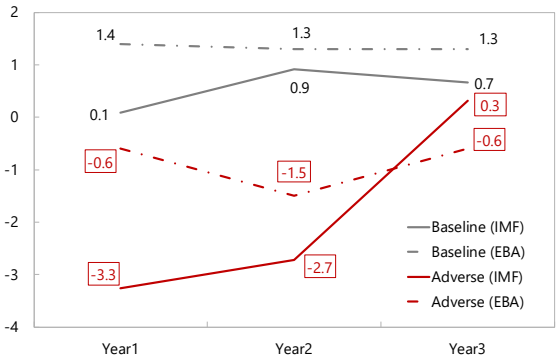
Increase in LT bond yields is partly due to the baseline.

LT government bond yields under Stress Scenarios, 2018-21
(In percent)



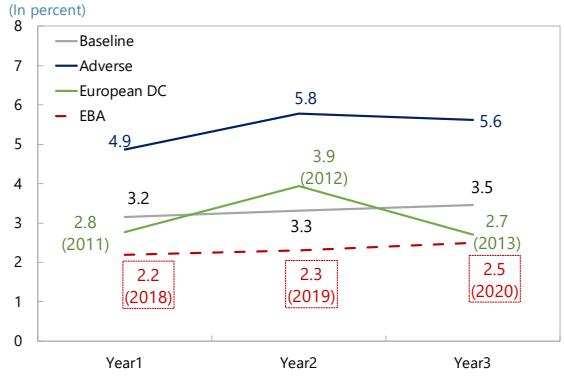
IMF adverse scenario more U-shaped than EBA.

Real GDP Growth: EBA(2018) vs IMF scenario
(In percent)



The adverse scenario includes a sharp increase in bond spreads relative to bunds.

LT government bond spreads relative to Bunds
(In percent)



Source: IMF staff calculations.
Note: *) The EBA stress test scenario covers the period 2017–2020.

Table 3. Italy: FSAP ST Baseline and Adverse Scenario (in percent; unless specified otherwise)						
	Baseline			Adverse		
	2019	2020	2021	2019	2020	2021
Real GDP Growth	0.0	0.9	0.7	-3.4	-2.7	0.3
Policy interest rate	0.0	0.2	0.3	0.1	0.3	0.3
Short-term money market spread	0.0	0.0	0.0	0.8	1.1	0.9
Long-term government bond yield	3.5	3.8	4.0	4.8	5.5	5.5
Nominal exchange rate app (-)/dep(+)	0.0	0.0	0.0	7.7	11.5	10.4
Inflation rate (CPI)	0.8	1.4	1.6	0.5	0.2	0.7
Unemployment rate	10.8	10.6	10.4	11.9	14.0	14.9

Source: IMF staff calculations.

Hurdle Rate

25. The hurdle rates for banks were differentiated between systemic and non-systemic banks (Table 4). Hurdle rates under the baseline consist of Basel III regulatory minima on CET1 (4.5 percent) and include other systemically important institution (O-SII) buffers for each G-SIB/O-SII. The O-SII buffer differs for each O-SII bank, ranging from 0.19 percent to 1.0 in 2021 and the phase-in period of the O-SII buffers during 2018 to 2021 was taken into account.[16] The final capital level is calculated on a fully loaded basis, including for IFRS 9 implementation. In addition to CET1, we evaluate the banks' T1 ratio and CAR. The leverage ratio (Tier 1 capital to non-risk weighted total assets) during the stress test horizon was also compared against the 3 percent Basel III minimum requirement. Banks that end the stress test horizon with a capital level or a leverage ratio below the relevant hurdle rates are considered to have failed the test.

Table 4. Italy: Hurdle Rates for Solvency Stress Tests
(in percent)

Minimum capital ratios	Hurdle rate (Baseline and Adverse scenario)	
	OSII	Other banks (Non-OSII)
Total Capital ratio (total capital to RWAs)	8 + OSII buffer	8
Tier I Capital ratio (Tier 1 capital to RWAs)	6 + OSII buffer	6
Common Equity Tier I Capital ratio (CET1 capital to RWAs)	4.5 + OSII buffer	4.5
Leverage ratio (Tier 1 capital to total assets)	3	3

Source: IMF staff calculations.

[16] Please see "Identification of the UniCredit, Intesa Sanpaolo, Banco BPM and Monte dei Paschi di Siena banking groups as other systemically important institutions authorized to operate in Italy", Banca d'Italia, November 30, 2017.

Credit Risk Analysis

26. Credit risk constituted the largest risk factor for the banking system (Figure 6). RWAs of credit risk accounted for 88 percent of total RWAs in the sample banks, in line with the banking system's asset composition. The largest portion of assets was loans, representing 71 percent, followed by debt securities. By sector, loans were mostly to large firms (27 percent), followed by mortgages (19 percent), small- and medium-sized enterprises (SMEs) (17 percent), and other financial corporations (11 percent).

27. Most of the sample banks apply partial IRB approach. Out of the nine banks, two exclusively apply the standardized approach to credit risk, while the remaining banks apply the IRB approach partially. Based on the RWAs, the IRB approach accounts for 50 percent (the median) of total credit exposure of the seven sample banks, with a range of 24 percent to 71 percent.

28. By geographic distribution, most of the sample banks' loan exposures are in Italy. Out of the total loans, 60 percent are distributed in Italy, with most of the remaining portfolio in EA countries (Figure 7). For customer loans, which consist of loans to non-financial corporations and households, 65 percent of the loan exposure is distributed in Italy, while the rest is in other countries, such as Germany, Austria and Turkey. Three of the SIs in the sample have a significant portion (larger than 30 percent) of their loan exposures outside Italy.

29. Default rates for exposures in Italy were estimated separately for five different portfolios. Historical default rates at the aggregate level were provided by the BdI for five portfolios: corporate large firms, corporate SMEs, mortgage, consumer, and financial institution.[17] Point-in-time (PiT) PDs are projected using regression models with macro variables as independent variables. Details of the estimations are included in Appendix III.

30. Default rates were estimated using a Bayesian Model Averaging (BMA) approach. Under this methodology, a subset of all possible models is first chosen where all explanatory variables (macrofinancial variables and lags) are statistically significant in explaining changes in PDs. The coefficients are then obtained using a weighted average of default rate estimates across multiple models, with the weights corresponding to the posterior probability of each specification (see Appendix III). The result is then attached to the starting point PDs of each sample bank to build the PD path of each bank (Figure 8).[18]

31. The projection of default rates for exposures outside Italy was estimated using Moody's expected default frequency (EDF) for geographical areas that were significant for the sample banks. Given that the sample banks have loan exposures in countries outside Italy, the PDs

[17] The historical default rates were taken from the Credit Register of Banca d'Italia for corporate large firms, corporate SMEs, mortgage and financial institution. For consumer loan, the historical default rate was provided by Banca d'Italia, with source from CRIF credit bureau.

[18] For consumer loans, due to the unavailability of bank-by-bank starting PiT, the aggregate starting point of PiT PD was applied to all sample banks.

were calculated for significant exposures in some countries, including Germany, Austria, Turkey, Russia and the United States. The following three categories were used: corporate consumer durables, consumer nondurables, and services. These categories were mapped to major COREP portfolios; i.e., corporate (including SME and specialized lending), mortgage, and consumer loans. The default rates were projected using similar BMA approach for exposures in Italy. The PiT shifts were then applied to regulatory PDs for non-defaulted exposures.

32. Credit risk associated with fixed-income instruments is differentiated between fair value (FV) and amortized cost (AC) holdings. The credit risk associated with FV holdings is embedded in the market risk methodology: the change in a security's price (and the resulting capital impact) reflects changes due to risk-free rate movement or changes in credit risk premia. For AC securities, changes in risk-free rates are immaterial for the calculation of capital requirements. Nevertheless, in the case of AC securities, provisions are made according to changes in credit spreads.

33. Conditional PD forecasts were generated based on the estimated model parameters. Given a weak macroeconomic outlook in the baseline, the PDs in most segments are projected to gradually increase in the baseline scenario and to worsen further in the adverse scenario. The impact under the adverse scenario displays idiosyncrasies across segments, with the impact on large firms and SMEs more sizable than those on mortgages and financial institutions. The magnitude of the projected PD shock under the adverse scenario for those severely impacted segments is consistent with historical stress episodes.

34. Real domestic output, unemployment rate, inflation, and short-term and long-term interest rates proved to be relevant for the buildup of credit risk. This is reflected in the higher than prior posterior inclusion probability and sizable long run multiplier estimate (i.e., coefficients for both the contemporaneous and lagged terms of the independent variables) for the sectoral PDs. The type and number of significant variables varies distinctly across segments, as manifested by the individual characteristics of their historical PDs.

35. Bank-by-bank LGD rates were used in the exercise. The FSAP's analysis on the recovery rate of NPLs, which consist of unlikely-to-pay (UTP) and bad loans, provided the reference of loss given default for the IRB portfolios and provisioning rate for the standardized exposure of the new and the existing NPLs. [19] The provisioning rate is calculated on a bank-by-bank basis differentiating between secured and unsecured loans for both UTP and bad loans. The secured loss rate was used for mortgage loans, while the weighted average of secured and unsecured loss rates was used for other type of loans. For secured loans, the median loss rate was at 42 percent of total NPLs, with a range between 38 percent and 46 percent. For unsecured loans, the median loss rate was at 65 percent of total NPLs, ranging from 54 percent to 72 percent in the sample banks. The same LGD rates are used for both the baseline and adverse scenario.

[19] See Technical Note on Tackling Non-Performing Assets. The BdI differentiates the NPLs into two sub categories based on their quality. The two sub categories are UTP (including past due exposures) and bad loans.

36. PIT parameters were used to compute loan loss provisioning. Loan impairments were calculated on all exposures including on-balance and off-balance sheet exposures, considering the migration of off-balance sheet items (credit line and guarantees) to on-balance sheet. Coverage included all asset classes for IRB and STA exposures reported in CRR.

37. The FSAP estimated further provisioning of about €4.9 billion (6.4 percent of existing provisions or 0.44 percent of RWAs) for all SIs and LSIs, largely in relation to the UTP portfolio. The estimates were based on assumptions used for loss rates as indicated above (UTP and bad loans; secured and unsecured), which were based on data on banks' internal workouts of NPLs from the BdI credit registry and loan servicing companies. The FSAP assumes that, on top of the provisioning needs for new defaulted loans, further loan losses will materialize due to the seasoning of the existing NPL portfolio. In particular, it assumes that, over the three-year horizon, 50 percent of the UTP portfolio will become bad loans, 20 percent will return to performing status, and the rest (30 percent) will be closed in banks' books as UTP. The required additional provisions were incorporated both in the baseline and stress scenarios.[20]

38. Interest payments were assumed to accrue only on performing exposures under both the baseline and adverse scenarios. The interest revenue on performing exposures was calculated on the gross carrying amount. While accounting rules allow banks to accrue interest income on non-performing exposures with provisioning required on the more delinquent and uncollectible assets, the stress test exercise took a more conservative approach which does not allow banks to project income on non-performing exposures.

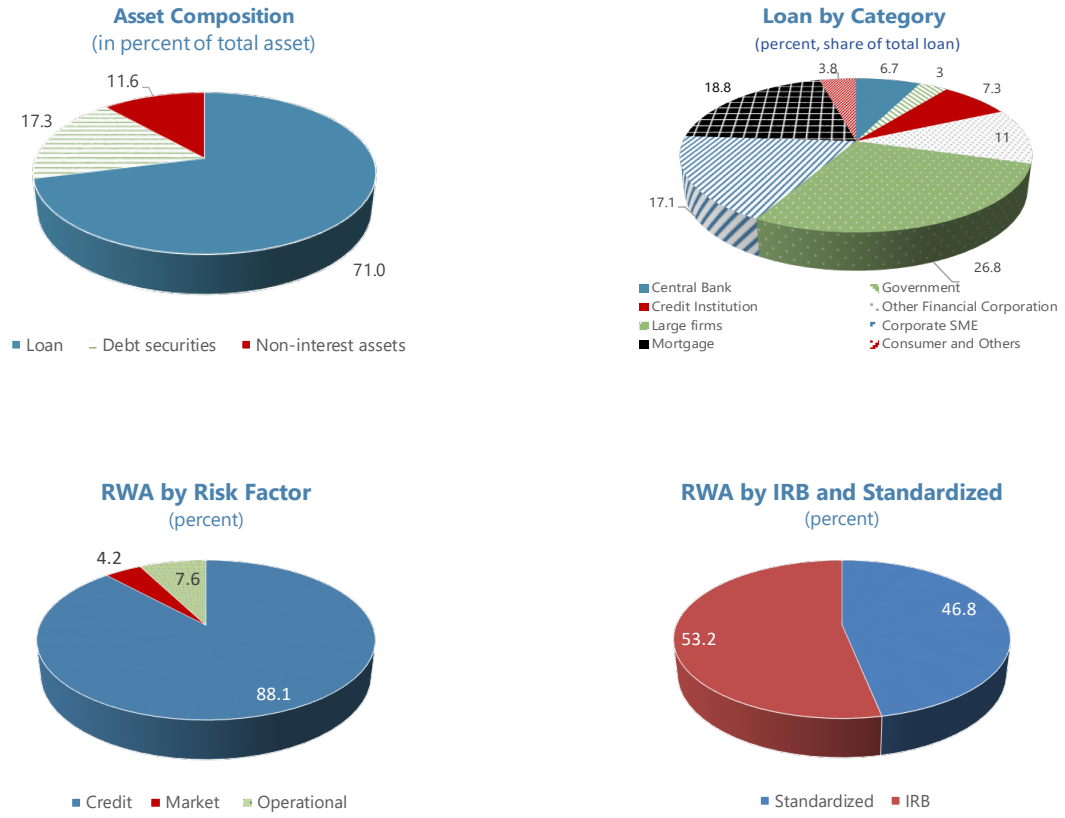
39. The exercise considered potential additional costs arising from NPL disposals. The results without NPL disposal plans include provisioning needs for new defaulted loans and, if applicable, gradual provisioning increases over the three-year stress test horizon to raise the coverage ratio of existing NPLs to the loss rates used by the FSAP on various portfolios (based on internal workout of NPLs assumption) (see above). However, loss rates from market-based NPL disposals are higher than loss rates from internal workouts. Considering that, the exercise included an additional scenario where banks internalize additional costs arising from a market-based disposal of NPLs that would allow them to reach the NPL ratio target for 2021 disclosed in their annual reports.[21] The additional provisions are calculated as the difference between loss rates of NPL sales and the loss rate from internal workout. The NPL disposal loss rate is, on average, 14 percentage points higher. Both scenarios use fully loaded IFRS 9 capital ratios.[22]

[20] The additional provisions pertaining to SIs (€4.3 billion) were phased out over the scenarios' three years equally.

[21] Reduction targets were included only for a subset of the nine banks in the sample. The rest of the banks in the sample did not indicate NPL reduction targets publicly.

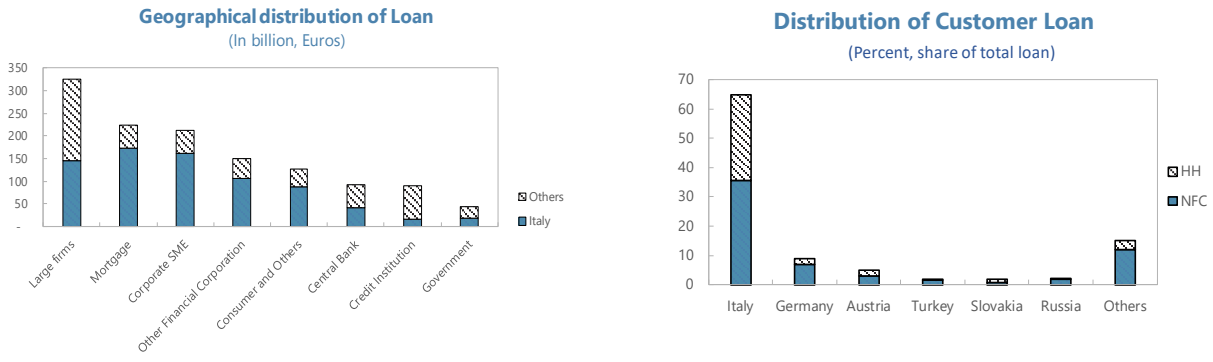
[22] Therefore, the capital ratios used for the stress tests reflect banks capital ratios if transitional arrangement for IFRS 9 had not been applied.

Figure 6. Sample Banks' Balance Sheet Composition



Sources: Banca d'Italia; European Central Bank; and IMF staff calculations.

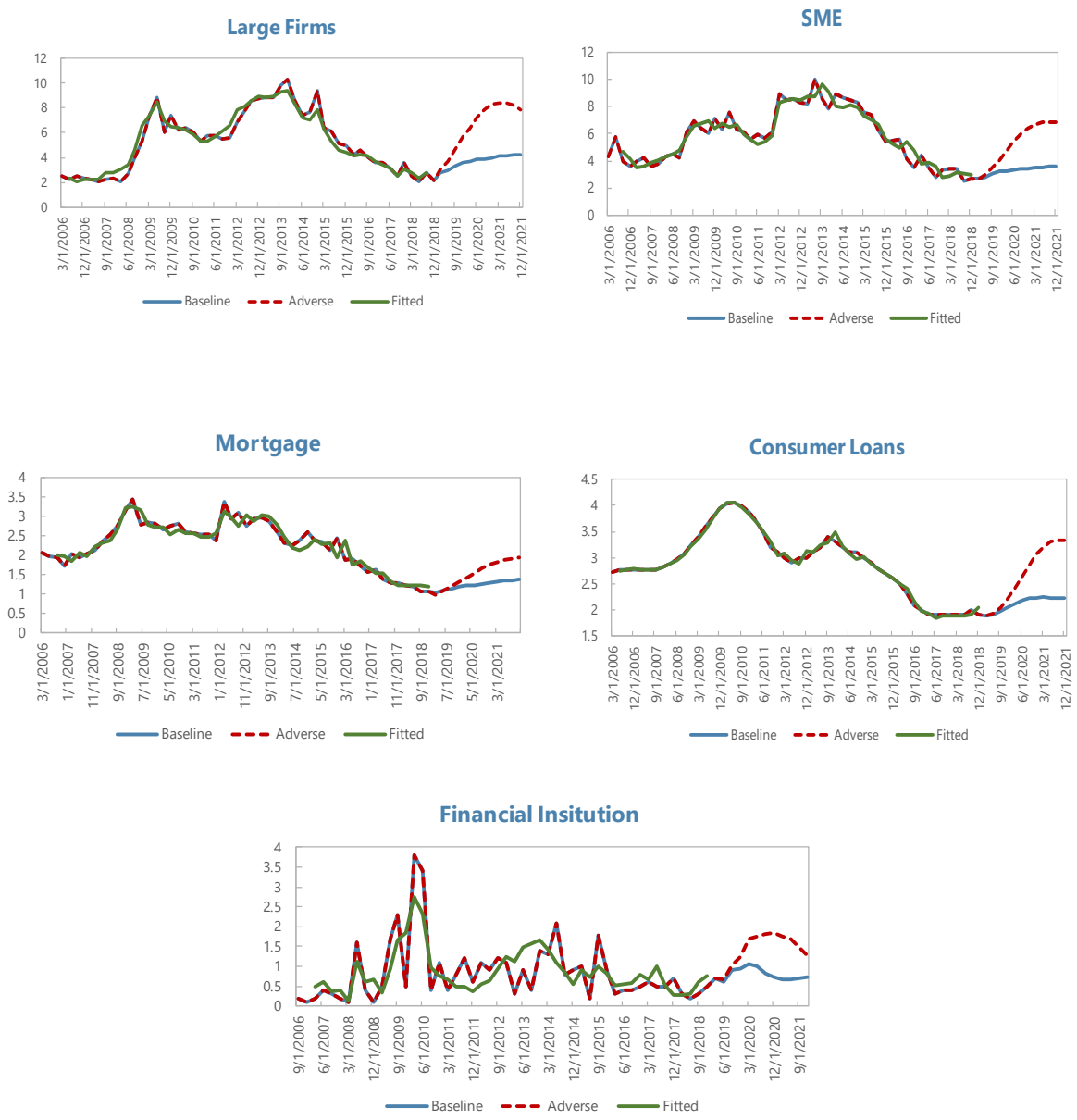
Figure 7. Geographical Distribution of Loans



Sources: Banca d'Italia; European Central Bank; and IMF staff calculations.

Figure 8. Projected Default Rates

Default rates rise as growth slows down and unemployment and interest rates increase.



Sources: Banca d'Italia; and IMF staff calculations.

Market Risk Analysis

40. Own-sovereign securities constitute the largest share of bank holdings of debt securities (Figure 9). As of December 2018, the share of own-sovereign securities was 44 percent of total debt securities (including FV and AC categories), followed by foreign-sovereign securities (34 percent) and securities issued by credit and financial institutions (19 percent). The own-sovereign securities were mostly booked at FV, either at fair value through profit or loss (FVTPL) or fair value through other comprehensive income (FVOCI), at 61 percent of total own-sovereign securities. The total share of securities booked at FV accounted for 69 percent of total. This classification maximizes

the capital impact of sovereign yield changes as the gains or losses would be absorbed directly through net profit and equity.

41. Duration varies across types of debt securities; own-sovereign securities at FV have relatively short duration. The average duration of FV own-sovereign securities is at around 4 years, much lower than the same securities at AC category, at 6 years on average. Foreign sovereign securities have average durations of around 5 and 6 years, for FV and AC categories. The relative shorter duration of sovereign securities at FV reduced the impact of sovereign yield changes on regulatory capital.[23]

42. Stress tests assessed the resilience of banks when facing different sources of market risks. In addition to credit risks, banks also faced risks from changes in market variables, such as interest rates, exchange rates and equity prices. These losses would be generated through the net open position in foreign currencies and market valuation losses for debt securities due to changes in market yield. The scope excludes amortized cost positions held in a hedge-accounting relationship, as well as hedge-accounting derivatives.

43. Market risk is treated as an add-on component, with a separate calibration that is consistent with the macroeconomic scenario. The market risk stress scenario will have an impact on both capital resources—either via profit and loss or via other comprehensive income—and capital requirements (RWAs). The impact on capital resources will comprise of positions in the trading book as well as other fair valued items in the banking book. The impact on RWAs for market risk evolve with balance sheet assumptions.

44. Market valuation losses corresponding to holdings of debt securities were estimated using the modified duration approach. For every country (in which the sample banks have significant holdings) and year, sovereign yield curves were constructed by linear interpolation of short- and long-term interest rates, as specified in the macroeconomic scenarios. Then, the average duration of debt portfolio was calculated for each bank based on the supervisory data (COREP). Losses were then calculated as the product of the size of each bond portfolio, average duration, and the changes in the yields. For non-sovereign securities, the yield moved in line with sovereign yield with a credit spread along the three-year horizon. The following formula represents the modified duration approach in the stress test:

$$\frac{\Delta \text{ Valuation}}{\text{Valuation}} = - MD \,.\, \Delta y_{MD}$$

where MD is the modified duration of the portfolio and Δy_{MD} is the change in the yield caused by the shift in the yield curve (vis-à-vis the value prevailing in the previous year) and measured at a point in time that matches the modified duration of the portfolio.

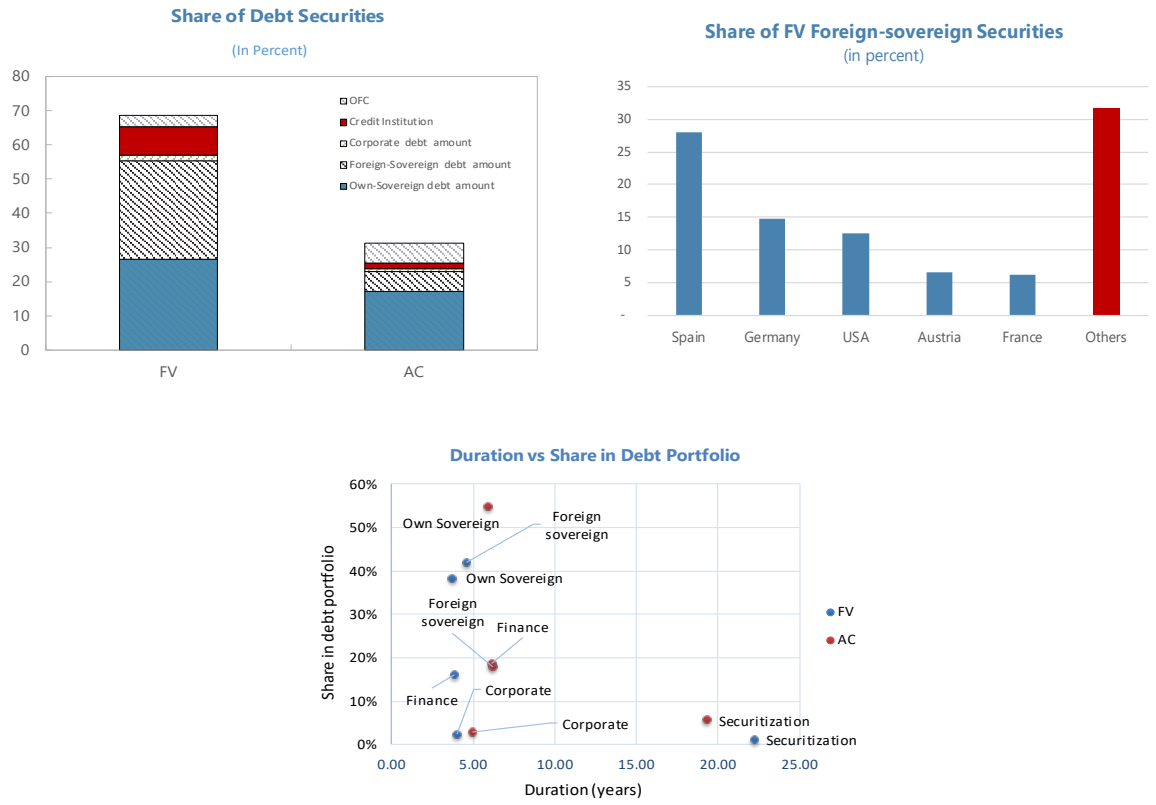
[23] Figures refer to end-2018 data. The fair value share and duration declined in 2019.

45. For equities held with trading intent, the FV impact was subject to a floor using an approach similar to EBA 2018 stress test methodology for exposures held in the trading portfolio. The market impact from full revaluation of equity holdings was subject to a floor using the following constraint:

$$\Delta \mathrm{Eq} = 1.5 * (-0.20\%(Eq^{Long} + Eq^{Short}))$$

where the VaR scaling factor has been set to the upper bound of 1.5, and the trading position includes the FV of equity instruments (assets) and the short positions in equity instruments (liabilities).

Figure 9. Sample Banks' Debt Holdings



Sources: Banca d'Italia; European Central Bank; and IMF staff calculations.

Model and Behavioral Assumptions

46. The net interest income was projected using the maturity gap analysis. To do so, the assets and liabilities that reprice in each period were tracked, up to the three-year stress horizon. The methodology assumes that a bank does not change its maturity profile over the stress testing period.

47. Funding rates were estimated using satellite models with BMA regression techniques. The evolution of the cost of funding and lending rates was considered a function of the interest rates projected in the scenarios. The funding rate was projected using the aggregate funding rate

for new deposits (front-book). The projection was mapped to five segments: retail overnight deposit, retail term deposit, wholesale overnight, wholesale term deposits, and debt securities. The projection was then attached to the starting point of each sample bank using the funding rate data for new deposits at end-2018, which was reported in the COREP.

48. Lending rates were also estimated using satellite models with BMA regression techniques, with funding rate projection as an input. The lending rate was projected using the aggregate lending rate for new loans (front-book). The projection was mapped to three segments: corporate, mortgage, and consumer loans. Similar to funding rates, the projection of lending rates was then attached to the starting point of each sample bank using the lending rate data for new loans at end-2018, which was reported in the COREP. Interest income from debt securities was projected based on the changes in the yield of the respective securities for both the baseline and adverse scenarios.

49. Portfolio-level data was used to measure gains or losses in the value of fixed income securities held in FV accounting portfolios, due to changes in risk-free interest rates and credit spreads. Gains and losses were calculated using the modified duration approach. The analysis covers the impact of the debt securities portfolio accounted in the FVTPL and FVOCI. Rebalancing of the portfolio was not allowed throughout the horizon. In the case of AC securities, provisions are made according to changes in credit spreads.

50. Income (profit and loss) was projected using all the risk factors in the stress test. Gains or losses associated with other market positions (commodity and currency net open position) are impacted via the evolution of these variables under the relevant scenario.[24] Any remaining items on the income statement are projected to grow in line with the size of the balance sheet. This included the projection of net fee and commission income and operational and administrative expenses. Under the adverse scenario, the growth in non-interest income and expenses was subject to a zero percent floor. Extraordinary income and loss were assumed not to recur during the projection period. The income tax was reflected in the profit and loss calculations which was set as 30 percent of income before tax.

51. The distribution of profit was subjected to the following dividend policy. Dividends are assumed to be paid out at 30 percent of current period net income after taxes by banks that are profit making (i.e., only if net income is positive) and in compliance with supervisory capital requirements. Banks were not allowed to issue new shares or make repurchases during the stress test horizon.

Interest Rate Risk in the Banking Book

52. Bank interest rates on new business were estimated and used as the input for interest rate risk in the banking book (IRRBB). Using BMA methodology, the satellite models estimate aggregate funding and lending rates on the portfolio level, which include interest rates on retail and

[24] Other market risks were negligible in the case of Italy.

wholesale deposits (both term and overnight), debt securities as well as household and corporate loans. Subsequently, the model outputs were used to project bank-specific interest rate paths by attaching the period changes of the aggregate rates in the forecasting horizon to the bank-specific starting point.

53. The projection of funding and lending rates was mapped to banks' financial assets and liabilities by product and counterparty using the short-term exercise (STE) IRRBB template. The IRRBB template provide bank-specific maturity ladder for fixed rate instruments and repricing date for floating rate instruments on portfolio level for both assets and liabilities. The template includes the following categories: (i) the asset side of the banking book comprises generic products related to debt securities and loans and advances underwritten by the banks; and (ii) the liabilities side comprises retail and wholesale overnight and term deposits, repos as well as debt securities.

54. The input for interest rate models is very similar to that of credit risk models. Most of the inputs for the credit risk model were used in the interest rate models, such as GDP growth, inflation, exchange rate, unemployment rate, and short- and long-term interest rates. As interest rates were received in a blended form and reflect both domestic and foreign exposures (mainly from the EA and the United States), most explanatory variables came under the form of Italy-specific and EA- and U.S.-based indicators to account for country-specific interest risk associated with both the domestic and foreign creditors/borrowers.

55. The relationship between lending rates and funding cost is incorporated in the model. To simulate bank-specific risk behavior and allow for a partial pass through of the rising funding cost to the lending rate, banks' funding cost was included as an additional explanatory factor in the projection of the lending rate. Therefore, the model was performed sequentially by first estimating the funding rate, which was then used as input for the projection of the lending rates.

56. The model also allows for the inclusion of PDs to incorporate credit risk in banks' interest rate determination. Specifically, household and corporate PDs estimated by the credit risk satellite models were included as an add-on risk factor and mapped into respective lending rate categories to capture banks' premium charges on borrowers with high default risk.

57. The projected interest rate paths were broadly in line with banks' portfolio characteristics. On the liability side, this is reflected by a more severe impact on the long term and unsecured debt portfolios as opposed to highly liquid and short-term funding. On the asset side, the increase in the lending rates also incorporates the increase in PDs associated with loan portfolios. However, to be conservative, a lower bound (5th percentile for the adverse and 25th percentile for the baseline) within the lending rate forecasted confidence band were selected to factor in the constrain faced by the banks in increasing lending rates. The resulting average decline on the net interest margin amounts to 0.07 percentage points under the baseline and 0.18 percentage points under the adverse scenario, respectively.

58. Variables related to money market rates and long-term sovereign yields are the main contributors in the projections of bank interest income and funding costs (Appendix IV). The long-run multiplier for variables associated with short- and long-term interest rates turn out to be sizable in the determination of both the lending and funding rates. Specifically, on the funding side, the 3-month money market rate and 10-year domestic sovereign bond yield spread explain most of the movement in the interest expense. On the lending side, an almost identical set of variables play similarly significant roles, with the addition of the U.S. long-term sovereign bond yield and the funding cost associated with retail term deposits. The long-run pass-through from Italy's sovereign bond yield and short-term interest rate on funding rates appears to be large, particularly from the government bond yield to retail term deposit rate and from the short-term rate to the wholesale term deposit rate and retail and wholesale overnight deposit rates.

59. The funding cost was measured using effective funding costs for the whole range of liabilities and incorporate and a repricing structure (Figure 10):

- The pricing of repos followed changes to the short-term money market rates (EURIBOR). The interest rate projections were linked to both the baseline and adverse scenario and therefore were expected to slightly increase under the baseline and considerably tighten under the adverse scenario (maximum 1.1 percentage points deviation from the baseline scenario).

- Funding from retail and wholesale deposits are repriced according to the output from the satellite models. Four deposit categories (i.e., wholesale overnight, wholesale term, household overnight, household term) were estimated by the satellite models. Rates evolve with economic conditions and benchmark rates.

- The pricing of debt securities is estimated by satellite models for new bond with contractual maturities above one year.

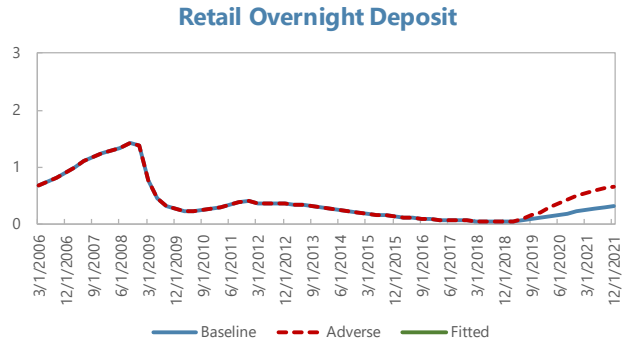
60. The interest income is measured using effective lending rates for the whole range of interest-bearing assets and considering the repricing structure (Figure 11):

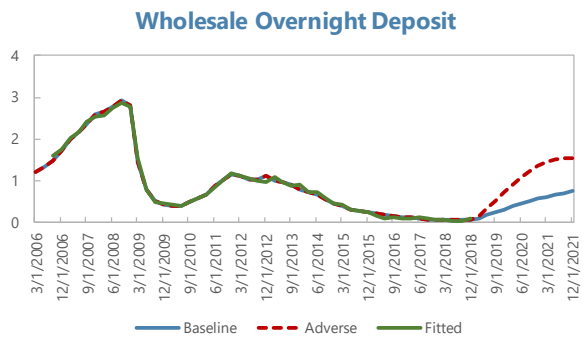
- The weighted average of lending rates was used to project interest rates on loans and advances, given limited decomposition in the IRRBB template. Specifically, lending rates on consumer loans, mortgages and non-financial corporates were weighted by their respective notional amount as of December 2018 to produce the forward paths.

- Rates on debt securities followed projections on the long-term sovereign bond yield, which was linked to the macroeconomic scenario.

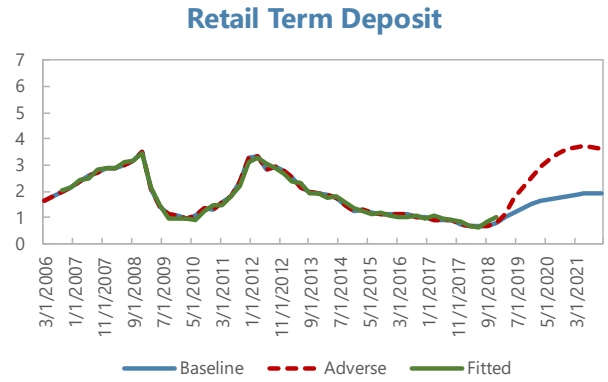
Figure 10. Funding Rate Estimation by Portfolio
(in percent)

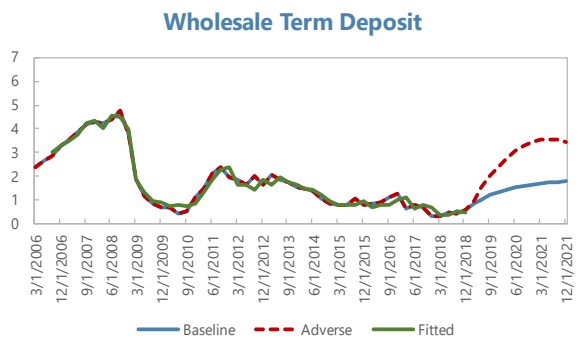
Funding rate increases modestly in the baseline, but the rise is much higher in the adverse scenario.



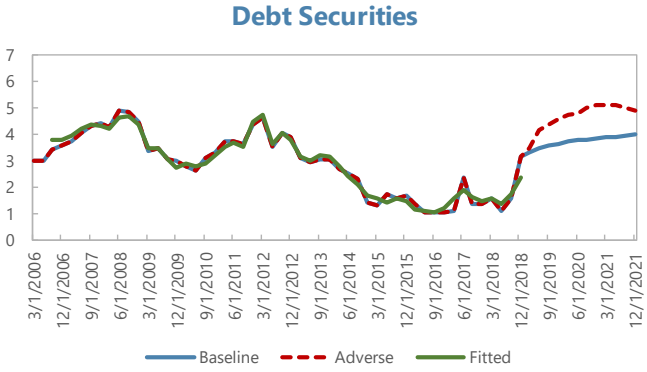


Term deposit rate increases are higher than on overnight deposits…



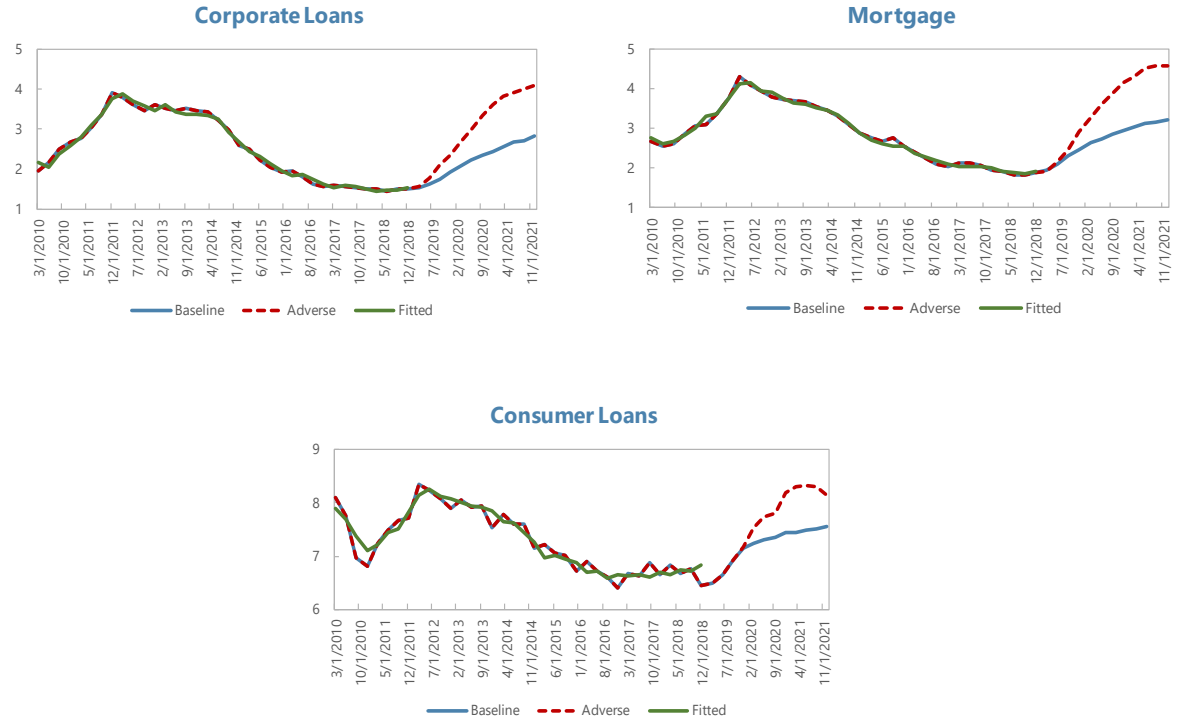


… and are even higher for debt securities



Sources: Banca d'Italia; European Central Bank; and IMF staff calculations.

Figure 11. Lending Rate Estimation by Portfolio
(in percent)



Sources: Banca d'Italia; European Central Bank; and IMF staff calculations.

C. Solvency Stress Test Results

61. Under the **baseline scenario**, the unfavorable macroeconomic outlook and the FSAP assumptions used on LGD, which included the transition of 50 per cent of UTPs to bad loans, increased the provisions needed during the three-years horizon.[25] The results are as follows (Figure 12):

- With the assumption of "no NPL disposal", the aggregate CET1 ratio of the sample banks would decline by 56 bps from 11.9 percent to 11.4 percent; the decline was mostly attributable to the increase in RWAs. With the assumption of "NPL disposal", the CET1 ratio would decline by 102 bps to 10.9 percent.
- Considering the hurdle rate of capital ratio minima plus OSII, with "no NPL disposal" assumption, one bank falls below the T1 threshold and another bank falls below the CAR threshold. When including NPL disposal targets, the first bank would fall short of the three capital thresholds. The resulting shortfall in capital is about 0.05 percent of GDP. The two banks would also see their leverage ratio fall below the minimum threshold of 3 percent.
- The main contributor to the drop in the capitalization ratios under the "NPL disposal" scenario is credit risk (the need for additional loan loss provisioning). Credit risk accounted for 4.5 percentage points of CET1 followed by an increase in RWAs of 0.5 percentage point,

[25] Please see paragraph 37 for details on the assumptions for LGD calculation.

which mostly comes from the positive asset growth of the sample banks. Besides credit risk, the increase in the sovereign yields also has an important impact through valuation losses and NII reduction related to higher funding costs (0.4 percentage points each). Meanwhile, the pre-provision revenue, including mainly aggregate NII, non-interest income, and non-interest expenses, increases the aggregate CET1 ratio by 4.9 percentage points relative to the starting point.

62. The **adverse scenario** has a significant impact on banks' capital ratios (Figure 12).

- Without the inclusion of NPL disposal plans, the average fully loaded CET1 capital ratio declines from 11.9 percent in 2018 to 8.2 percent in 2021.[26] Three banks would see their capital ratios drop below the thresholds, with an average CET1 ratio decline of 9.3 percentage points.[27] The asset share of the three banks is 8.5 percent of the sample's assets, and the resulting shortfall in capital is about 0.2 percent of GDP.[28] The results do not change materially with the inclusion of NPL disposal plans.
- The aggregate leverage ratio would decline by 1.4 percentage points from 5.8 percent to 4.4 percent. The three failed banks would see their leverage ratio decline below the 3 percent threshold.
- Credit risk was the largest contributor to the decline in capital ratios. The decline in the average CET1 ratio related to credit risk provisioning amounted to about 5.3 percentage points. The increase in the sovereign yields also has an important impact through valuation losses (1.2 percentage point decline in CET1) and NII reduction related to higher funding costs (0.9 percentage points). Heightened credit risk (partly driven by PiT shifts to risk parameters), valuation effects in FX exposures, and the projected path of loans that is still positive for some banks, contribute to an expansion of RWAs, thereby lowering CET1 by 1.2 percentage point across the sample banks. The pre-provision revenue, including mainly aggregate NII, non-interest income, and non-interest expenses, increases the aggregate CET1 ratio by 4.7 percentage points relative to the starting point. While the resulting capital shortfall against the threshold is small at about 0.2 percent of GDP, capital needs to bring the CET1 ratio of the 9 SIs in the stress scenario back to the end-2018 level of 12 percent is about 2.2 percent of the GDP.

- **The FSAP conducted sensitivity analysis using alternative scenario assumptions.** To assess the potential impact of higher loss rates under the stress scenario, the FSAP calculated banks' CET1 ratios if loss rates were further increased by 20 percent.[29] Furthermore, CET1 ratios were evaluated against a higher threshold of 7 percent, which incorporates the capital

[26] If amortized debt securities were valued at mark-to-market, the average CET1 ratio will further decrease to 7.2 percent.

[27] Two banks fall short of the three capital thresholds and an additional bank falls short of the T1 and CAR thresholds.

[28] This shortfall considers the amount of capital that would be necessary to meet minimum regulatory requirements (4.5 percent of CET1). To regain market confidence, banks would need to have a capital ratio in line with peers and substantially above the minimum.

[29] The "no NPL disposal" stress scenario was used as the base for this exercise.

conservation buffer (CCB). The number of bank failures do not change in the adverse scenario if a CET1 threshold of 7 percent was used or the LGD rates were increased by 20 percent. However, combining the two new assumptions (CET1 threshold of 7 percent and a 20 percent increase in LGD), an additional bank will fall slightly below the 7 percent CET1 threshold.

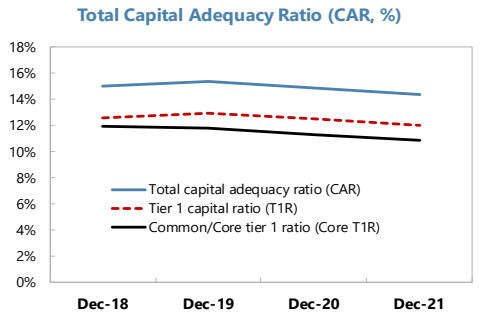
Figure 12. SIs Solvency Stress Test

Top-down solvency stress tests covered 9 out of 11 SIs and considered an Italy specific stress scenario.[1]

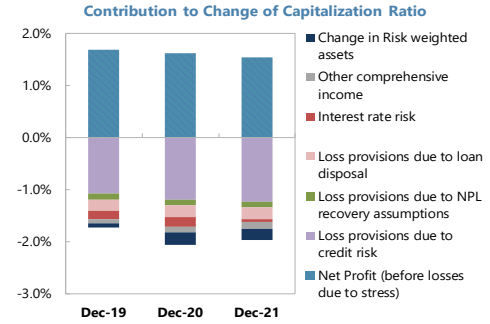
Scenario	Average CET1 ratio (percent) All 9 banks	Number of banks with CET1 ratio<4.5%+OSII	Number of banks with T1 ratio <6%+OSII	Number of banks with CAR<8%+OSII	Asset share of undercapitalized banks (CAR<hurdle) (percent)	Max capital shortfall vis-à-vis capital thresholds (percent of GDP)	Average leverage ratio[6] (percent) All 9 banks
Baseline - end-2018[2]	11.9	0	0	0	0	0	5.6
Baseline - end-2021							
Without NPL disposal plan[3]	11.4	0	1	1	...	0.01	5.5
With NPL disposal plan[4]	10.9	1	1	2	...	0.05	5.3
Adverse end of 2021							
Without NPL disposal plan[5]	8.2	2	3	3	8.5	0.21	4.4
With NPL disposal plan[5]	8.1	2	3	3	8.5	0.25	4.3

Notes:
' Adjustments to provisions based on the FSAP's use of estimated LGD rates based on market data were applied to all baseline and stress scenarios. Adjustments were phased-in equally over 3 years in each of the scenarios.
[2]The capital ratio is fully loaded IFRS9 implementation (post phase-in of initial IFRS 9 impact).
[3] In total, two banks breach the capital thresholds: one bank breaches the Tier 1 target and another the CAR target.
[4] In total, two banks breach the capital thresholds: one bank breaches the three capital thresholds and another bank the CAR target.
[5] In total, three banks breach the capital thresholds: two banks breach the three capital thresholds and another bank breaches the Tier1 and CAR thresholds.
[6] Leverage ratio is proxied by Tier1 capital divided by Total assets (non-risk weighted).

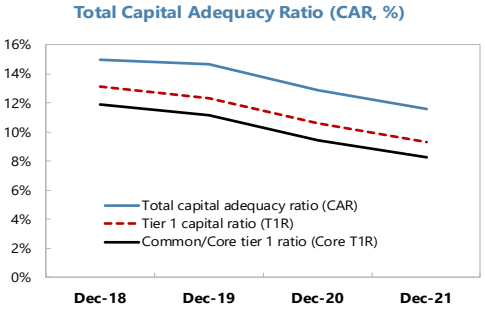
Under the baseline, with NPL disposal plan, average CET1 ratio falls by 100 bps



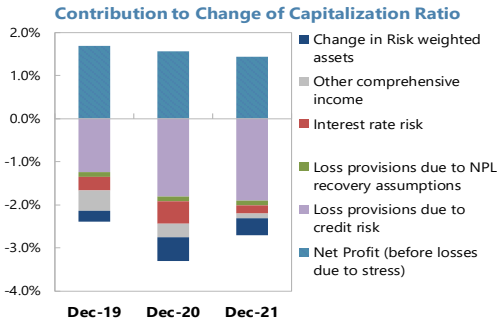
Credit risk is the main source of losses followed by the increase in interest rates.



Average CET1 ratio falls by 370 bps in the adverse scenario.[1]



Main losses arise from the flow of new NPLs but losses associated with higher yields are also significant.[1]



Source: IMF staff.
Note:[1] The adverse scenario in this graph reflects the "without NPL disposal plan", which assumes that banks will not be required to undertake further disposal of their NPLs under crisis conditions.

SENSITIVITY ANALYSIS OF SIGNIFICANT AND LESS SIGNIFICANT INSTITUTIONS

63. The variation in balance sheet health indicators is large among the LSIs. The CET1 ratio for the sector is 15.2 percent on a fully-loaded (FL) basis,[30] yet a quarter of banks by assets have fully loaded capital levels less than 10 percent. The NPL ratio for the group is 13 percent (22 percent for the corporate sector portfolio), while some individual institutions have ratios up to 35 percent. Exposure to own-sovereign is 26 percent of assets for the group but is much larger (up to 37 percent) for the smaller LSIs.

64. A sample of 62 LSIs were subjected to three static, one-factor sensitivity tests: (i) a sharp increase in yields to assess losses from debt portfolio holdings; (ii) loan losses from new NPL formation; and (iii) IRRBB. The sensitivity analysis of the LSIs indicates vulnerabilities in an important segment of banks, which warrant attention. The capital ratios of about a quarter to one-third of the sample included in the analysis fall below the 7 percent CET1 threshold under the tests indicated in (i) and (ii) above.[31] Further, the impact of a sharp increase in yields is higher in the case of LSIs when compared to SIs, highlighting the higher concentration of Italian sovereign bonds in LSIs' portfolios. The reference dates for SIs and LSIs are December 2018 and June 2018 respectively.

65. The sample of 9 SIs were subjected to three sensitivity tests. Tests included: (i) a sharp increase in yields to assess losses from debt portfolio holdings; (ii) concentration risk; and (iii) reduction in the SME supporting factor (an EA-specific regulation). No bank falls below the 7 percent CET1 threshold in the case of an increase in yields. Furthermore, the analysis indicates that SIs are largely resilient to concentration risk. A reduction in the SME supporting factor only mildly affects the average capitalization of the SIs on average, although the impact can be high in some banks.

A. Debt Portfolios Sensitivity Test

66. This exercise applies to certain exposures in banks' debt portfolios. Debt categories in FV portfolios are subject to mark-to-market changes due to changes in the yields. Valuation changes associated with the increase in yields are applied to all own-sovereign, financial and non-financial corporate, and securitized debt, according to the modified duration approach (duration for all these portfolios are available, except securitized debt, which is a small part of LSIs debt portfolio). In addition, we add provisions for those exposures held in AC portfolios according to the increase in spreads, using an LGD of 45 percent.

67. To calibrate the scenario, we compute on a daily basis, the 30-day change in yields since 2000. We choose k^{th} percentile of the monthly increase in the average of LT (10-year) and ST

[30] The 138 bps difference with the transitional CET1 ratio is almost entirely due to IFRS9 transitional arrangements.

[31] The 7 percent CET1 reflects the minimum threshold of 4.5 percent plus the CCB. Since the sensitivity analysis only involve one stressed factor, a higher threshold is used compared to the scenario analysis for SIs.

(3m) yield. Note that the average yield is not directly used in the scenario, it is just used to help us choose the percentiles. As such, the changes in the yield curve slope are historically accurate. Three calibrations are used (Table 5):

- 95th percentile of year 2011 (scenario 1)
- 98th percentile of 2000–2018 (scenario 2)
- 95th percentile of 2000–2018 (scenario 3)

Table 5. Italy: Debt Portfolio Sensitivity Analysis Scenarios

		ST	LT	Average	Date
Scenario 1	95th percentile of 2011[1]	3.2	1.4	2.3	12/19/2011
Scenario 2	98th percentile, 2000–18	2.1	0.4	1.2	10/14/2008
Scenario 3	95th percentile, 2000–18	0.8	0.8	0.8	8/16/2012

Source: IMF staff calculations.

[1] This scenario also corresponds to the 99.5 percentile over the 2000–18 period.

As seen in the table, scenario 1 and 2 assumed a flattening yield curve, as the shock for ST yield is higher than LT yields.

Results

68. Results show that banks are vulnerable to mark-to-market losses arising from Italian government bond holdings (Table 6, and Figures 13 and 14). In the most stressful scenario, which corresponds to the rapid rise in yields observed in 2011, capital losses amount to 300 bps for the group of LSIs and almost a quarter of the group by assets see their CET1 ratio fall below 7 percent with a total capital shortfall of 0.02 percent of GDP. Estimated capital needs to bring the sample banks' CET1 ratio back to the starting ratio of 15.2 percent is 2.1 percent of GDP. As regards the SIs, among the 9 SIs included in the test, no bank falls below the 7 percent threshold. These results highlight the higher concentration of Italian sovereign bonds in LSIs' portfolios.[32]

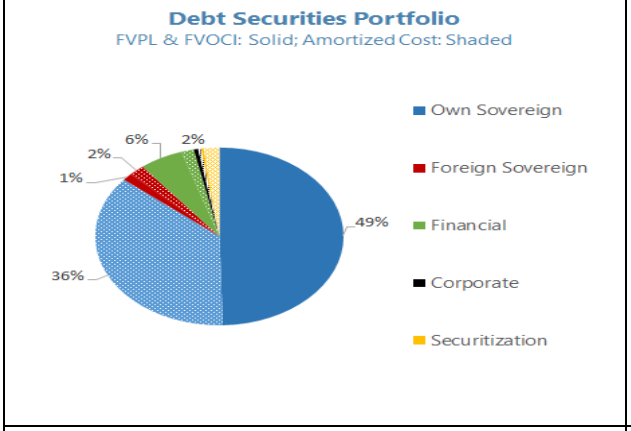
[32] Data are as of June 2018. In the second half of the year the share of debt securities in the FV portfolio declined as banks moved some of the FV portfolio to the AC portfolio. Accordingly, the impact of the sovereign shock on banks' capital ratios would be lower than in the FSAP's simulations.

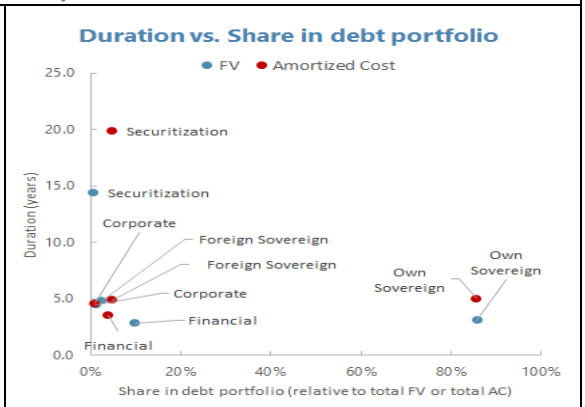
Table 6. Italy: Debt Portfolio Sensitivity Analysis Results

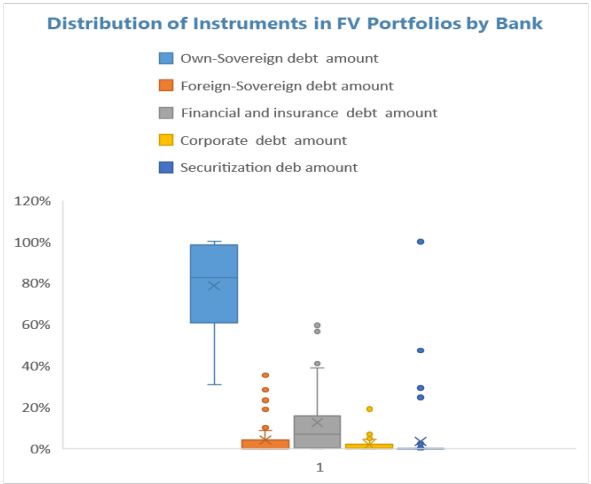
	SIs			LSIs		
	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Aggregate CET1 impact (bps)	131	75	52	300	185	120
$< 7\%\ CET1$						
#banks	0	0	0	10	3	2
Share of assets	0%	0%	0%	22%	6%	6%
$< 4.5\%\ CET1$						
#banks	0	0	0	4	1	0
Share of assets	0%	0%	0%	2%	0%	0%
Losses (share of assets)	0%	0%	0%	1%	0%	0%

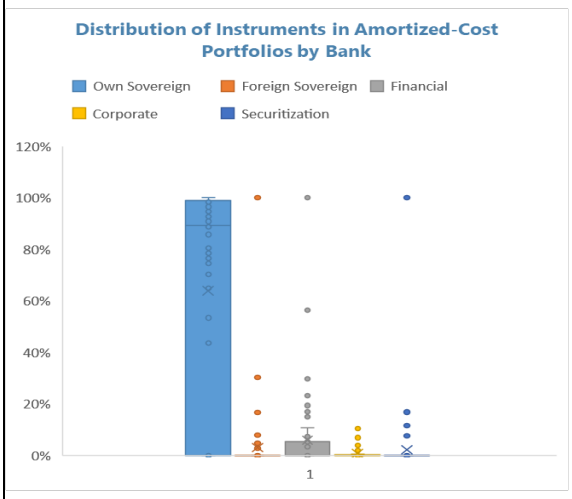
Source: IMF staff calculations.

Figure 13. LSIs: Debt Portfolio Characteristics (End-June 2018)





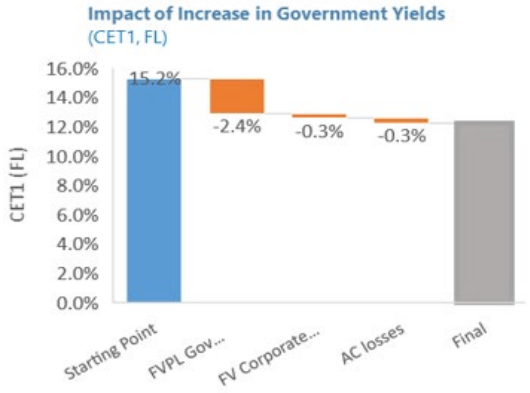




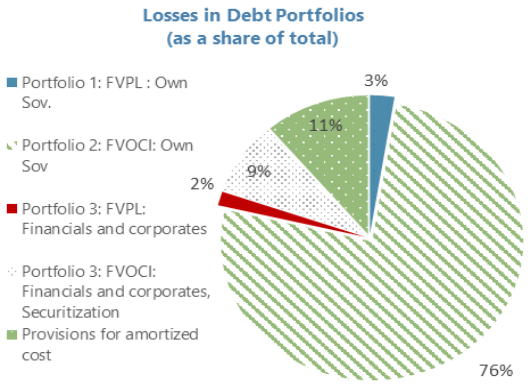
Source: BdI and IMF staff calculation.

Figure 14. LSIs: Debt Portfolio Sensitivity Test Results (as of June 2018)

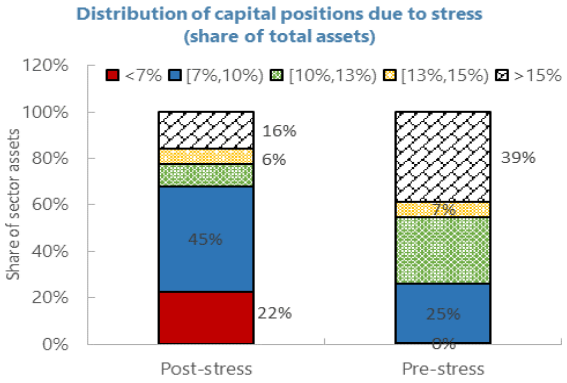
Italian debt held at fair value can cause large losses in the case of upward shocks to sovereign yields.



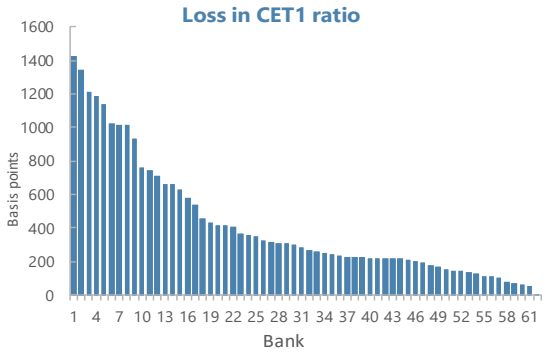
Most losses originated in positions kept at fair value.



Debt portfolio shocks can let a meaningful share of the LSI segment undercapitalized.



Distribution of losses show that a few LSIs, including a relatively large one, are more exposed to yield shocks, leading to a large impact on their CET1 ratio.



Sources: Banca d'Italia; European Central Bank; and IMF staff calculations.

B. Loan Losses due to NPL Flows

69. The test considers new flows of NPLs for three portfolios: household loans (HH), non-financial corporates (NFC) and government loans (GG). The LSIs were subjected to a flow of new NPLs in line with the historically worst observed NPL flows. [33] Default rates were adjusted to consider the fact that LSIs have higher PDs than the system and the starting point of each bank. The provisioning needs associated with the new NPL flows were set at 60 percent of the stock of new NPLs. In addition, we include the provisions required, if any, to bring the coverage ratio for the

[33] The worst historically-observed new NPL flows were recorded at the end of twin peak crisis in 2013, which resulted in a cumulative drop in GSP of about 9 percent.

existing stock of NPLs up to 60 percent. The 60 percent is a conservative average, but one that is often used in stress tests; while 60 percent may be on the conservative side for a mortgage loan, it is on the lower side for consumer credit and a proportion of corporate credit.[34]

70. Shocks were defined based on historical observations. For each loan portfolio, we choose the kth percentile quarterly PD since 2000, available for the banking sector (system-wide). We then adjust this stress PDs to take into account the fact that LSIs have higher PDs than the system, such that:

$$PD_{Stress}^{LSI} = PD_{Stress}^{System} \frac{PD_t^{LSI}}{PD_t^{System}}$$

Furthermore, we adjust the bank-specific stress PDs by the starting point PD for the same bank, such that the PD for the LSI sector as a whole reaches the desired level. In other words,

$$PD_{Stress}^{i} = PD_{Stress}^{LSI} \frac{PD_t^{i}}{PD_t^{LSI}}$$

Taking the starting point PDs into account affects the distribution of losses and penalizes banks that already have higher PDs.

71. We consider two scenarios that differ in the severity of the shocks.

- Scenario 1: Maximum PDs for HH, NFC, GG since 2000, system-wide.
- Scenario 2: 80th percentile PDs for HH, NFC, GG since 2000, system-wide.

As of June 2018, the system-wide new flows are around the median of new flows observed since 2000s.

72. The provisioning needs associated with the new NPL flows are 60 percent of the stock of new NPLs. In addition, we calculate the provisions required, if any, to bring the coverage ratio for the existing stock of NPLs up to 60 percent.

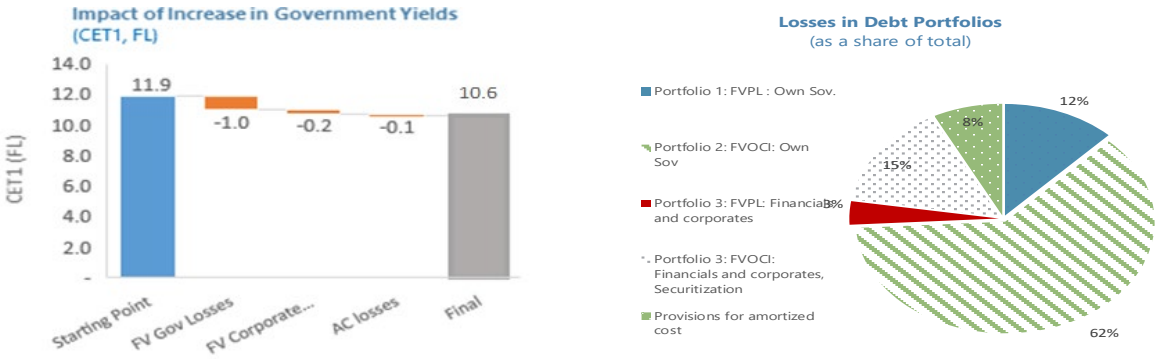
73. Results show that credit losses can be meaningful for some banks and are larger in the corporate portfolio. In the most severe scenario, capital losses amounted to 365 bps for the group of LSIs, with 14 banks (35 percent of the group by assets) falling below the 7 percent CET1 ratio. Capital needs to bring back banks' CET1 ratio to 7 percent are about 0.1 percent of GDP (Table 7 and Figures 15 and 16). Estimated capital needs to bring the sample banks' CET1 ratio back to the starting ratio of 15.2 percent is 0.26 percent of GDP.

[34] See section on solvency stress tests for SIs. A more granular approach to provisioning was employed, depending on the type of loan and collateral. For secured loans, the estimated median loss rate for SIs was at 42 percent of total NPLs, with a range between 38 percent and 46 percent. For unsecured loans, the median loss rate was at 65 percent of total NPLs, ranging from 54 percent to 72 percent in the sample banks. In a sensitivity analysis, given the single factor nature of the exercise, The FSAP takes a more conservative view.

C. Interest Rate Risk in the Banking Book

74. Most LSIs have a positive interest-rate gap on their banking book, helping NII in case of an increase in interest rates. The IRRBB exercise was conducted by the BdI, but detailed results were shared with the FSAP team. The average loss of economic value of equity due to a +/- 200 bps interest rate change is 2.6 percent, nevertheless, a number of small banks face losses greater than 20 percent of economic value of capital in the case of a -200 bps interest rate shock, and several come close.

Figure 15. SIs: Debt Securities Sensitivity Test (as of December 2018)



Source: Banca d'Italia; and IMF staff calculations.

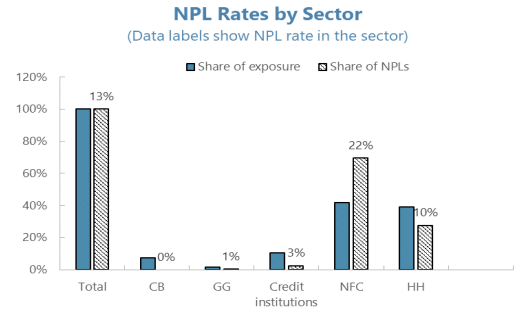
Table 7. Italy: NPL Losses Sensitivity Analysis (End-June 2018)

	Scenario 1	Scenario 2
Aggregate CET1 impact (bps)	365	311
<7% CET1		
# banks	14	12
share of assets	35%	29%
Losses (share of assets)	1.9%	1.8%
<4.5% CET1		
# banks	6	4
share of assets	9%	8%

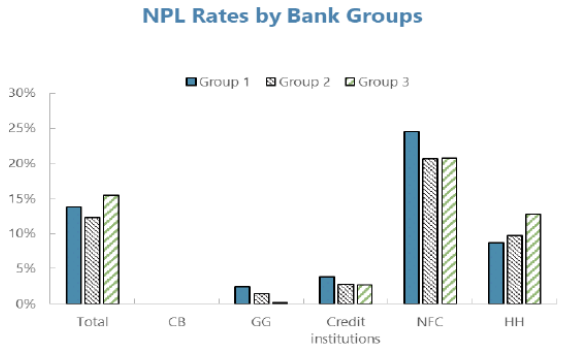
Source: IMF staff calculations.

Figure 16. LSIs: Asset Quality, Loan Portfolios, Loan Loss Impact

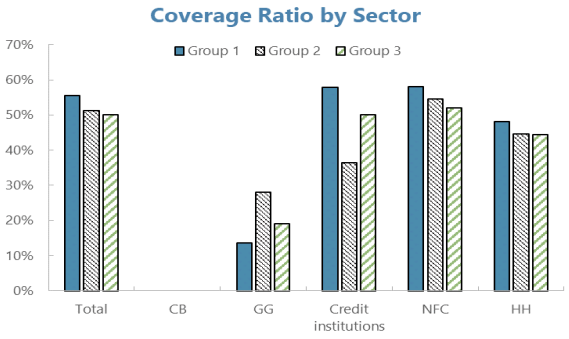
The largest share of NPLs are formed by loans to non-financial corporates (NFC)



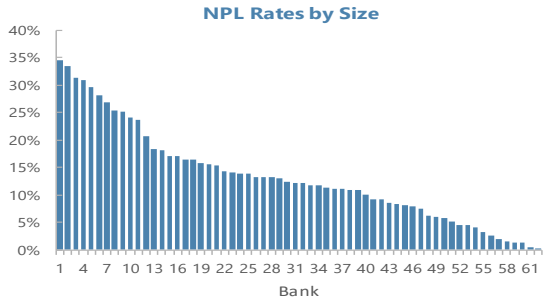
*Smaller LSIs (group 3) have higher NPL ratios. *)*



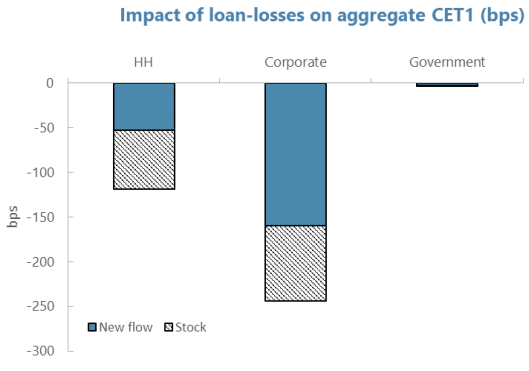
Coverage ratio are also slightly smaller among small LSIs



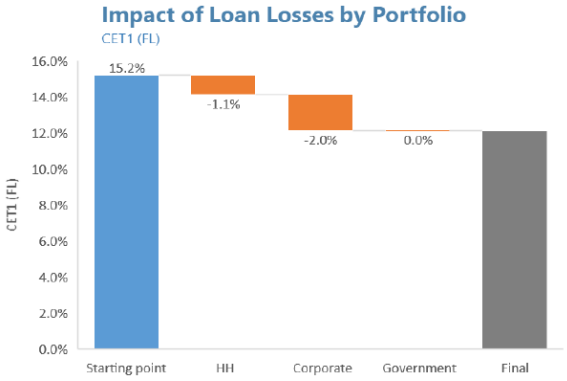
NPL ratio vary widely among LSIs.



NPL shocks have meaningful impact on LSIs' capital ratio



Most losses in case of NPLs shock are likely to originate in the corporate portfolio.



Sources: Banca d'Italia; European Central Bank; and IMF staff calculations.
Note: *) Group 1 represents banks with assets share more than 4 percent; Group 2 between 1 percent and 2 4 percent, and Group 3 less than 1 percent.

D. Concentration Risk and SME Supporting Factor in Significant Institutions

75. The FSAP also assessed the role played by the SME supporting factor and concentration risks (Figure 17). The result refers to the starting point position of the banks as of end-2018.

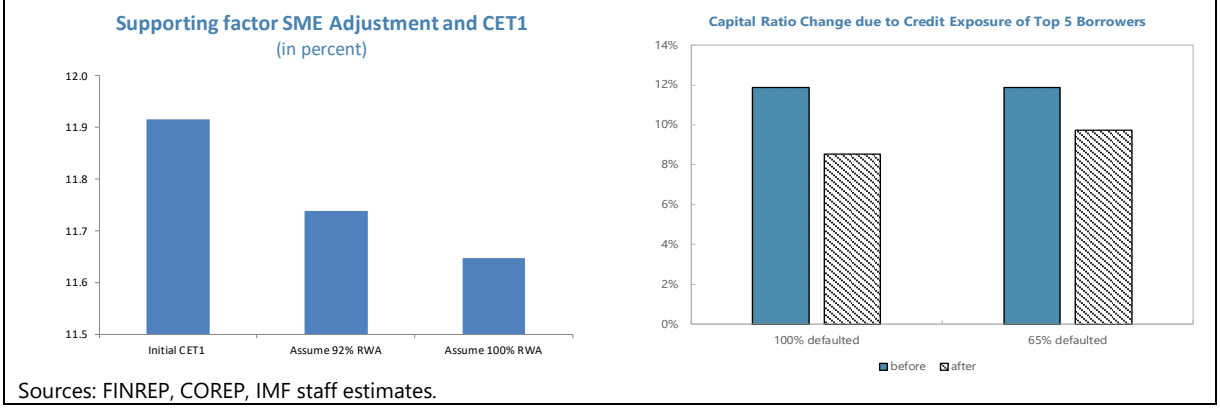
- The CRR has introduced a deduction in capital requirements for exposures to SMEs by applying the so-called SME supporting factor of 0.7619. The FSAP assessed the impact of this provision, considering the relatively large size of the SME portfolio in Italy. The analysis assigned a risk weight of 92 percent (the average risk weight of SME exposure that is not subject to supporting factor) and of 100 percent. The result showed that, on average, the SME supporting factor boosted the CET1 ratio by 18 bps (assuming 92 percent RWA) or 27 bps (assuming 100 percent RWA). The maximum impact of SME supporting factor to CET1 ratio is 60 bps for one sample bank (assuming 92 percent RWA).

- Concentration risk was tested by assessing the impact to bank's capital from the simultaneous default of their largest exposures. The test assessed banks' resilience under the assumption of a simultaneous hypothetical default of the five largest borrowers of each bank. The analysis used the net amount of the exposures. The results are as follows:

- Using zero recovery rate, the simultaneous default of the five largest borrowers would cause the aggregate CET1 ratio of sample banks to decline by 3.4 percentage points from 11.9 percent to 8.5 percent. No banks would see their CET1 ratio below the 4.5 percent threshold.

- Using a provisioning rate of 65 percent, the simultaneous default of the five largest borrowers would cause the aggregate CET1 ratio of sample banks to decline by 2.2 percentage points from 11.9 percent to 9.7 percent. No banks would see their CET1 ratio below the 4.5 percent threshold.

Figure 17: SIs Sensitivity Test



Sources: FINREP, COREP, IMF staff estimates.

LIQUIDITY STRESS TESTS

76. Three different liquidity stress tests were conducted to assess the resilience of the banking sector against funding and market liquidity shocks. The FSAP team conducted LCR, NSFR and cashflow-based analyses for the 11 SI banks and 61 LSIs. The LCR, NSFR and cashflow-based analyses were conducted in EUR. The cashflow-based analysis is similar to the LCR test but considers different maturities of assets and funding sources. Specifically, it simulates an outflow of funding over maturity buckets from 1 day to 90 days, as opposed to the single 30-day window assumed by the LCR.

77. The results indicate relatively strong liquidity positions, but the analysis points to two vulnerabilities of banks' liquidity profile:

- The aggregate liquidity is boosted by reliance on TLTRO: at close to € 250 bn and representing on average about 10 percent of banks' total liabilities, Italian banks are the largest users of this facility in the EA.[35]

- Liquid assets are concentrated in own government securities making liquidity ratios susceptible to adverse market valuations of these securities. Banks would benefit from diversifying their bond exposures to other non-Italy sovereign bonds. Diversification by maturity and type of asset would also help banks when faced with liquidity shocks.

A. NSFR-based Liquidity

78. The stable funding structure of the banking system (excluding capital and undrawn credit and liquidity facilities) differs for SIs from LSIs (Figure 18). Mainly, data (as of end-October 2018 for SIs and end-June 2018 for LSIs) highlights the following differences:

- Retail funding is the largest source of available stable funding (ASF) for LSIs (59 percent) but represents a much smaller share of total funding for SIs (28 percent of SIs' total funding structure). Additionally, corporate funding makes 20 percent of LSIs' total funding, and debt instruments make 9 percent of their total funding.

- In contrast, SIs' funding sources include: central bank funding (13 percent of total funding), unsecured funding from financial institutions (17 percent of total funding), and unstable retail funding (17 percent). These sources of funding are not significant for LSIs.

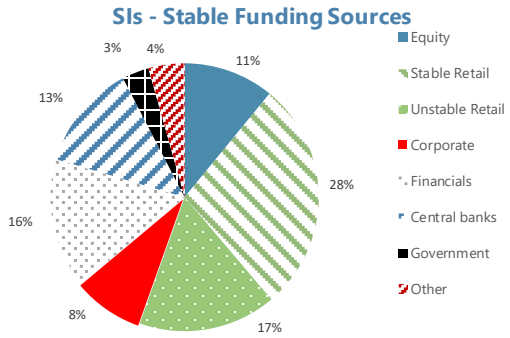
79. NSFR ratios are already above 1 for the majority of SIs and LSIs. The FSAP sample included 11 SIs and 59 out of 61 LSIs. Looking into the overall NSFR for banks, the data indicate that SIs' ASF has a lower factor compared to the European bank average, due to their reliance on less-stable sources of funding (and wholesale funding) (Figure 18). Meanwhile, LSIs show a lower

[35] In March 2019, ECB announced a new series of operations (TLTRO-III), starting in September 2019 and ending in March 2021, each with a maturity of two years.

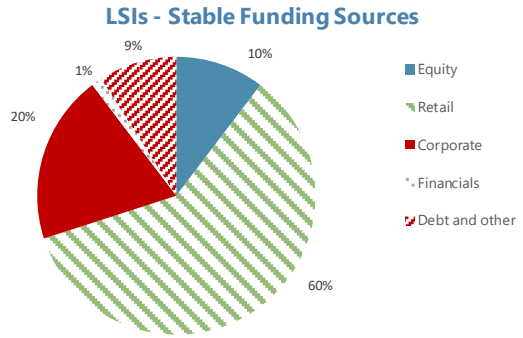
required stable funding (RSF) factor compared to European banks' average due to the large share of government bonds on their asset side, which reduces their RSF factor, and contributes to higher NSFR ratios.

Figure 18. Liquidity: NSFR and Structure of Funding

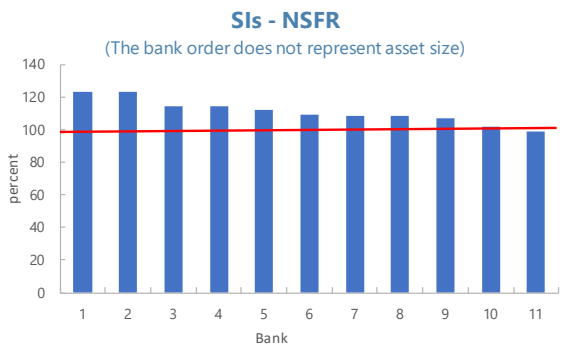
Retail funding is the largest source of stable funding for LSIs…



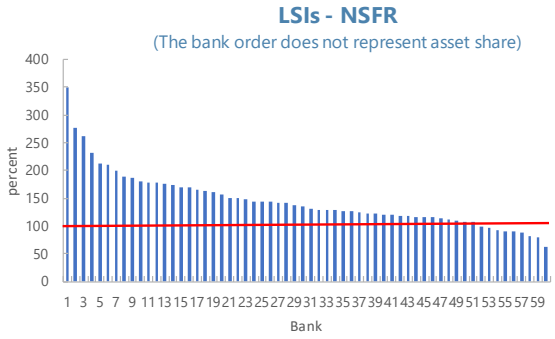
…but represent a smaller share of stable funding of SIs.



Most SIs…



…and LSIs already comply with the NSFR.



Sources: Banca d'Italia; and IMF staff calculations.

B. LCR-Based Liquidity Stress Test

80. In addition to Basel III LCR prescribed scenario that go beyond the Basel (CRR) parameters for the calculation of LCR are considered. These scenarios are as follows:

- **Retail scenario** simulates a (retail) deposit run. The key assumptions are: (i) 10 percent run-off rates for stable retail deposits and 15–20 percent for less stable retail; (ii) 75 percent (40 percent) run-off rates for operational (non-operational) deposits not covered by Deposit Guarantee Scheme; and (iii) 10 percent haircut on government securities for the calculation of high quality liquid assets (HQLA).

- **Wholesale scenario** simulates a wholesale deposit and wholesale market funding withdrawal. The key assumptions are: (i) 100 percent run-off rates for wholesale funding from other financial institutions; (ii) 50 percent run-off rates for operational and non-operational

deposits not covered by Deposit Guarantee Scheme; and (iii)10 percent haircut on government securities for the calculation of HQLA.

81. Banks' liquidity profiles are broadly comfortable, yet results indicate that banks are particularly vulnerable to a retail event (Table 8). The aggregate LCR (at 160 percent for SIs and 230 percent for LSIs) is comfortable (Figure 19). Reliance on retail deposits, considered as a more stable source of funding, is high particularly for LSIs. Moreover, almost all HQLA is composed of level 1 assets. When subjected to two severe retail and wholesale scenarios where outflows are stressed beyond LCR rates, 9 SIs accounting for 91 percent of the group's assets fall below the 100 percent LCR in a retail stress scenario, although the average stressed LCR for the system falls just below the 100 percent threshold and the liquidity shortfall represents only 1 percent of liabilities. LSIs accounting for 26 percent of LSI assets fall below the 100 percent threshold in a retail scenario, although the system remains substantially above minimum thresholds.

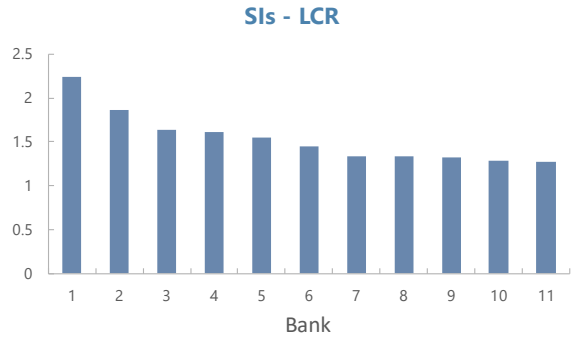
Table 8. Italy: LCR Stress Test Results

	SIs			LSIs		
	LCR	Retail Scenario[2]	Wholesale Scenario[3]	LCR	Retail Scenario[2]	Wholesale Scenario[3]
System-wide LCR	156%	92%	110%	229%	157%	189%
Number of Banks w/ LCR<100%	0	9	1	1	10	7
Share of Group Assets	0%	91%	7%	0.5%	26%	16%
Liquidity shortfall (millions of euros)[1]	0	16,768	1,494	10	1,341	433
Liquidity shortfall (share of Liabilities of failed banks)	0.0%	0.9%	1.0%	1.0%	2.3%	1.2%

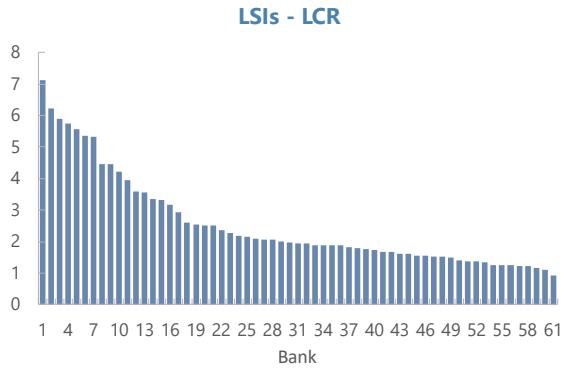
Source: IMF and BdI staff calculations.
Notes: [1] Liquidity shortfall is the amount of liquid asset needed to restore LCR to 100 percent.
[2] Retail scenario simulates a (retail) deposit run. The key assumptions are: (i) 10 percent run-off rates for stable retail deposits and 15–20 percent for less stable retail deposits; (ii) 75 percent (40 percent) run-off rates for operational (non-operational) deposits not covered by Deposit Guarantee Scheme; and (iii) 10 percent haircut on government securities for the calculation of high-quality liquid assets (HQLA).
[3] Wholesale scenario simulates a wholesale deposit and wholesale market funding withdrawal. The key assumptions are: (i) 100 percent run-off rates for wholesale funding from other financial institutions; (ii) 50 percent run-off rates for operational and non-operational deposits not covered by Deposit Guarantee Scheme; and; (iii) 10 percent haircut on government securities for the calculation of HQLA.

Figure 19. Liquidity Coverage Ratio

LCR ratios are comfortable among SIs.



Despite the large variation, LSIs' LCR ratios are also broadly comfortable.



Sources: Banca d'Italia; and IMF staff calculations.

C. Cashflow-Based Liquidity Stress Test

82. The cash flow-based liquidity stress test (CFLST) analyzes the liquidity risk exposure and risk bearing capacity of a sample of 11 SIs and 55 LSIs. The CFLST incorporates a set of embedded scenarios that allow the FSAP team to estimate the order of magnitude of potential liquidity needs of individual banks and the banking system under multiple stress scenarios. It also reveals the level of liquidity risk tolerance; i.e., under which circumstances banks would need additional liquidity support because of the mismatch of cash flows, and the absence of available counterbalancing capacity under stress. In addition, the CFLST highlights the liquidity risk exposures of banks in the banking system, such as potential reliance on unsecured short-term funding, wholesale funding from corporates, or holdings of less liquid assets in the counterbalancing capacity (CBC).

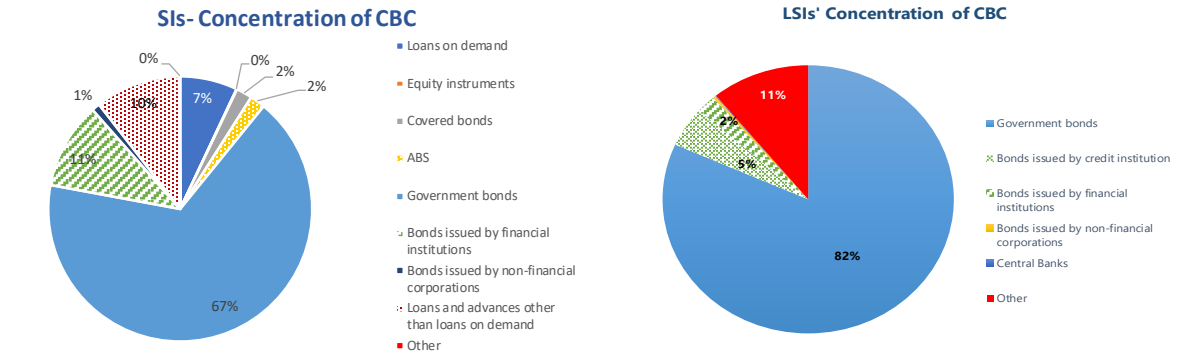
83. The CFLST focuses on two key indicators, the banks' net-funding gap (NFG), and banks' CBC. The NFG is defined as the difference between cash-inflows and cash-outflows in each time bucket, and the sum of these differences across buckets (i.e., the cumulated net-funding gap CNFG). The CBC is defined as the sum of cash inflows banks can generate under stress at reasonable prices in the respective bucket. The cumulated CBC is the sum of the counterbalancing capacities across time buckets. The analysis builds on data collected within the COREP templates (Maturity Ladder, C66.00).

84. The composition of SIs' and LSIs' CBC shows a high concentration in general government items, which could subject banks to market liquidity risks during stressed periods. For LSIs, 82 percent of the CBC is composed of general government items. Meanwhile, government items make 67 percent of SIs' CBC (Figure 20). Such a large exposure to sovereign securities improves the quality of the composition of the CBC but exposes banks to higher sovereign risk.

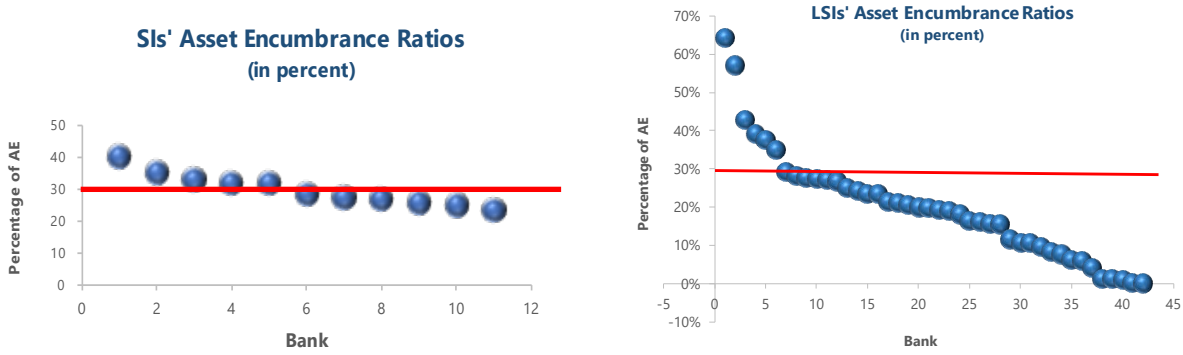
85. High asset encumbrance (AE) ratios among some of the LSIs in the sample could hinder their ability to further tap wholesale funding markets (especially unsecured ones) and may be subject to heightened funding shocks. The AE ratios among SIs are 30 percent on average, higher than the LSIs' (22 percent) (Figure 20). However, some of the LSIs in the sample have AE ratios above 40 percent. This, to a considerable extent, reflects funding constraints as well as a shift towards secured market borrowing (such as repos). Banks with high AE ratios may not only face higher outflows from short-term market and deposit funding during idiosyncratic and systemic liquidity events, but also could face difficulties in obtaining additional liquidity in the markets or central banks (as central banks do typically require collateral for funding operations).

Figure 20. Composition of CBC and Asset Encumbrance Ratios for SIs and LSIs

The composition of the buffer of liquid assets is heavily concentrated in government bonds, particularly for LSIs.



High asset encumbrance ratios among some of the LSIs in the sample could hinder their ability to further tap wholesale funding markets.



Source: IMF staff calculations.

86. Contractual liquidity risk exposure for SIs in the sample is very high, reflecting the reliance on demand deposits. Contractual outflows within the first month amounts to about 75 percent of total assets, while contractual inflows amount to about 38 percent of total assets. Thus, the cumulative net funding gap over the first 4 weeks reaches about 37 percent of total assets

or 818 billion EUR. The heatmap reveals that 31 percent of liquidity exposure in the first month is concentrated in outflows from retail deposits, followed by 10 percent of contractual outflows from corporate deposits (Figure 21). Meanwhile, repos collateralized with zero percent risk-weighted securities would form around 12 percent of contractual outflows in the first month. On the other hand, the main drivers of contractual inflows are reverse repos against zero percent risk-weighted securities (15 percent of contractual inflows), and corporate and other inflows (10 percent of contractual inflows combined).

87. Liquidity risk exposures for LSIs is also high and concentrated in retail deposits (41 percent of contractual outflows). Concentration in retail deposit outflows is high in the first month of contractual outflows (37 percent in the first month, versus 41 percent in the total outflows horizon). Overnight risk exposure is also high for corporate deposits (12 percent of contractual outflows), and other deposits (8 percent of contractual outflows). Similarly, liquidity exposures to repos against 0 percent risk-weighted securities make 16 percent of contractual outflows in the first month of the horizon. In the case of contractual inflows, exposures to retail, corporate, and central bank inflows in the first month make a small portion of contractual inflows (around 9 percent of total inflows in the first month, versus 48 percent of contractual inflows for the entire horizon). Meanwhile, exposures to reverse repos against 0 percent RW securities are about 6.5 percent of contractual inflows in the first month.

88. Run-off rates are calibrated for inflows and outflows, depending on the length of the stress horizon, and the severity of the market stress. Specifically, run-off rates for outflows are less severe in a 5-day stress horizon, and more severe in a 3-month stress horizon. Additionally, run-off rates are higher for unsecured than for secured wholesale funding, as well as for non-insured deposits than for insured ones. Table 9 summarizes the calibration of the inflow and outflow parameters.[36] The inflows parameters are in principle 100 percent of the contractual inflows, except for inflows from loans to retail and for corporate customers (inflows 0 percent). This is in line with the objective of the CFLST to assume that banks will continue business as normal, i.e., analyze the ability of banks to cope with liquidity stress while maintaining their ability to lend to the real economy. In fact, when a bank cuts credit lines and/or stops granting loans, it may send a negative signal to the markets about its financial situation, which could lead to further outflows from that bank.

[36] Further references can be found: BCBS (2014), Liquidity stress-testing: a survey of theory, empirics and current industry and supervisory practices", BCBS Working Paper 24. BCBS (2014), "Literature review of factors relating to liquidity stress – extended version" and the literature cited therein. Schmieder et al. (2012). Hałaj, G., D. Laliotis (2017), "A top-down liquidity stress test framework", In: Dees, S., J. Henry, R. Martin (eds.), "Stress-Test Analytics for Macroprudential Purposes in the euro area", ECB, 168–191. Commission Implementing Regulation (EU) 2016/322 of 10 February 2016 amending Implementing Regulation (EU) No 680/2014 laying down implementing technical standards with regard to supervisory reporting of institutions of the liquidity coverage requirement.

Figure 21. Heatmap of Contractual Cash Flows, SIs.

Most of the contractual cash outflows are concentrated within the first month, and open maturity deposits dominate….

	Overnight	Greater than overnight up to 2 days	Greater than 2 days up to 3 days	Greater than 3 days up to 4 days	Greater than 4 days up to 5 days	Greater than 5 days up to 6 days	Greater than 6 days up to 7 days	Greater than 7 days up to 2 weeks	Greater than 2 weeks up to 3 weeks	Greater than 3 weeks up to 4 weeks
LT unsecured issuances	0.13%	0.01%	0.00%	0.01%	0.00%	0.00%	0.00%	0.02%	0.03%	0.05%
Secured issuances	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.08%
ST paper due	0.01%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.01%	0.01%
Repo's against 0% RW securities	4.31%	2.82%	2.20%	0.22%	0.33%	0.00%	0.00%	0.95%	0.46%	0.80%
Repo's against 20% RW securities	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Repo's against covered bonds	0.01%	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.02%	0.01%	0.03%
Repo's against corporate bonds	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Repo's against RMBS	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Repo's against other CB eligible assets	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%
Repo's against non-CB elig. equities	0.01%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Repo's against other non-CB elig. Assets	0.17%	0.05%	0.04%	0.00%	0.01%	0.00%	0.00%	0.01%	0.00%	0.02%
Retail deposits	31%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Corporate deposits	10%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Central Bank dep. outflows	0.06%	0.13%	0.02%	0.00%	0.11%	0.00%	0.00%	0.04%	0.06%	0.10%
Other dep. outflows	2.87%	0.01%	0.20%	0.01%	0.02%	0.00%	0.00%	0.02%	0.04%	0.19%
Fin. inst. (not within IPS) dep. outflows	5.25%	0.13%	0.28%	0.09%	0.05%	0.01%	0.01%	0.18%	0.14%	0.11%
IPS outflows	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
FX-swap outflows	0.63%	0.73%	0.36%	0.21%	0.20%	0.00%	0.00%	0.57%	0.72%	0.55%
Derivative outflows	0.19%	0.14%	0.05%	0.07%	0.04%	0.01%	0.06%	0.13%	0.40%	0.29%
Other outflows	1.58%	1.20%	0.07%	0.02%	0.02%	0.00%	0.00%	0.05%	0.01%	0.08%
Total	56.86%	5.26%	3.67%	0.70%	0.87%	0.06%	0.10%	2.27%	2.21%	2.62%

Most of the cash inflows are concentrated outside of the 30-day horizon

	Overnight	Greater than overnight up to 2 days	Greater than 2 days up to 3 days	Greater than 3 days up to 4 days	Greater than 4 days up to 5 days	Greater than 5 days up to 6 days	Greater than 6 days up to 7 days	Greater than 7 days up to 2 weeks	Greater than 2 weeks up to 3 weeks	Greater than 3 weeks up to 4 weeks
Rev. repo's against 0% RW securities	6.28%	4.63%	1.43%	0.28%	0.46%	0.00%	0.00%	1.13%	0.26%	0.38%
Rev. repo's against 20% RW securities	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Rev. repo's against covered bonds	0.02%	0.03%	0.00%	0.04%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%
Rev. repo's against corporate bonds	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Rev. repo's against RMBS	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.03%
Rev. repo's against other CB eligible assets	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Rev. repo's against non-CB elig. equities	0.05%	0.02%	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.01%
Rev. repo's against other non-CB elig. assets	0.39%	0.22%	0.04%	0.00%	0.01%	0.00%	0.00%	0.08%	0.03%	0.10%
Retail inflows	0.34%	0.08%	0.09%	0.02%	0.03%	0.01%	0.01%	0.21%	0.34%	0.20%
Corporate inflows	2.30%	0.12%	0.15%	0.11%	0.14%	0.02%	0.04%	0.50%	0.55%	0.63%
Central Bank inflows	1.71%	0.04%	0.00%	0.00%	0.03%	0.00%	0.00%	0.03%	0.01%	0.00%
Other entities inflows	0.40%	0.00%	0.03%	0.00%	0.00%	0.03%	0.00%	0.03%	0.01%	0.03%
Fin. Inst. (not within IPS) Inflows	1.22%	0.06%	0.28%	0.05%	0.03%	0.02%	0.02%	0.16%	0.13%	0.20%
IPS inflows	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
FX-swap inflows	0.63%	0.72%	0.35%	0.21%	0.20%	0.00%	0.00%	0.57%	0.72%	0.55%
Derivative inflows	0.26%	0.14%	0.05%	0.07%	0.04%	0.01%	0.07%	0.13%	0.40%	0.30%
Other inflows	2.36%	1.31%	0.20%	0.00%	0.04%	0.00%	0.00%	0.42%	0.14%	1.21%
Total	15.99%	7.40%	2.64%	0.78%	0.99%	0.08%	0.15%	3.28%	2.61%	3.65%

Sources: European Central Bank and IMF staff calculations. Data for 2018:Q3.

Table 9. Italy: Scenario Parameters: Run-off Rates for the Major Components of In- and Outflows

Outflows/Inflow	Range of run-off factors (in percent) across mild, medium, severe and most severe scenarios
Unsecured LT/ST Issuances and financial deposits	30–100
Secured issuances	30–100
Stable retail deposits	0.5–10.5
Unstable retail deposits	1.25–29.3
Operational corporate deposits (NFCs)	1.25–38
Non-operational corporate deposits (NFCs)	20–55.7
Repo across all collateral classes*	100
Deposits outflows from financial institutions	50–100
FX-Swaps in-/outflows	15–100
Derivative in-/outflows	25–100
Retail / corporate inflows	0
Central bank inflows	100
Other entities inflows	0–30
Financial institutions inflows	30–100
Other inflows	0-100
Committed lines provided by the bank (FI)	50–100
Committed lines provided by the bank (non-FI)	50–100
Margin calls (derivatives)	2–10
Adverse market outflows (derivatives, HLBA)	0–100
Outflows due to rating downgrades	0–100

Source: IMF staff calculations.

89. The cashflow liquidity stress test runs a large set of embedded scenarios of increasing severity, for a 4-week, 3 months as well as 5-day time horizon. The same scenarios are applied for SIs as well as LSIs. The following scenarios are included for each time-horizon: a baseline scenario and four stress scenarios with increasing severity (mild market stress, medium market stress, severe market stress and a most severe market stress). Each of the stress scenarios is combined with three different approaches to the counterbalancing capacity (Figure 22):

- Full CBC: fully endogenous liquidity supply by the central bank as long as banks have unencumbered eligible collateral;
- Full CBC with market haircuts: a full CBC is assumed, but market-specific haircuts[37] and bank-specific market price effects are imposed on elements of the CBC.

[37] Specific haircuts to the CBC are calibrated based on discussions with the authorities and the ECB.

- Partial CBC with market haircuts: non-marketable components of the counterbalancing capacity (i.e., credit claims and committed lines provided to the banks) are disregarded; market haircuts are imposed again.

90. The results of the liquidity stress test for a 4-week horizon show that liquidity shocks can be substantial, but that most SI banks are able to cope even under the highest stress scenarios. SIs are resilient in the face of a four-week shock, as liquidity remains ample in the system (Figure 23), and potential liquidity needs become prevalent only under the most severe scenario. However, the liquidity risk exposure of the sample is relatively high for SIs, as the average scenario impact can range from -3 percent of total assets in a mild market, to -12 percent of total assets in a most severe market, and total CBC as a share of their total assets can decline from 15 percent to 5 percent. Potential liquidity needs could reach 12 billion euros in the most severe market scenario.

91. Some LSIs on the other hand are less resilient when faced with the same adverse shocks for a 4-week horizon. While most LSIs are also resilient to significant liquidity shocks; potential liquidity needs become prevalent even in a mild market scenario for a few of them (Figure 23 and Tables 10 and 11). Specifically, LSIs face CBC shortfalls which could range from 20 million euros in a medium stress market scenario, to almost 1.1 billion euros in the most severe market scenario. Additionally, the scenario impact can range from -3 percent to -13 percent of LSIs' total assets.

92. On aggregate, SI banks are moderately resilient to shocks over the longer, three-month horizon, while LSIs face liquidity strains in the events of such shocks. Under the most severe market scenario, the average impact of a scenario can amount to -18 percent of SI's total assets, and potential liquidity needs could reach up to 100 billion euros. LSIs face further challenges to maintain a positive CBC, as potential liquidity needs can arise early in a mild market scenario (-1.4 million euros) and reach almost 11 billion euros in the most severe market scenario. Additionally, 32 out of the 55 LSIs in the sample are not able to maintain a positive CBC in case of a most severe market stress.

93. SI and LSIs are resilient in the event of a five-day stress horizon. The liquidity stress test results for the five-day time horizon show that all SI and LSIs banks can maintain a positive CBC during a five-day stress horizon. As for liquidity, it remains ample enough to sustain the severity of the shocks: CBC as a share of total assets declines to 7 percent in the most severe scenario for SIs, while it remains as high as 17 percent of total assets in the most severe scenario for LSIs.

94. The analysis reveals that banks are resilient to liquidity shocks, but less so in a prolonged stress environment. Most of the SIs and LSIs remain liquid at the one-month horizon, even in the severe scenario, but less so at the three months horizons. The banks that feature a negative CBC after stress are very heterogeneous with respect to the causes of their liquidity problems: some have low initial CBCs, other feature relatively large shares of credit claims in their initial CBC; some have high outflows due to committed lines to customers, others due to outflows from deposits of financial institutions or other deposits.

Figure 22. Stress Test Scenarios

To deal with parameter uncertainty, CFLST was based around multiple scenarios…

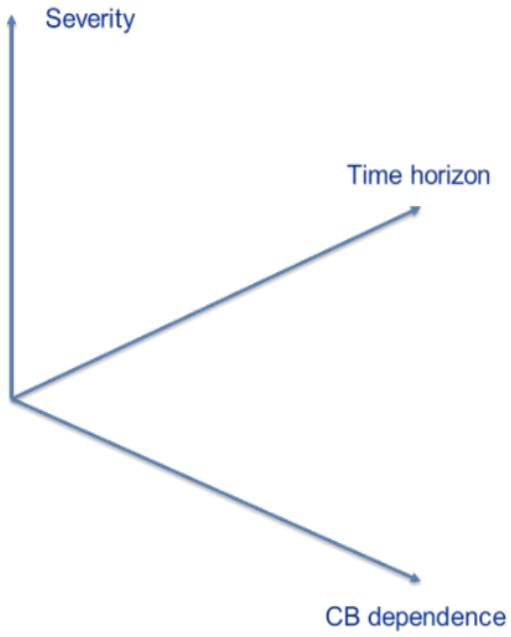
Severity
- Baseline/mild/severe market
- Severe combined with idiosyncratic

Time horizon
- Indentical: 4 weeks and 3 months
- Specific: 5 days

CB dependence
- Market liquidity only
- Limited CB support
- Full CB liquidity insurance

29 scenarios

Which were grouped according to the three dimensions: severity, time horizon and dependence on CB support



Sources: IMF staff calculations.

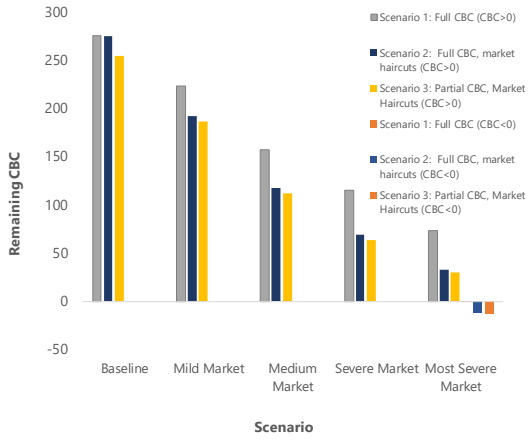
Table 10. Italy: Banking Sector Liquidity Cashflow Stress Test Results, One Month Horizon								
	SIs				LSIs			
	Mild Market	Medium Market	Severe Market	Most Severe Market	Mild Market	Medium Market	Severe Market	Most Severe Market
Scenario 1								
Remaining CBC as a share of total Assets	15%	12%	10%	8%	21%	20%	20%	18%
Number of banks unable to maintain a positive CBC	0	0	0	1	0	2	2	4
Scenario 2								
Remaining CBC as a share of total Assets	15%	10%	7%	5%	17%	15%	14%	12%
Number of banks unable to maintain a positive CBC	0	0	0	2	0	3	7	11
Scenario 3								
Remaining CBC as a share of total Assets	13%	10%	7%	5%	16%	14%	13%	11%
Number of banks unable to maintain a positive CBC	0	0	0	3	1	4	7	15
Source: IMF staff calculations.								

Table 11. Italy: Banking Sector Liquidity Cashflow Stress Test Results, Three Months Horizon								
	SIs				LSIs			
	Mild Market	Medium Market	Severe Market	Most Severe Market	Mild Market	Medium Market	Severe Market	Most Severe Market
Scenario 1								
Remaining CBC as a share of total Assets	12%	10%	5%	2%	20%	19%	14%	10%
Number of banks unable to maintain a positive CBC	0	0	2	5	3	4	14	23
Scenario 2								
Remaining CBC as a share of total Assets	8%	5%	3%	1%	16%	14%	8%	4%
Number of banks unable to maintain a positive CBC	0	0	3	6	3	6	25	30
Scenario 3								
Remaining CBC as a share of total Assets	10%	7%	2%	-2%	15%	13%	7%	3%
Number of banks unable to maintain a positive CBC	0	0	6	8	4	8	27	32
Source: IMF staff calculations.								

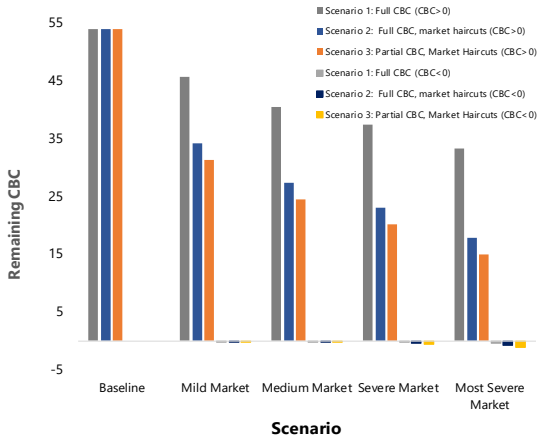
Figure 23. Cash Flow Liquidity Stress Test

(in billions)

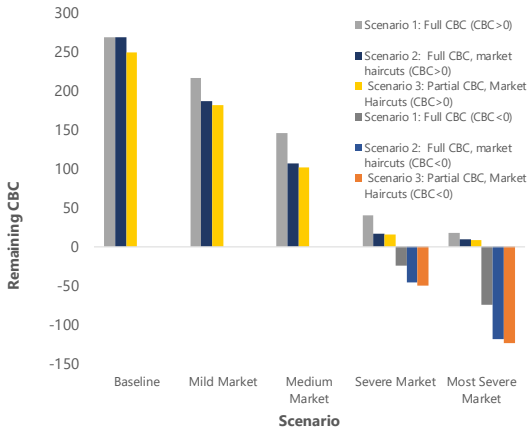
Impact of Scenario on CBC… SIs, 1-month



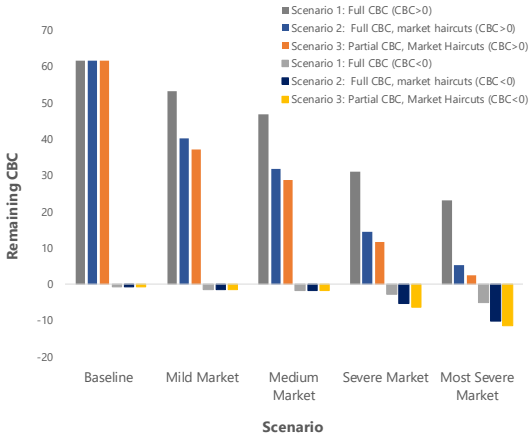
1M-LSIs ….



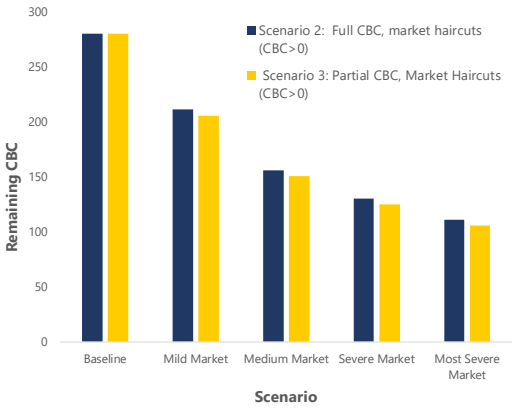
Impact of Scenario on CBC… SIs, 3-month



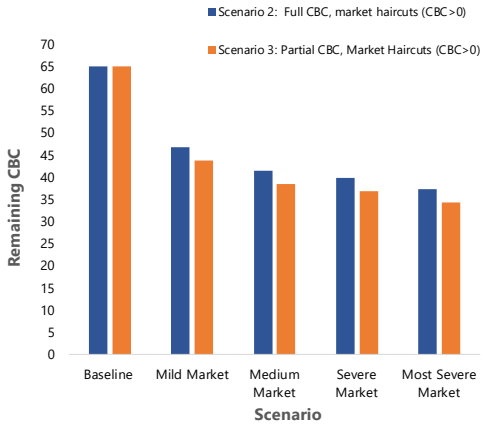
3M- LSIs ….



Impact of Scenario on CBC… SIs, 5-day



5day- LSIs



Source: IMF staff calculations.

PROFITABILITY ANALYSIS

95. Healthy bank profitability is essential for banks to continue to address the legacy issue of high NPLs and evolving regulatory challenges (e.g., MREL requirements). In this context, the FSAP analyzed the drivers of and prospects for banks' profitability. The analysis explores why profitability has remained low in Italy, and what are the drivers of profitability for banks. The work also estimates the cost of replacing the ECB's long-term refinancing operations (TLTRO), which were initially set to mature in June 2020, and how their replacement may impact profitability.

A. Drivers of Profitability

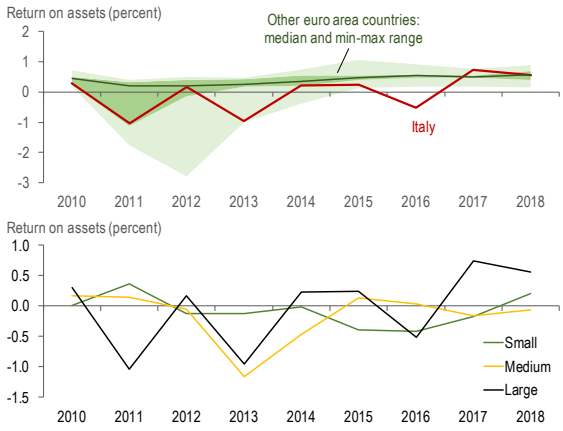
96. This section looks into the underlying reasons for low profitability in the Italian banking system. The analysis relies on a dataset of 381 banks from S&P's SNL database, and covers the changes in the above-mentioned sample of banks from 2010 to 2017. The coverage of the dataset is inclusive to banks with different business models: it includes 99 joint stock (SpA) companies, 26 mutual ("popolari") banks, and 254 credit cooperative banks (BCCs). The banks are grouped by size: the largest banks are those with balance sheets larger than 30 bn euros; the mid-sized banks are the ones with balance sheets between 4 bn euros and 30 bn euros; and the smallest sized banks are those with balance sheets smaller than 4 bn euros.

97. A system-wide view on profitability shows that, despite strong fluctuations during the past years, profitability rebounded in 2017–18 to levels close to the EU median (Figure 24). However, the rebound in profitability has been largely driven by the group of large banks. Profitability for medium and small banks continue to be low, although it has significantly improved since the twin crises.

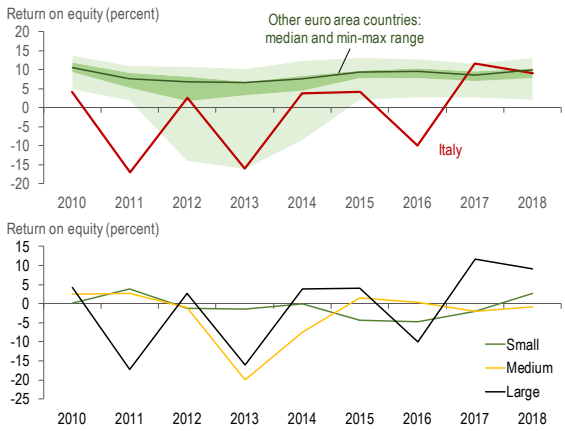
98. Low profitability for small- and mid-sized banks is hampered by a mix of structural and cyclical factors. Small- and mid-sized banks retain high operating costs compared to large banks, and to the EU median in general. The reduction in operating costs by large banks was not equally matched by small- and medium-sized banks. Figure 24 depicts the consolidation efforts made by banks in Italy over the period of 2010–17.

Figure 24. Banks' Profitability

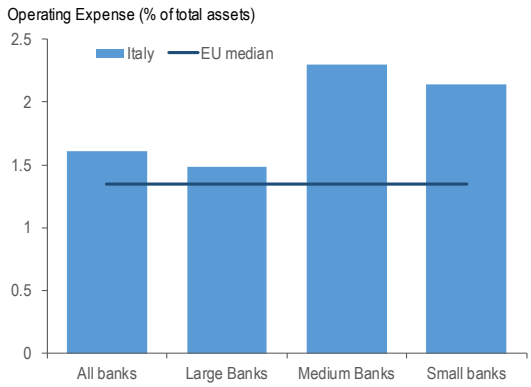
Banks' return on assets has rebounded in 2017 but has remained under the EU median for medium and small banks.



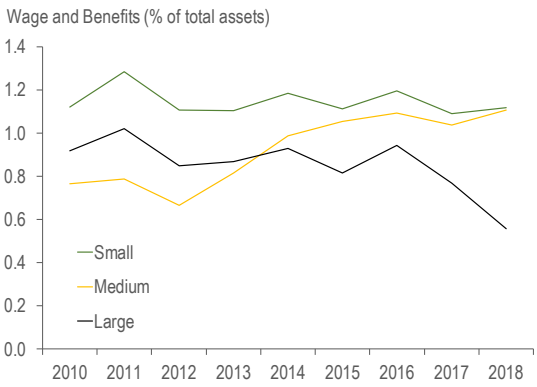
Similarly, return on equity has improved for large banks, but falls below the median for the remaining banks.



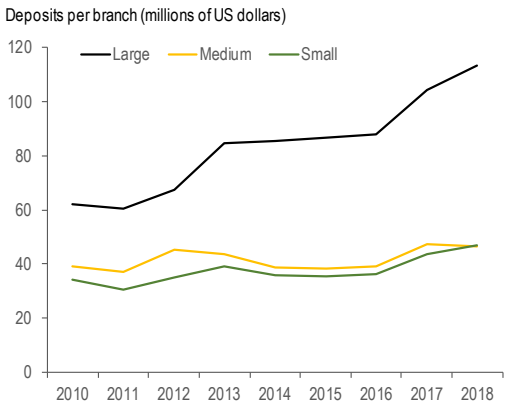
Medium- and small-sized banks retain high operating expenses…

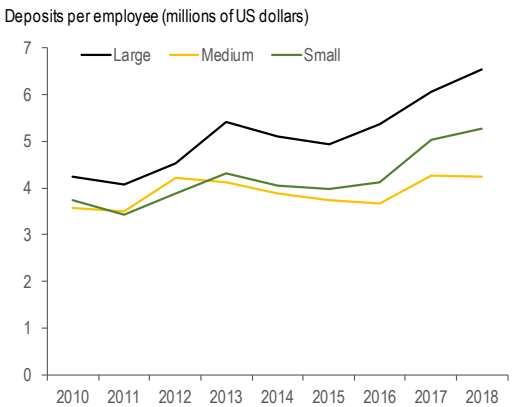


…and have not significantly reduced their personnel expenses, in contrast to large-sized banks.



Large banks made the most significant improvements in both ratios of deposits to branches and deposits-to-employees.





Sources: SNL and IMF staff calculations.

99. Cyclical factors, such as low and negative interest rates, also act as headwinds to banks' profitability. Data shows that net interest income as a share of operating income declined significantly for all banks from 2010 to 2017, as the policy rates declined in the EA (Figure 25).

100. The FSAP looked at the changes to the main contributing factors to profitability, proxied by return on assets (ROA), in the Italian banking sector between 2010 and 2018. The waterfall charts reported in Figure 25 present the changes in drivers of profitability between 2010 and 2017 to the Italian banking sector, as well as large-sized banks, medium-sized banks, and small-sized banks. The waterfall charts focus on the following drivers of profitability: non-interest income, operating expenses, provision, other non-operating items, taxes, net interest income, and an "other" category, which is a residual. All items are divided by total assets.

101. The improvement in systemwide profitability between 2010 and 2018 was mainly driven by the performance of large banks. Profitability rebounded in the banking system between 2010 and 2018, driven by increases in non-interest income and other non-operating items, an improvement in tax revenue, and the reduction of operating expenses and provision needs. However, the breakdown of the banking system by size shows that on net, only large banks' profitability has improved over the period. In comparison, ROA of medium- and small-sized banks is lower in 2018 compared to 2010.

102. The decomposition of the change in ROA between 2010 and 2018 shows that net interest income has had the most negative impact on banks' profitability. The waterfall charts show that for the banking sector, large-sized banks, and small-sized banks, net interest income's contribution to the change in ROA has been significant.[38] However, medium-sized banks appear to have been able to moderate the impact of low interest rates on their NII, with a resulting positive contribution between 2010 and 2018. On the other hand, all banks' profitability has benefitted from an increase in non-interest income, reinforcing what was above-mentioned regarding substitution of interest income with other sources of income.

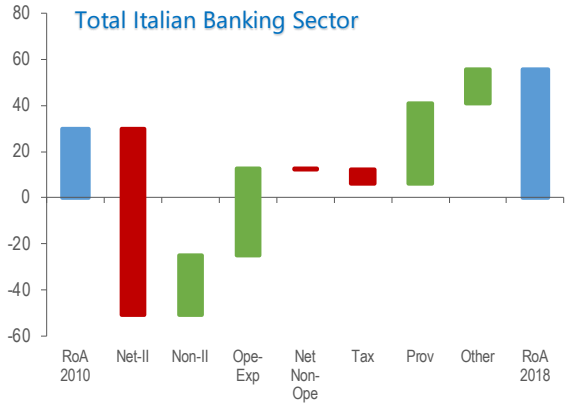
103. Medium-sized banks' profitability continues to be negatively impacted by the increased need for provisioning. As for large banks, the waterfall chart shows that provisions decreased in 2018 compared to 2010. This is because provisioning expenses significantly increased between 2012 and 2014 but have been on a declining trend since.

104. Large banks have reduced their operating expenses in an effort to boost profitability. On net, the banking system has reduced its operating expenses between 2010 and 2018, as the largest banks reduced their expenses the most. Meanwhile, operating expenses increased for medium and small banks, further pressuring profitability.

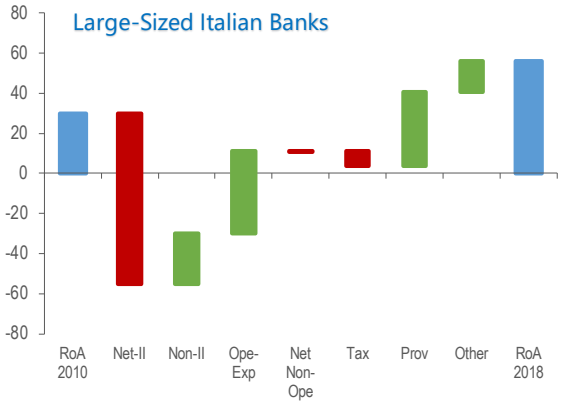
[38] The sample of banks is closed and their classification according to size is effected in 2018 and applied backward to ensure the consistency of the clusters over time.

Figure 25. Drivers of Profitability, 2010–2018

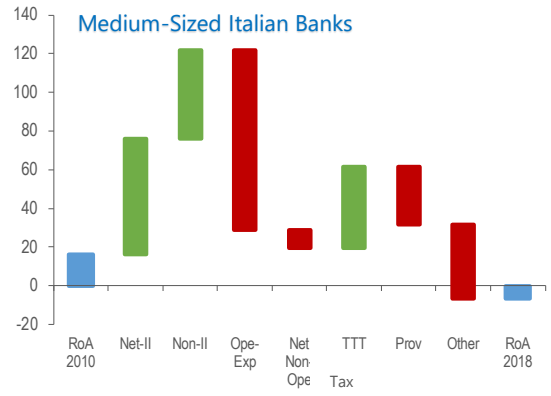
On average, profitability in the Italian banking sector has improved…



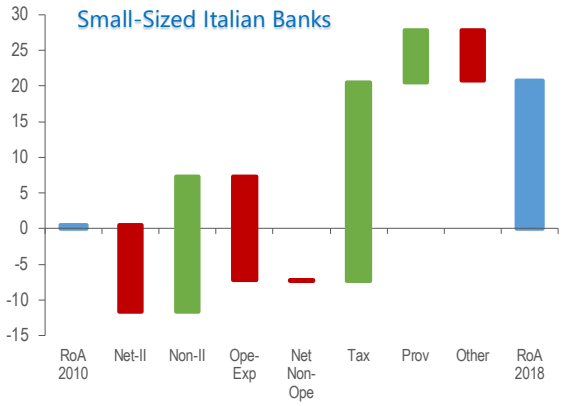
…Driven mainly by an improvement in large banks' profitability.



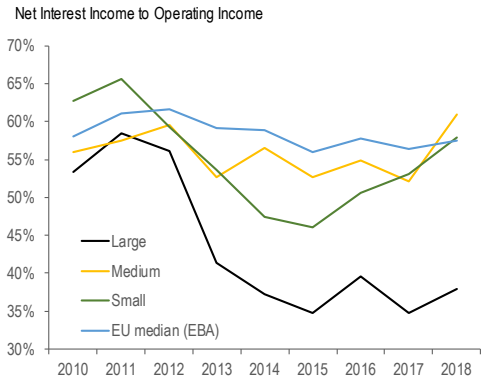
Despite improvement in net interest income, medium-sized banks' profitability in 2018 has declined compared to 2010 because of higher operating expenses.

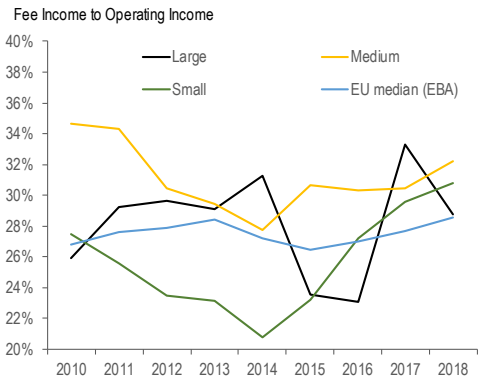


Small-sized banks' profitability have also improved compared to 2010, with declines in net interest income and operating expenses compensated by improvements in, taxes, non-interest income and provisions.



Overall, banks have increasingly relied on fee income in recent years as low interest rates depressed their profitability





Sources: SNL data and IMF staff estimates.

B. The Impact of TLTRO on Banks' Profitability

105. The FSAP conducted analysis to estimate the support that the ECB's TLTRO provides to banks' profitability. Italy's banks are main users of these operations, with about 200 billion euros of the ECB's TLTROs allotted to Italy's SIs. Banks currently benefit from a negative interest rate of -0.4 percent on TLTRO II borrowings (estimated at about 2 percent of SIs' NII on average). Furthermore, replacing TLTRO funding with market-based sources will be costlier for banks. In March 2019, the ECB announced a new series of operations (TLTRO-III), starting in September 2019 and ending in March 2021, each with a maturity of two years. TLTRO-III will continue to support the banking system, reducing the need for banks to tap more expensive funding sources in the near term.

106. The market cost of an equivalent amount to TLTRO financing depends significantly on the funding mix and market conditions. If banks used short-term funding while maintaining comfortable LCRs and NSFRs (e.g., with the ECB's main refinancing operations window at a zero percent rate or short-term retail deposits at a 0.38 percent rate),[39] they will incur relatively low funding costs. However, longer-term market funding would be costlier (Table 12). Banks' CDS spreads have risen 25 percent on average in the period after May 2018: bonds issued by banks during the second half of 2018 were priced at much higher prices compared to early 2018 or 2017. More recently, banks' CDS spreads have declined. Based on reported market prices for bond issuance in the second half of 2018, retail deposit rates, and the ECB's main refinancing window, Table 13 and Figure 26 present an illustrative range of estimates of the market-based cost of an equivalent amount to TLTRO financing.

Table 12. Italy: Bond Issuances and Spreads

(Bond Issuance, May 2018-January 2019)					
Issuer Name	**Date of Issuance**	**Amount Issued**	**Maturity**	**Payment Rank**	**Spread Vs. EUR 5yr Mid-Swap Rate**
UniCredit	11/27/2018	USD 3 billion	12/4/2023	Sr Non-Preferred	420 bps
UniCredit	1/15/2019	USD 2.5 billion	1/14/2022	Sr Non-Preferred	365 bps
Intesa	8/30/2018	EUR 1.1 billion	8/30/2023	Sr Preferred	188 bps
MPS	1/29/2019	EUR 1.1 billion	1/29/2024	Secured	190 bps
Bond Issuance, prior to May 2018					
UniCredit	1/18/2018	EUR 1.8 billion	1/18/2023	Sr Non-Preferred	70 bps
UniCredit	4/12/2017	USD 1.2 billion	4/12/2022	Sr Preferred	200 bps[1]
Intesa	3/20/2018	EUR 1.5 billion	3/20/2028	Sr Preferred	77 bps

Source: Bloomberg, IMF staff estimates.

Note: [1] UniCredit did not provide an equivalent for the spread via the EUR mid-swap rate. IMF staff roughly estimate it to be around 190 bps via the 5yr EUR mid-swap rate.

[39] The deposit rate here is the average interest rate on current account, sight and overnight deposits reported by the BdI.

Table 13. Italy: Illustrative Estimates of Annual Market-based Cost of an Equivalent TLTRO Funding
(as of end-2018)

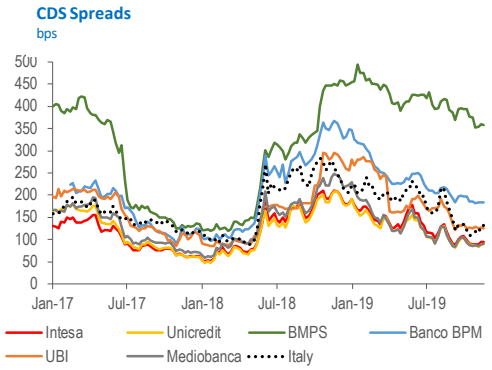
Types of Funding	Funding Cost (percent)	Gross TLTRO	TLTRO, Net of 50% of Banks' Excess Reserves[1]
		Impact of Gross TLTRO Replacement (Percent of banks' equity)	Impact of Net TLTRO Replacement (Percent of banks' equity)
Retail deposit rate	0.4	0.5	0.4
ECB's MRO	0.0	0.0	0.0
Long term bond – low volatility period (Intesa bond issuance, 2018)	1.8	2.2	1.8
Long term bond – high volatility period (UniCredit bond issuance, 2018)	4.2	5.2	4.2
Funding Mix 1: 30% Retail, 30% MRO,40% Bonds (Intesa price)		1.3	1.0
Funding Mix 2: 30% Retail, 30% MRO,40% Bonds (UniCredit price)		2.7	2.2
Funding Mix 3: 50% MRO, 50% Bonds (Intesa price)		1.1	0.9
Funding Mix 4: 50% MRO, 50% Bonds (Unicredit price)		2.6	2.1

Sources: Bloomberg; European Central Bank; Banca d'Italia; and IMF staff estimates.
Note: [1]This estimate assumes banks will replace TLTRO liquidity by using half of their excess reserves and financing the rest.

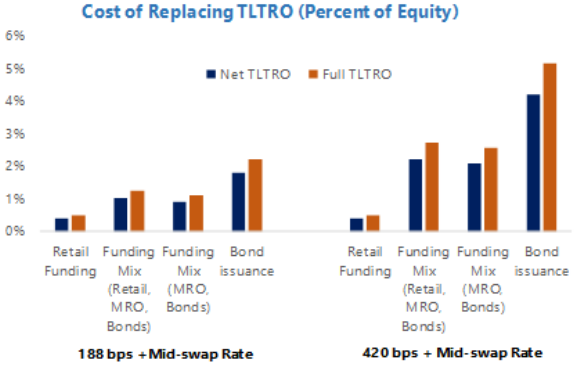
107. Costs of replacing TLTRO by market funding can have a meaningful impact on banks' profitability. Based on reported market prices for bond issuance, retail deposit rates, and the ECB's main refinancing window, we calculate the potential impact of replacing TLTROs on banks' equity. Namely, we consider that if banks replace TLTRO by five-year bond issuance, then the price of issuance could range from "188 bps + mid-swap rate" to "420 bps + mid-swap rate". Additionally, we consider the scenario when banks can use up to half of their excess reserves at the ECB for their financing needs ("net TLTRO" scenario). If banks were to use funding mixtures, replacement costs could vary from 1–3 percent of banks' equity on aggregate, but the impact varies significantly by bank. The cost from TLTRO refinancing could also be passed-through to lending rate or mitigated by deleveraging, which are not considered in this analysis.

Figure 26. Replacement of TLTRO

Banks' CDS spreads have increased in the second half of 2018 by about 25 percent raising their funding costs, but CDS spreads declined significantly since then.



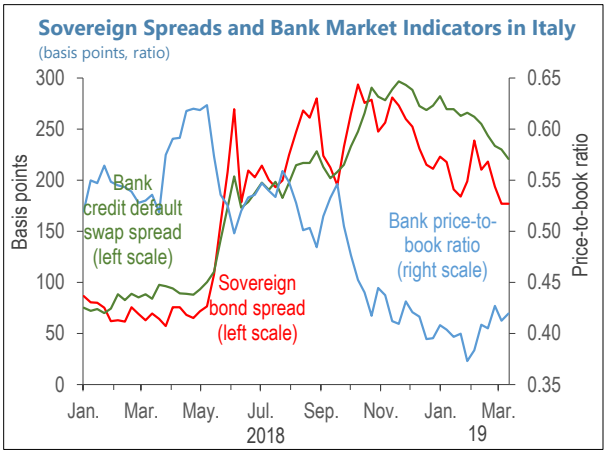
Cost of replacing TLTRO will depend on the funding mix banks choose and is costliest if banks choose Long-term bond issuance.



Sources: Bloomberg; European Central Bank; Banca d'Italia; and IMF staff estimates.

CORPORATE STRESS TEST

108. Heightened sovereign spreads and slowing growth pose renewed risks of adverse sovereign-bank-corporate feedback loops. Favorable monetary and funding conditions in the aftermath of the twin crisis have supported balance sheet recovery and reduced corporate vulnerabilities. Banks' asset quality has improved notably. However, high sovereign yields coupled with a slow growth environment raise the risks of adverse feedback loops between banks, corporates, and the sovereign. Higher spreads have increased marginal funding costs for Italian banks that are highly exposed to the sovereign. This could lead to higher retail lending rates to corporates. Furthermore, high NPLs can lead to credit rationing with a negative impact on growth.[40] Bank lending to corporates has been historically low and interest rates to corporates are highly differentiated with smaller and more vulnerable firms facing high borrowing costs. Debt servicing difficulties in turn can worsen asset quality on bank balance sheets. This underscores the need for corporate stress test.



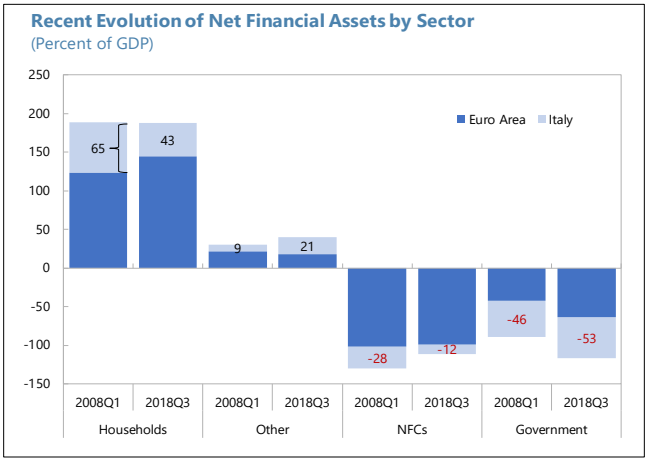
[40] EIB (2014) document that in the euro zone both the stock and flow of gross NPL ratio to loans have strong and significant negative impact on growth in corporate loans. This finding is echoed by Cucinelli (2015) who, based on a sample of Italian banks, find a negative impact of gross NPL ratio on overall loan growth. Bredl (2018) finds that higher stock of NPLs is associated with higher lending rates if not sufficiently covered by loan loss reserves. Accornero and others (2017) argue that lending to NFCs in Italy is negatively affected by the flow of new NPLs.

109. The corporate sector stress test assesses the financial resilience of Italian corporates to adverse macroeconomic conditions. The stress test relies on a micro-simulation model that captures interlinkages between the macroeconomic environment and corporate vulnerability indicators. Calibrated to the adverse macroeconomic scenario, the stress test reveals a relatively high sensitivity of profitability, interest coverage ratio, and the share of debt held by vulnerable corporates to an interest rate, profit, and combined shocks.[41]

110. The remainder of this section is organized as follows. Subsection A presents the national accounts view of the NFC sector. This is confirmed by the firm-level data in Subsection B that further presents key concepts and distributional characteristics of vulnerability indicators. In Subsection C these are used to construct a microsimulation model that is used to assess the resilience of the corporate sector to an adverse macro-economic scenario. Subsection D concludes.

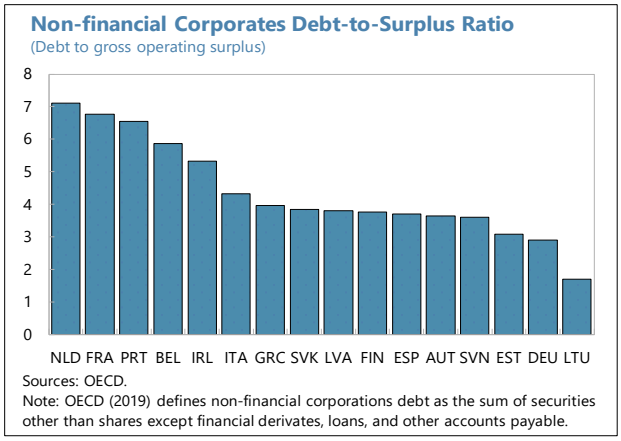
A. Aggregate Balance Sheet Developments in the Non-Financial Sector

111. The interconnectedness analysis conducted by the FSAP indicates that households are substantial net lenders. Households are by far the 'richest' institutional sector in Italy with overall household debt well below European peers and accumulated net financial assets of about 200 percent of GDP by end-2007, up from 156 percent of GDP at end-1995. Together with real assets the net wealth of Italian households can be measured at about 5½ times the GDP (Bank of Italy, 2015). Over the past three years, despite declining real estate prices, households have benefitted from favorable credit conditions (Bank of Italy, 2018c). Their real gross disposable income grew at an average rate of 1 percent per year. Until recently, employment has been increasing at a three-year average rate of about 1 percent—the fastest growth in a decade—and labor market conditions have tightened. Households' bad debt to banks account only for about one-fifth of the economy-wide bad debt, or just above 5 percent of bank loans to households, posing relatively modest risks to the banking sector. According to Banca d'Italia (2019) the share of vulnerable households in recent years has been around 11–12 percent, down from a peak of about 19 percent during the 2012 recession. Households in Italy are therefore not likely to be a major source of macro-financial risks to banks.

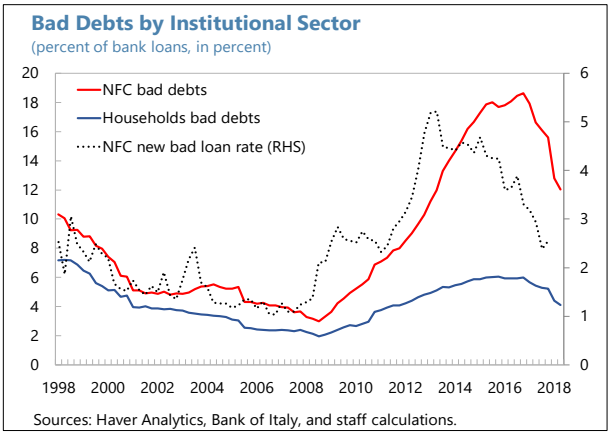


[41] See IMF (2017, 2013) for technical details and application of corporate stress testing methodology.

112. The non-financial corporate sector gross debt to surplus ratio is close to the euro area average (text chart). After peaking in 2012, it has fallen to just above the 2017 levels. With net financial assets at -112 percent of GDP, the corporate sector is slightly more indebted than the euro area average (see text chart in preceding paragraph). Corporate indebtedness imposes a significant drag on total factor productivity growth (Anderson and Raissi, 2018) that has been persistently anemic in Italy, declining more in frontier manufacturing firms (OECD, 2017; Kangur, 2018), and lagging the EA.



113. The corporate sector has been the primary source of bad debts for banks and faces highly differentiated lending rates. Bad loan inflows from the corporate sector have declined notably (text chart). And while accommodative monetary policy eased financing conditions, bank credit growth to NFCs has been weak. Such dynamics reflect the selectiveness of banks (Banca d'Italia, 2019) as tight credit conditions have been especially applied to riskier firms who face higher cost of borrowing and tend to have lower profitability (e.g., analysis by Cerved, 2017 concludes that SMEs face highly differentiated lending rates depending on their size and riskiness). As a result, lending to corporations as a share of GDP has steadily declined.

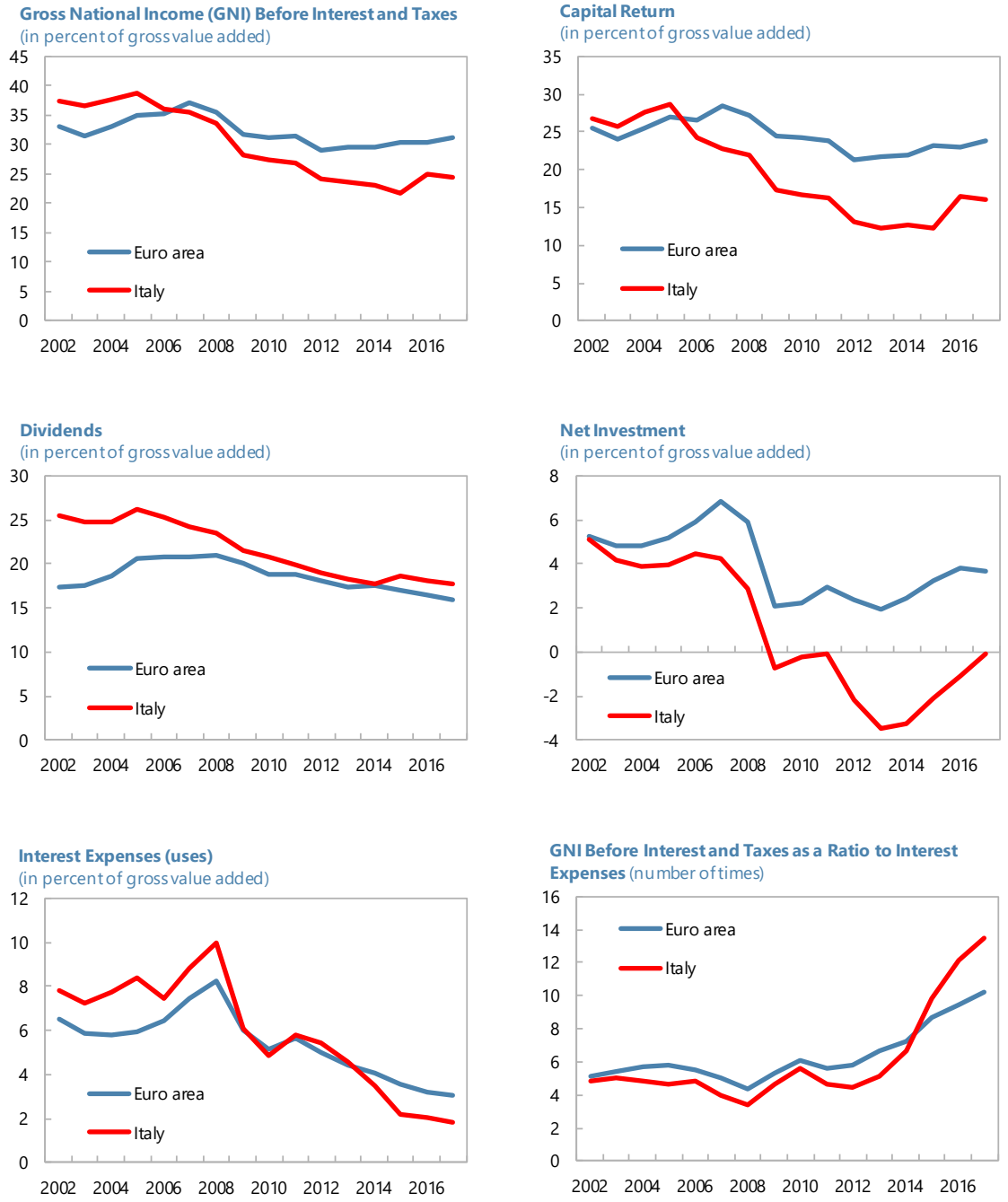


114. Dominated by small firms, the Italian corporate sector is generally less profitable than its euro area peers. Gross national income (GNI) of NFCs before interest and taxes—a national accounts measure of profitability—has declined throughout the past decade and remains about 7 percentage points below the euro area average as share of gross value added (Figure 27). As Italian corporates generally bear heavier effective tax burden compared to its European peers, the decline in after-tax capital return has been more pronounced. The decline in these national accounts measures of profitability are mostly reflected in lower dividends—distributed income of corporations—as well as net investment. Such internal adjustment pattern of lower profit margins and reductions in real quantities is the result of firms facing rigid nominal wages, a high unit labor cost (ULC) gap with their European peers by over 30 percent and low productivity (see Kangur, 2018).[42]

[42] Several factors can explain low productivity growth of Italian firms. Production mix in Italy is generally concentrated in lower-technology and labor-intensive products, reflecting low utilization of ICT capital that Pellegrino and Zingales

(continued)

Figure 27. Non-Financial Corporate Sector in National Accounts Statistics



Sources: CERVED; and IMF staff calculations.
Note: The calculations and source data for capital return are taken from Garcia-Macia (2019).

(2017) assign to prevalently loyalty-based management. A product mix has been distancing from technological frontier; OECD (2017) estimates that the productivity of top Italian manufacturing firms has declined by almost 15 percent between 2001 and 2012, whereas the productivity of OECD top 5 percent firms has increased by more than 30 percent and assigns three-quarters of the productivity gap to the small size of the Italian firms.

115. While the corporate sector debt-servicing capacity has improved in recent years, the sector remains sensitive to shocks. Corporate sector vulnerabilities have receded in recent years against the background of prolonged cyclical monetary accommodation and fiscal support. Italian corporates have benefited more than other countries in the euro area from the monetary stimulus that has contributed to a decline in interest expenses as a share of value added from around 8–10 percent pre-crisis to below 2 percent in 2017. This in turn has more than doubled the ratio of GNI before interest and taxes to interest expense that in 2017 reached its historical peak of 13.5 per cent (compared to an average of about 5 percent between 2002 and 2007). At the same time, lending rates are highly differentiated and remain high for smaller and more vulnerable companies, unit labor costs remain elevated and corporate profitability and net investment low. Important segments of the corporate sector can thus remain vulnerable to shocks, contributing to higher debt-at-risk and posing risks for banks' asset quality.

B. Financial Vulnerabilities at a Micro-Level

Overview of the Corporate Sector through the Lens of Micro-data

116. The corporate sector stress test relies on firm-level balance sheet data. The firm-level database, compiled by CERVED, provides detailed balance sheet and income statement data on nearly the whole population of Italian non-financial corporates. The sample covers the period 2002–17 and comprises of more than 10 million observations for 1.5 million firms.[43] The coverage reflects the structure of the Italian corporate sector, with about 80 percent of firms in 2017 comprising of micro-firms with less than 10 employees and 1 percent of firms comprising of large companies with more than 249 employees.[44] According to the Structural Business Survey conducted by Eurostat micro-enterprises account for about 28 percent of the value added of the total business economy.

Sample Coverage by Firm Size 2002-2017

Firm size	Observations	Firms
Total	10,214,845	1,531,853
Micro	8,682,340	1,454,908
Small	1,127,716	234,468
Medium	327,110	55,853
Large	77,679	11,335

Note: the sum of micro, small, medium, and large firms can exceed the reported total due to some firms switching the size categories over time.

117. CERVED database provides consistency across time, firm size, and other characteristics. While the coverage of firms increases gradually across time, the structure of the database remains broadly consistent. Two structural features warrant highlighting. First, the database standardizes accounting presentations across industries that in the Italian law can follow different reporting

[43] At the time of cut-off, the database was still missing a small share of firms for 2017 (14 percent compared to 2016 number of firms). Missing data mostly relates to micro firms that generally tend to be less profitable and more vulnerable.

[44] The firm size follows the 2003 European Commission (EC) recommendation. Micro-firms employ less than 10 employees and have revenues or total assets less than €2 million. Small firms employ less than 50 employees and have revenues or total assets less than €10 million. Medium-sized firms employ less than 250 employees and have revenues or total assets below €50 or €43 million, respectively. The remaining firms are classified as large firms.

standards. Second, firms with simplified accounting rules are not obliged to report their full liability structure. As these are mostly micro firms and tend to be more vulnerable compared to sample average, relying on sub-components of debt can bias the analysis of debt-at-risk. This, however, will not affect the analysis of debt-at-risk based on aggregate debt. The database is cleaned by dropping all firms for which at any point in time observations on total assets, tangible fixed assets, or sales are zero or missing. Following Anderson and Raissi (2018) we drop a small number of observations where total assets in any given year either increase or decrease by more than 50 times compared to the previous year to alleviate problems with extreme outliers. Finally, with a decline in interest rates in recent years an increasing number of mostly micro-firms—reaching to 40 percent of total firms and holding up to 9 percent of total debt in 2017—report zero interest expenses. This is exacerbated by data rounding up to thousands of euros that would lead to an optimistic bias if the observations were treated as zeros. To alleviate this issue, we drop observations with zero interest payments if financial debt is positive for two consecutive years. In a very small number of cases we impute interest expenses based on an average effective interest rate (in case of non-zero debt).

118. Cyclical factors have supported balance sheet recovery while profitability remains structurally low.[45] A period of economic recovery, driven largely by cyclical factors such as a supportive monetary environment[46] and corporate tax incentives, have allowed firms to improve their liquidity positions and reverse the crisis-led trend of declining net investment. Over the period of 2015-17, following the twin crisis, liquidity positions of Italian corporates improved markedly (Table 14). Corporates have used this time to reduce their leverage both by reducing gross debt stock that now stands at close to 2007 levels and by building up equity. Still, profitability has been slow to recover. In 2017 both average and median EBIT over assets remain about 6-7 percent below average pre-crisis levels and about 17-18 percent below the 2007 peaks. While median profitability remains below the pre-crisis average levels for all firm size classes in a range of 14-2 percent, average EBIT per assets remains particularly low for micro and large companies. It is also noteworthy that across all indicators median values are worse than average and show smaller improvement, indicating a smaller set of high-performing firms and a longer tail of weaker firms.

Debt Overhang and Financial Vulnerabilities

119. Analysis of corporate debt overhang relies on a set of vulnerability indicators capturing corporates' debt servicing capacity in the medium term. Throughout this note, following earlier analysis of corporate debt overhang and stress test (see, for example, IMF 2013, 2017 for technical details and application of corporate stress testing methodology), the capacity to service debt is measured by the interest coverage ratio defined as a ratio of EBIT to interest expenses.[47] This provides a natural cut-off point of 1, below which firms are unable to service debt

[45] For consistency with ICR we rely on EBIT as a measure of corporate profitability.

[46] Banca d'Italia (2018b) estimates the contribution of monetary policy to GDP growth in 2016–17 at 1.5 and 0.9 percentage points, respectively, and the contribution of fiscal policies at 0.3 percentage points in both years.

[47] Other definitions of ICR are also used in the literature. When the focus is on short-term cash position, a ratio of earnings before interest, taxes, and amortization (EBITDA) to interest expenses is a useful indicator. However, given

(continued)

under the *status quo* (i.e., without changing corporate policies, such as reducing operating costs or cash reserves). The share of debt of firms with ICR less than 1 is therefore labelled as "debt-at-risk". In deriving debt-at-risk we rely on total corporate debt stock, including both financial and non-financial debt. At the same time, in the stress scenarios discussed below only part of debt that is more sensitive to interest rates is subject to shocks. This stressed debt excludes advances, trade credits and pension and other fund liabilities, and accounts for about 65 percent of total debt.[48]

120. Supported by exceptional monetary accommodation, the debt servicing capacity of Italian corporates has improved markedly (Table 15). Monetary accommodation has driven effective interest rates to historical lows and, along with continuing recovery in profitability, has almost doubled the median ICRs compared to pre-crisis years. ICRs are lower for smaller firms and higher for larger firms; a gap that has increased over recent years. Smaller and riskier firms don't only have higher leverage and lower profitability rates than larger firms, but also face tighter financing constraints and higher bank lending rates (Cerved, 2018). Along with the improved ICRs, the share of firms-at-risk and debt-at-risk have considerably declined from their crisis-driven peaks of around 40 percent and 35 percent to 24 percent and 20 percent, respectively.

121. At the same time share of vulnerable firms in Italy as well as debt-at-risk remain strikingly high. The share of vulnerable firms with ICR less than 1 has declined from a pre-crisis average of 37 percent to 26 percent though remains substantial: more than a quarter of firms are not able to generate sufficient operating income to cover their debt servicing costs. The share of debt held by these vulnerable companies is 23 percent, increasing to 47 percent when adding also companies with subpar performance (ICR between 1 and 3, following the categorization in IMF, 2019, for comparability). Vulnerability indicators are high also for large Italian companies that tend to be more profitable compared to smaller firms: out of all large companies 14 percent have ICR less than 1, holding 18 percent of all debt of large companies and 40 percent of all corporate debt-at-risk. Although international comparisons of micro-data are scarce, these indicators highlight important vulnerabilities in the Italian corporate sector.

that the focus of stress-tests looking 3 years ahead is on firms' medium-term economic viability, EBIT should be the preferred measure of profitability as it makes an explicit allowance for capital expenditures and may be more informative for comparing companies across different industries and capital intensities. EBITDA can make especially capital-intensive companies to look like they have more funds to make interest payments.

[48] The database does not allow to separate interest expenses by liability categories. It is therefore important to retain broader definition of interest-bearing debt (as compared to financial debt only) to match desirable economy-wide properties and not to over-estimate effective interest rate for the basis of shocks (see section on shock specification).

Table 14. Italy: Firm Characteristics in Micro-Data

Share of Firms by Firm Size

Firm size	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Micro	85	85	85	85	85	85	85	86	86	86	86	86	86	86	81	78
Small	11	10	10	11	11	11	11	10	10	10	10	10	10	10	14	17
Medium	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4
Large	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Liquidity Ratio by Firm Size (Median, in percent)

Firm size	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total	4.1	4.0	4.0	4.2	4.3	4.1	3.5	3.6	3.6	3.5	3.2	3.5	4.0	4.6	5.3	5.5
Micro	4.4	4.3	4.3	4.5	4.7	4.5	3.8	3.8	3.8	3.7	3.4	3.6	4.0	4.6	5.2	5.3
Small	2.8	2.7	2.8	3.1	3.1	2.9	2.3	2.6	2.7	2.6	2.6	3.1	3.8	4.6	5.8	6.4
Medium	2.8	2.8	2.9	3.1	3.1	2.8	2.2	2.5	2.6	2.3	2.5	3.1	3.6	4.3	5.3	5.9
Large	2.3	2.3	2.6	2.5	2.6	2.5	2.1	2.3	2.4	2.1	2.4	2.8	3.1	3.8	4.2	4.7

Liquidity Ratio by Firm Size (Average , in percent)

Firm size	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total	5.6	5.5	6.1	6.1	5.9	5.8	5.2	5.6	5.6	5.5	5.9	6.3	7.0	7.4	8.0	8.4
Micro	7.2	7.0	6.9	7.2	7.2	7.1	6.1	6.0	5.9	5.9	5.7	5.9	6.5	7.0	7.6	8.0
Small	7.2	6.6	7.2	7.2	7.0	7.0	6.1	6.5	6.6	6.7	6.9	7.6	7.9	8.7	9.6	10.2
Medium	5.7	6.3	6.3	6.8	6.8	6.2	5.4	6.1	6.6	6.1	6.4	7.2	7.7	8.5	9.4	10.1
Large	4.5	4.3	5.4	5.0	4.7	4.9	4.4	5.0	4.8	4.7	5.6	5.9	6.7	6.9	7.2	7.5

Debt-to-Equity Ratio by Firm Size (Median)

Firm size	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total	3.6	3.5	3.6	3.6	3.7	3.7	3.1	3.0	3.0	3.0	2.8	2.7	2.6	2.6	2.6	2.7
Micro	3.3	3.3	3.3	3.4	3.4	3.4	2.9	2.8	2.9	2.8	2.6	2.6	2.5	2.5	2.5	2.6
Small	5.1	5.1	5.2	5.3	5.5	5.5	4.2	4.0	4.1	4.1	3.7	3.6	3.4	3.4	3.5	3.4
Medium	3.9	3.9	3.9	3.9	4.1	4.2	3.1	3.0	3.0	3.0	2.8	2.6	2.6	2.5	2.5	2.5
Large	3.6	3.5	3.5	3.5	3.6	3.7	3.1	2.9	3.0	2.9	2.8	2.6	2.5	2.4	2.3	2.3

Debt-to-Equity Ratio by Firm Size (Average)

Firm size	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total	2.7	2.6	2.5	2.6	2.6	2.7	2.4	2.3	2.3	2.4	2.4	2.3	2.2	2.1	1.9	1.9
Micro	3.8	3.8	3.7	3.6	3.7	3.7	2.7	2.8	2.9	2.9	3.1	2.9	2.9	2.8	2.6	2.3
Small	3.4	3.1	3.4	3.3	3.1	3.4	2.7	2.6	2.7	2.7	2.7	2.5	2.3	2.2	2.2	2.1
Medium	2.7	2.7	2.5	2.5	2.7	2.7	2.3	2.2	2.2	2.3	2.3	2.1	2.0	1.9	1.8	1.8
Large	2.3	2.1	2.1	2.1	2.1	2.3	2.2	2.1	2.0	2.1	2.1	2.0	1.9	1.8	1.7	1.8

EBIT per Total Assets by Firm Size (Median, in percent)

Firm size	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total	3.6	3.3	3.3	3.3	3.8	4.0	3.4	2.5	2.6	2.7	2.3	2.4	2.7	2.9	3.1	3.3
Micro	3.2	2.9	2.9	3.0	3.5	3.7	3.1	2.3	2.4	2.5	2.1	2.2	2.4	2.7	2.8	2.9
Small	5.1	4.6	4.4	4.3	4.7	5.0	4.4	3.4	3.3	3.4	3.1	3.4	3.7	3.9	4.0	4.0
Medium	4.9	4.4	4.4	4.2	4.6	4.9	4.2	3.1	3.3	3.4	3.0	3.4	3.8	4.0	4.1	4.2
Large	4.7	4.6	4.5	4.5	4.9	5.0	4.4	3.5	3.8	3.8	3.5	3.8	4.1	4.4	4.5	4.6

EBIT per Total Assets by Firm Size (Average, in percent)

Firm size	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total	4.4	4.1	4.3	4.5	4.9	5.2	4.3	3.2	3.7	3.4	2.9	3.0	3.2	3.7	4.0	4.3
Micro	2.9	2.4	2.2	2.2	2.8	3.5	2.3	1.2	1.4	1.5	0.8	0.8	1.1	1.3	1.7	2.2
Small	4.9	4.1	4.1	4.2	4.3	4.9	3.9	2.6	2.8	2.8	2.1	2.6	3.1	3.7	4.1	4.7
Medium	4.2	4.4	4.2	4.2	4.8	4.8	3.7	2.6	3.2	3.1	2.5	3.1	3.8	4.2	4.7	5.0
Large	4.9	4.7	5.2	5.5	6.0	6.1	5.5	4.4	5.1	4.6	4.3	4.0	4.0	4.6	4.7	4.7

Source: CERVED; and IMF staff calculations.

Table 15. Italy: Vulnerability Indicators in Micro-Data

ICR by Firm Size (Median)

Firm size	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total	1.6	1.6	1.7	1.8	1.9	1.8	1.5	1.5	1.9	1.9	1.5	1.7	2.0	2.3	2.7	3.3
Micro	1.4	1.4	1.5	1.6	1.8	1.7	1.4	1.4	1.8	1.8	1.4	1.5	1.8	2.0	2.3	2.9
Small	2.3	2.2	2.4	2.5	2.5	2.3	1.9	2.1	2.7	2.5	2.0	2.4	2.8	3.6	4.3	5.3
Medium	2.5	2.5	2.8	2.8	2.8	2.4	2.0	2.2	3.1	2.8	2.2	2.8	3.4	4.6	6.0	7.0
Large	2.9	3.3	3.6	3.7	3.7	3.1	2.4	3.0	4.2	3.5	2.9	3.4	4.2	5.7	7.5	9.2

ICR by Firm Size (Average)

Firm size	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total	2.5	2.5	2.9	3.0	3.0	2.8	2.2	2.2	3.0	2.6	2.1	2.2	2.5	3.4	4.2	4.5
Micro	1.4	1.2	1.3	1.3	1.5	1.7	1.1	0.8	1.1	1.0	0.5	0.6	0.8	1.1	1.5	2.2
Small	2.3	2.2	2.3	2.5	2.5	2.3	1.8	1.6	2.2	2.0	1.4	1.8	2.3	3.1	3.9	4.2
Medium	2.5	2.5	2.8	2.9	2.9	2.6	1.9	1.9	2.9	2.4	1.8	2.5	3.1	4.0	5.3	6.6
Large	3.1	3.1	4.0	4.0	3.8	3.7	3.0	3.5	4.5	3.7	3.3	3.1	3.3	4.4	5.1	4.8

Debt Shares by Firm Size

Firm size	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Micro	19	20	20	21	21	21	21	23	23	23	24	24	24	23	21	18
Small	15	16	15	15	16	16	15	15	16	15	15	15	14	14	15	15
Medium	19	17	17	17	17	17	17	16	16	16	15	15	15	15	15	16
Large	47	47	47	47	46	47	46	46	45	46	46	46	47	48	49	51

Share of Firms by ICR Category

ICR category	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
ICR < 1	38	39	38	37	35	35	38	41	37	37	41	39	37	34	29	26
1 ≤ ICR < 2	17	17	16	16	15	17	17	14	13	14	14	14	14	13	14	13
2 ≤ ICR < 3	9	9	9	9	9	9	8	8	8	8	7	8	8	8	9	8
ICR ≥ 3	36	36	37	39	41	40	36	37	42	41	38	40	42	46	49	53

Share of Debt by Firms' ICR Category

ICR category	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
ICR < 1	31	30	28	27	27	28	33	34	29	31	35	34	32	29	25	23
1 ≤ ICR < 2	23	24	19	19	20	21	23	19	17	18	18	16	21	14	14	18
2 ≤ ICR < 3	10	12	16	13	10	13	12	12	10	13	12	13	10	11	10	7
ICR ≥ 3	36	34	37	41	43	38	33	35	43	38	35	36	37	46	51	53

Debt-at-Risk by Firm Size (Median, ICR < 1)

Firm size	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Micro	28	31	33	34	34	34	32	34	38	36	36	37	39	40	38	33
Small	12	14	14	14	14	14	15	16	16	17	17	15	14	13	14	13
Medium	16	15	17	15	15	16	17	16	16	16	15	14	13	13	14	14
Large	44	40	37	37	36	36	37	33	30	31	32	34	34	34	35	40

Share of Firms with ICR < 1 in Total Firms by Size

Firm size	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total	38	39	38	37	35	35	38	41	37	37	41	39	37	34	29	26
Micro	41	42	41	40	38	38	41	43	40	39	43	41	39	36	32	30
Small	20	21	20	19	18	18	23	27	21	22	28	24	21	17	15	13
Medium	21	22	21	22	20	20	26	30	23	24	29	25	21	18	15	14
Large	23	21	21	21	20	20	26	28	22	22	26	23	20	18	15	14

Source: CERVED; and IMF staff calculations.

122. Gross debt and debt-at-risk are concentrated in micro and large companies. By most metrics Italian micro enterprises stand out as the most vulnerable category in Italy (Table 2). Despite this and the overwhelming presence of micro companies, historically the lion's share of debt has been held by large companies. More recently, the latter have broadly maintained their gross debt levels comparable to their recent crisis levels, while the number of micro companies as well as their debt has been declining. This reflects higher net exit rates among more vulnerable micro firms (De Socio and Michelangeli, 2015) whose numbers have been falling since 2012, while the number of large firms has rapidly recovered from the crisis impact, reaching their peak in 2017.[49] As a result, an increasing share of debt and debt-at-risk is being held by large companies, reaching 51 percent and 40 percent in 2017, respectively. While among micro firms debt-at-risk is rater uniformly distributed with a ratio of debt-at-risk to the share of vulnerable companies (ICR<1) close to 1; among large companies this ratio is close to 3, indicating that debt-at-risk is concentrated in a smaller number of companies. Overall, about 73 percent of debt-at-risk is held by micro and large companies.

123. Vulnerabilities are concentrated in four larger sectors that account for about 70 percent of debt-at-risk. The text table provides a breakdown of the sample by sectors, reporting sectoral ICRs as well as shares of firms, debt and debt-at-risk. More than one quarter of debt and debt-at-risk is held by manufacturing firms. Considering the relatively high median ICR, the manufacturing sector has a rather wide distribution of debt. Construction and real estate are the most vulnerable sectors as indicated by high shares of debt-at-risk and relatively low ICRs. These two sectors together account for about 45 percent of gross firms' non-performing exposures in mid-2018 (Banca d'Italia, 2018a). Finally, the trade sector where more than one-fifth of all the micro-companies are concentrated accounts for another 14 percent of debt-at-risk. Professional services, despite being close to 90 percent comprised of micro companies, stand out as one of the least vulnerable sectors (as indicated by the high ICR) that according to the OECD product market indicators are protected by high entry regulations (OECD, 2013).

Median ICR and Debt by Sector (2017, in percent)

Sector	Firms	ICR	Debt	Debt at risk
Total	100	3.3	100	100
Agriculture	2	1.3	1	1
Mining	0	2.0	3	1
Manufacturing	18	4.6	27	25
Electricity	1	2.2	7	5
Water	1	4.7	2	1
Construction	14	2.8	9	16
Trade	22	3.7	16	13
Transport	4	4.5	11	5
Accommodation	6	2.3	2	3
Communication	4	4.7	6	8
Real estate	13	2.0	8	15
Professionals	6	5.0	2	2
Support services	4	4.0	3	1
Education	1	3.7	0	0
Health	2	3.7	1	1
Arts and entertainment	2	2.2	1	1
Other services	1	3.0	0	0

[49] A special insolvency regime for large firms in Italy with the objective of, inter alia, preservation of large firms and protection of broader social and employment considerations (see Belhocine and others, 2018, for an overview), might have contributed to lower exit rates of large firms.

124. Debt and debt-at-risk are also geographically concentrated. Northern areas in Italy stand out with higher median ICRs compared to country-wide median values. Almost one-third of total as well as of all vulnerable firms are located in north-western area. Being the largest geographical area, the firms in north-west hold about 36 percent of all corporate debt in Italy. However, this is also where the largest vulnerabilities are concentrated: almost half of all debt-at-risk held by vulnerable firms in Italy is concentrated in firms in north-west. This stands in contrast to firm productivity and public-sector efficiency indicators that are generally higher in northern provinces and lagging in the south (OECD, 2017). At the same time companies in the south only hold 10 percent of overall corporate sector debt-at-risk.

Median ICR and Debt by Area (2017, in percent)

Sector	Firms	ICR	Debt	Debt at risk
Total	100	3.3	100	100
North-west	31	3.6	36	48
North-east	23	3.8	21	20
Center	23	2.8	32	23
South	23	3.3	10	10

125. Corporate debt holdings are highly concentrated in the least profitable firms with low debt servicing capacity. About 43 percent of total debt is held by firms with subpar ICR (less than 3 following IMF, 2019, to ensure comparability) and more than 60 percent is held by companies with ICR less than 5. This is an improvement compared to the 2012 sovereign crisis when corporate vulnerabilities were at their highest: as much as 65 percent of debt was held by firms with ICR less than 3, increasing to 76 percent for firms with ICR less than 5. Nevertheless, even now the bulk of corporate debt is held by firms with lower profitability and lower ICRs. This underscores the still vulnerable nature of the corporate sector to adverse shocks. Further, under the historically low interest rate environment the impact of a, say, 100 bps interest rate shock on ICRs is proportionately higher than under more normal interest rate conditions.

Distribution of total corporate debt by ICRs (rows) and EBIT per assets (columns), (2017, in percent)

	<0	1	2	3	4	5	6	7	8	9	10	>10	Sum
<0	17	0	0	0	0	0	0	0	0	0	0	0	17
[0, 1)	0	4	1	0	0	0	0	0	0	0	0	0	6
[1, 2)	0	6	3	3	2	1	0	2	0	0	0	0	18
[2, 3)	0	1	1	2	1	1	1	0	0	0	0	0	7
[3, 4)	0	0	1	1	1	2	1	0	0	0	0	0	7
[4, 5)	0	0	1	1	1	3	0	0	0	1	0	0	7
[5, 6)	0	0	0	1	0	1	0	0	0	0	0	1	5
[6, 7)	0	1	0	0	0	0	0	0	0	0	0	0	3
[7, 8)	0	0	0	0	0	0	0	0	0	0	0	0	2
[8, 9)	0	0	0	0	0	0	0	0	0	0	0	0	2
[9, 10)	0	0	0	0	0	0	0	0	0	0	0	0	1
>10	0	1	1	1	2	2	2	3	2	1	2	9	26
Sum	17	14	9	10	7	9	5	7	4	4	2	12	100

Distribution of total corporate debt by ICRs (rows) and EBIT per assets (columns), (2012, in percent)

	<0	1	2	3	4	5	6	7	8	9	10	>10	Sum
<0	23	0	0	0	0	0	0	0	0	0	0	0	23
[0, 1)	0	6	3	2	1	0	0	0	0	0	0	0	12
[1, 2)	0	2	4	5	3	2	2	1	0	0	0	0	18
[2, 3)	0	0	1	1	2	1	1	1	3	0	0	0	12
[3, 4)	0	1	0	1	1	1	1	0	0	0	0	0	5
[4, 5)	0	0	0	3	0	1	0	0	0	0	0	0	6
[5, 6)	0	0	0	0	0	0	0	1	0	0	0	0	3
[6, 7)	0	0	0	0	0	0	0	0	0	0	0	0	2
[7, 8)	0	0	0	0	0	0	0	0	0	0	0	0	1
[8, 9)	0	0	0	0	0	0	0	0	0	0	0	1	2
[9, 10)	0	0	0	0	0	0	0	0	0	0	0	0	1
>10	0	1	1	1	1	1	1	1	1	1	1	7	16

C. Stress Test

Specification of shocks

126. The sensitivity analysis investigates the resilience of the Italian corporate sector to adverse macroeconomic developments. In conducting the stress test, we expose each firm to three types of shocks—a profit shock, an interest rate shock, and a common shock—and examine their impact on corporate vulnerability indicators.

127. The profit shock is determined econometrically by relating the change in EBIT for every firm to GDP growth. More specifically, we estimate the following equation for each firm-size category:

$$\Delta \mathrm{EBIT}_{\mathrm{ijkt}} = \alpha + \beta_1 \Delta \ln(\mathrm{VA})_{\mathrm{jt}} + \beta_2 \mathrm{U}_{\mathrm{kt}} + \gamma_{1\mathrm{j}} \mathrm{d}_{\mathrm{j}} + \gamma_{2\mathrm{K}} \mathrm{d}_{\mathrm{K}} + \gamma_{\mathrm{t}} \mathrm{d}_{\mathrm{t}} + \mathrm{e}_{\mathrm{ijkt}}$$

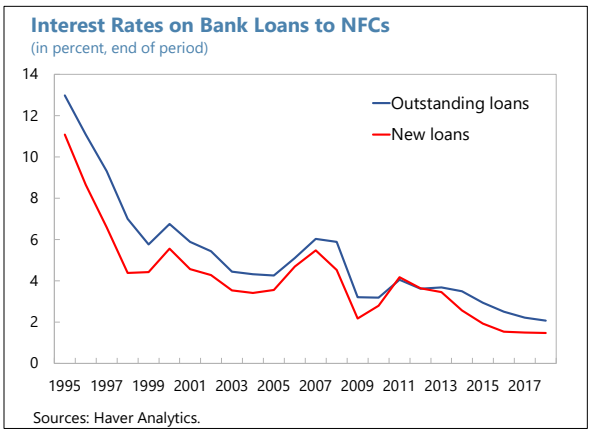
where EBIT of each firm *i* is related to the gross value added (VA) in industry *j* across time *t* and to the unemployment rate (U) in a geographical region *k,* while controlling also for industry-specific effects d_j, geographical area effects d_K, and time-effects d_t. In this manner, parameters for each firm-size class are identified by a panel regression across 21 economic sectors at NACE-2 level,[50] 20 geographical regions and over the period 2004–17. The estimated output semi-elasticity for the full sample is 0.84, though it varies considerably across firm size.

128. The interest rate shock is related to the ECB main refinancing rate and 10-year sovereign spreads over German bunds. The shock is calibrated based on econometric estimates by Albertazzi and others (2014), who find a full long-run pass-through of ECB main refinancing rate to new lending rates. The estimated pass-through of a 100 bps increase in sovereign spreads against German 10-year bunds is close to two-thirds on average while at the time of a sovereign crisis the pass-through to new lending rates in the long-term is estimated to be full. Given that the adverse scenario foresees a persistent increase in spreads in a magnitude comparable to sovereign crisis, an appropriate estimate of pass-through is 100 percent. Given that the funding composition of banks has shifted from wholesale towards ECB and deposit funding, we allow for more muted pass-through of sovereign spreads in the order of two-thirds.

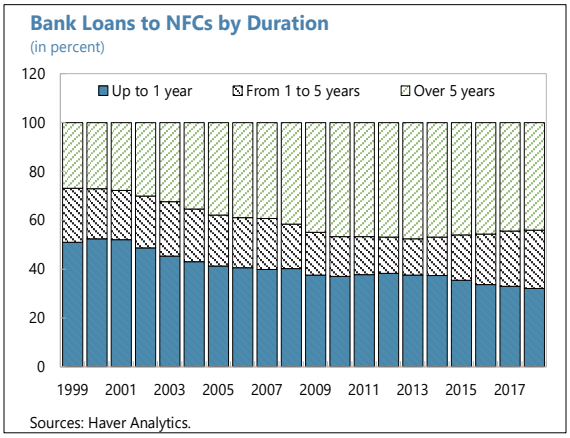
129. The combined shock is obtained by a simultaneous application of the profit and interest rate shocks. These shocks can reinforce each other and are not equal to the sum of individual shocks when implemented separately.

[50] Statistical classification of economic activities (NACE) at the level of 2-digit desegregation.

130. Several key assumptions govern the interest rate shock. Given that micro data only captures the effective interest rate on outstanding debt, it is important to determine how quickly will the existing debt be repriced following an interest rate shock. As the text chart shows, interest rates on new and outstanding corporate loans move very closely with the bulk of the change in new lending rates passing through to outstanding debt within the same year. This is not a feature of effective rate on total debt as not all corporate liabilities are equally sensitive to or carry equal interest rates. We assume that about 35 percent of total debt are less sensitive to interest rate developments.[51] The remaining or "effective debt" allows to match the observed pass-through from interest rates on new to existing loans as well as the level of interest rates on outstanding loans also in the micro-data compared to the reported aggregate data. As regressions in Appendix V show, passthrough of new lending rates to interest rate calculated on the effective debt is similarly rapid that, however, is not the case with other definitions of debt.



131. Such feature indicates that factors affecting new lending rates will quickly pass through to interest rates on outstanding debt. This is certainly the case for policy rates as most corporate rates are priced based on Euribor or Libor and only a very small share of corporate debt is issued at fixed rate. The evidence on pass-through indicates that also other factors affecting new lending rates such as sovereign spreads can quickly pass through to existing debt. Still, we allow for a possibility that domestic risk factors will have more gradual pass-through depending on the maturity structure of debt. The average maturity of bank loans to NFCs in Italy has lengthened and can be assessed in the range of 4–5 years. To match this, and allowing for full repricing of short-term debt, we assume that about one-third of long-term debt will be repriced over the 3-year horizon of the stress test.



Back-Testing

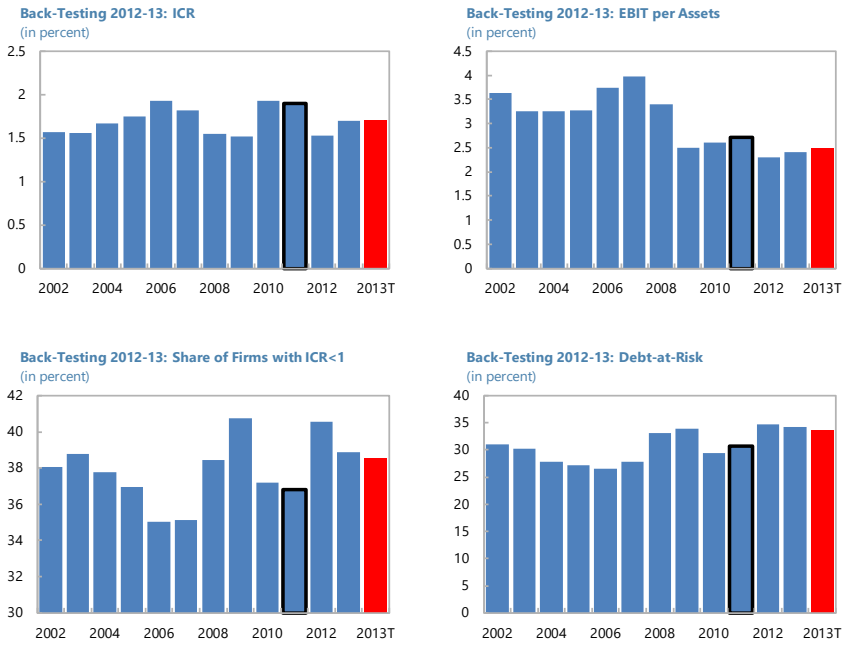
132. We perform a back-testing exercise to evaluate the model's performance during the previous sovereign crisis episode. Back-testing is constructed to capture a recent 2012–13 Italy's sovereign crisis episode that is the closest to the stress-test adverse scenario that is similarly driven

[51] These comprise of short-term trade credits, accounts payable, and some pension and other fund liabilities.

by domestic factors. We investigate the out-of-sample model predictions of corporate vulnerability indicators, taking the 2011 as a last observable data-point and determining the size of shocks by the historical macroeconomic data for 2012–13. The predicted vulnerability indicators are then compared to the historical corporate sector data to assess the model's performance.

133. The test results confirm the ability of the micro-simulation model to capture the sovereign crisis episodes (Figure 28)**.** The model is able to predict reasonably well both the corporate vulnerability dynamics as well as the share of vulnerable firms and debt-at-risk. at the end of the 2012–13 test-period. The crisis episode witnessed sizeable output loss, large swings in sovereign spreads as well as some monetary policy accommodation. Overall, the results speak to the models' ability to capture variations in corporate sector indicators driven by domestic shocks (e.g., sovereign spreads) that also underpin the stress test adverse scenario.[52]

Figure 28. Back-Testing the Micro-Simulation Model for Non-Financial Corporate Sector



Source: IMF staff estimates.

[52] The model performs well also on distributional characteristics. It replicates very closely the distributions of firms and debt by ICR categories, firms and "firms-at-risk" by firm size as well as overall debt by firm size. Debt-at-risk is only marginally (by 0.8 pp) under-estimated while slightly overestimating debt held by firms with ICR between 1 and 2. This is also reflected in slight under-estimation of debt-at-risk held by large companies (that hold the largest share of debt) and over-estimating by 2 percentage points debt held by small and medium sized firms. Overall, result do not provide any evidence for "over-reacting" to shocks. Model also captures well the 2012 turning point, predicting a median ICR of 40 and debt-at-risk of 35 percent. Similar back-test for the 2008-09 GFC episode shows that while the model can capture turning points, it is not able to replicate the full depth of the recession. This is mostly due to lower model-predicted decline in corporate profitability between 2007 and 2009.

Stress-Test Results

134. The stress-test assesses firms' debt servicing capacity under the FSAP adverse macroeconomic scenario. The stress-test is conducted as an out-of-sample simulation exercise, covering a 3-year horizon. In the baseline scenario the exercise assume that the outstanding amount of debt held by companies at the end of 2017 would be kept constant throughout the 3-year period of the stress test. The shocks are calibrated to the 3-year cumulative difference in nominal GDP between the adverse scenario and the baseline used for the banking sector stress tests; sovereign spread shock is calibrated to the mean difference between Italian and German 10-year government bond yields over the three-year horizon. The scenario is driven by Italy-specific shocks and does not assume any monetary accommodation. The timing of the sovereign spread shock occurring almost fully in the first year, could imply fast passthrough and repricing of outstanding debt over the stress-test horizon, especially if the shock is permanent in expectations.

135. Debt-at-risk is sensitive to both the profit and interest rate shocks. Figure 29 reports the aggregate results for adverse and medium scenario; the latter assumes half the value of the shocks under the severe scenario. In both cases the corporate sector does not get any further gains from accommodative monetary conditions, as has been the case during the previous crises. As a result, under the combined profit and interest rate shock envisaged under the adverse scenario, the share of vulnerable firms and debt-at-risk rise to 40 and 38 percent, respectively, from their respective values of 26 and 23 percent before the application of shocks. Both medium and adverse scenarios therefore reverse the gains from recent economic recovery and monetary accommodation, with the adverse scenario taking the corporate vulnerability indicators back to the levels observed at previous crisis episodes. These results are consistent with the outcome of the banking sector solvency stress tests, where the majority of losses emanate from corporate credit risk.

136. Several factors drive the corporate sector responsiveness. More detailed stress test results in Appendix VI reveal an interplay of the following key factors:

- *Severity of then adverse scenario.* The adverse scenario is more severe than the recent crisis episodes with a cumulative nominal output loss of about 10 percent and sovereign yields remaining near historic highs for the duration of 3 years.
- *Monetary accommodation.* While the monetary conditions remain accommodative as is reflected in historically high ICRs, the baseline scenario envisages some tightening in outer years while the adverse scenario does not allow for further accommodation.
- *Profitability.* Corporate profitability has been supported by cyclical factors and remains structurally below pre-crisis levels.

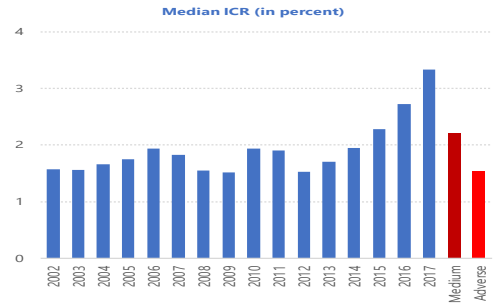
- *Concentration of debt.* Corporate debt is concentrated in low-profitability and low-ICR categories. In a low interest rate environment shocks can have unproportionately large effects.

D. Conclusions

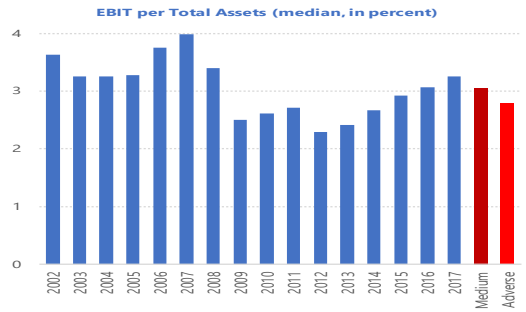
137. The Italian corporate sector remains vulnerable. The non-financial corporate sector in Italy has been gradually recovering in the aftermath of the twin crises. Inflows of corporate bad loans has declined sharply, remaining above the pre-crisis levels, while accommodative monetary policy has contributed to nearly doubling the ICRs in four years. Nevertheless, profitability is still below the pre-crisis average and net investment is slow to recover. Corporate debt is concentrated near low-ICR and low-profitability segments and thus vulnerable to shocks. The stressed environment erodes fully the gains from monetary easing, lowering the ICR close to historical lows. In response, the share of vulnerable firms as well as debt-at-risk increase to their earlier crisis-driven peaks. This indicates that corporate sector remains an important source of vulnerabilities that can exacerbate asset quality concerns for the banking sector.

Figure 29. Corporate Sector Stress Test

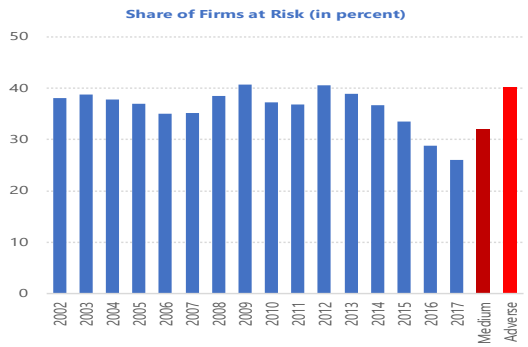
Debt service capacity of corporates improved markedly in recent years of exceptional monetary accommodation.



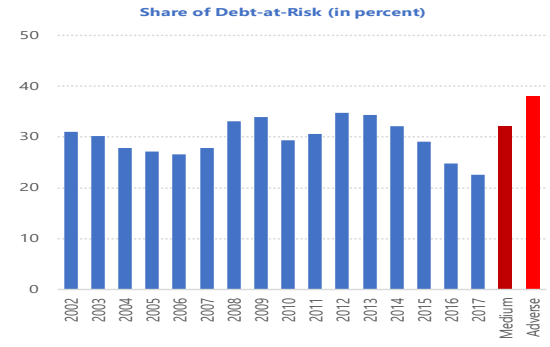
Profits have gradually risen, but they are still below their pre-crisis average, leaving firms exposed to interest shocks.



Combined profit and interest rate shocks take median ICRs and the share of firms-at-risk to crisis years....



...potentially raising the share of debt-at-risk to just below 40 percent.



Sources: CERVED; and IMF staff estimates.

INTERCONNECTEDNESS ANALYSIS

138. The interconnectedness analysis examined domestic interbank and inter-sectoral financial linkages as well as cross-border spillovers. Financial interlinkages across different sectors in Italy is based on quarterly flow-of-funds data published by the Bank of Italy. To examine potential spillover effects across domestic banks, network test based on bank-by-bank balance sheet supervisory data follows Espinosa-Vega and Solé (2011). Cross-border spillovers are assessed using two complementary approaches: a) balance-sheet based analysis applies the Espinosa-Vega and Solé (2010) methodology to Bank for International Settlements (BIS) Consolidated Banking Statistics on cross-border bank exposures; and b) market-data based contagion stress tests uses data on daily equity returns of stock price indices (total market and banking sector indices, separately) and sovereign CDS, and follows the methodology developed by Diebold and Yilmaz (2014).

139. Direct domestic interbank contagion is limited, but exposures of Italy's financial sector to the government and the nonfinancial corporate sector remain a key source of risk. The network analysis of interbank interconnectedness suggests very limited risk of contagion within the banking system owing to small interbank exposures. However, the flow-of-funds analysis indicates cross-sectoral contagion risk owing to: (i) growing cross-sectoral exposures; (ii) the significant role of the government bond market for banks, nonbanks (particularly insurance firms), and foreign investors; (iii) indirect links of households to sovereign risk intermediated through the financial system; and (iv) important direct links of banks, households and nonresidents to corporate debt. Furthermore, contagion risk within the banking sector could be triggered by confidence effect, but this effect is not considered in this analysis.

140. Cross-border linkages for Italy are high, but net outward spillovers have recently declined. Italy's banking system embraces significant inward and outward cross-border spillovers, particularly with respect to other European countries. While Italian stock markets, bank returns, and sovereign CDS spreads have historically been net shock transmitters of stress, their importance as net shock originators declined since May 2018 and increased as net shock receivers. This suggests that shocks originating externally are becoming increasingly relevant to the Italian financial system. Foreigners have been selling Italian securities, while domestic residents have continued to build their net foreign asset position, thus exposing Italy relatively more to external shocks. [53]

A. Inter-sector Financial Linkages

141. This section analyzes macro-financial interlinkages, sectoral dependencies, and related vulnerabilities for all resident sectors. The approach uses the quarterly flow-of-funds data published by the Bank of Italy (via Haver) covering the period 1995:Q1–2018:Q1 to map balance sheet exposures among the various sectors. The analysis focuses on two periods: (i) 2008:Q1–2012:Q2, which tracks the evolution of sectoral interlinkages from just before the GFC to after the

[53] Portfolio outflows intensified in 2018:Q2-Q3 totaling €72 billion, about 80 percent of which were related to government securities.

GFC and before the announcement of the Outright Monetary Transactions (OMT) program; and (ii) 2012:Q2–2018:Q1, which covers the period after the introduction of the OMT program to the latest date available at the time of this analysis.

142. The analysis includes eight institutional sectors comprising main non-financial sectors and financial subsectors (see Appendix VII). In particular, the non-financial institutional sectors include: Government (GOV), Non-financial Corporations (NFC), Households and Non-profit Institutions Serving Households (HH) and the Rest of the World (RoW). The financial sector comprises the following subsectors: Bank of Italy (BdI), Other Deposit-taking Institutions (MFI),[54] Insurers and Pension Funds (INP), and Other Financial Institutions (OFI). Furthermore, 13 broad financial instruments categories are used, which aggregate a total of 29 financial instruments.[55] See Table 16 for a detailed view of the financial instruments and their relative shares in total assets/liabilities.

Table 16. Italy: Financial Accounts by Financial Instruments, 2018:Q1

ECB Code	Financial Instrument	Total assets/liabilities EUR Million	% share
F1	Monetary Gold and SDRs	98880.0	0.6
F2	Currency and transferable deposits	2416822.0	14.7
F29	Other deposits	1574671.0	9.6
F32	Bonds	3484970.0	21.2
F31	Short-term securities	130959.0	0.8
F41	Short-term loans	629123.0	3.8
F42	Medium-term and Long-term loans	1949574.0	11.9
F51	Shares (listed/ unlisted) and other equity	2845765.0	17.3
F52	Investment fund shares or units	1089773.0	6.6
F6	Insurance, pension and standardized guarantee schemes	1038056.0	6.3
F7	Financial Derivatives and employee stock options	240995.0	1.5
F8	Other accounts receivable/ payable	921787.0	5.6
F81	Trade credits and advances	718846.0	
F89	Other accounts receivable/ payable, excluding trade credits and advances	202941.0	
	Total	**16421375.0**	**100.0**

Sources: Banca d'Italia (via Haver) and IMF staff calculations.
Note: This table aggregates assets/liabilities across all institutional sectors. Shares are highlighted using a color scale, where the largest is red and lowest is green.

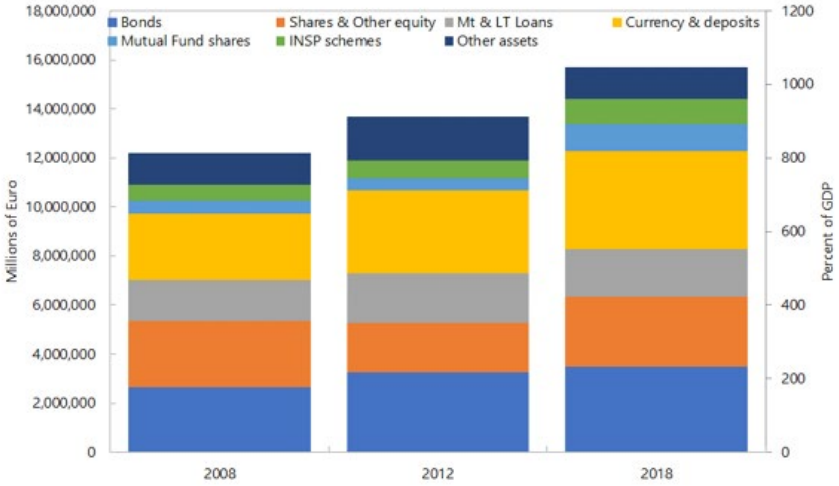
143. Balance sheets and intersectoral exposures in Italy have grown over time (Figure 30). The overall amount of inter-sectoral balance sheet exposures stood at approximately 905 percent of gross domestic product (GDP) in 2018:Q1, up from 665 percent in 2008:Q1. Considering intra-sectoral exposures, the sum of total assets stood at 1020 percent of GDP in 2018:Q1, up from 775 percent in 2008:Q1. During 2008–12, exposures increased mainly through bank purchases of government bonds, and through an increase in currency and deposits. In the following period, 2012–16, the increase was driven by a rise in equity holdings issued by NFCs, banks, and nonresidents, an increase in currency and transferable deposits, and due to a rise in mutual fund shares.

[54] MFIs are deposit-taking corporations except the central bank, including money market funds (MMFs). This includes Poste Italiane Bancoposta, which is a postal bank. We use the terms banks and MFIs in this section interchangeably.

[55] This classification follows that of the ECB's "Financing and investment dynamics" statistics.

144. The structure of inter-sectoral exposures by financial instruments has been largely stable over time, and is dominated by government securities, cash and deposits, equity and loans (Figure 30). In 2018:Q1, currency and deposits were nearly a quarter of total issued instruments and include as main participants MFIs, households, and the rest of the world. Bonds were the second largest components of total issued instruments, where central and local government bonds accounted for 60 percent of total bonds issued.[56] Equity instruments, mainly issued by NFCs were nearly 17 percent of total issued instruments.

Figure 30. Increase in Intersectoral Exposures, 2008:Q1–2018:Q1



Source: Banca d'Italia (via Haver).

145. Government is the largest net borrower, followed by corporates, while the household sector has the largest net financial assets. Government's net borrowing has been gaining prominence over time and increased from 87 percent of GDP in 2008:Q1 to 135 percent in 2018:Q1. As in 2008:Q1, NFCs' liabilities to their counterparties remained at 125 percent of GDP in 2018:Q1, although they have declined in absolute terms. Households provide a significantly large amount of funding to the economy, while the financial system intermediates credit between ultimate lenders and ultimate borrowers (Figure 31).

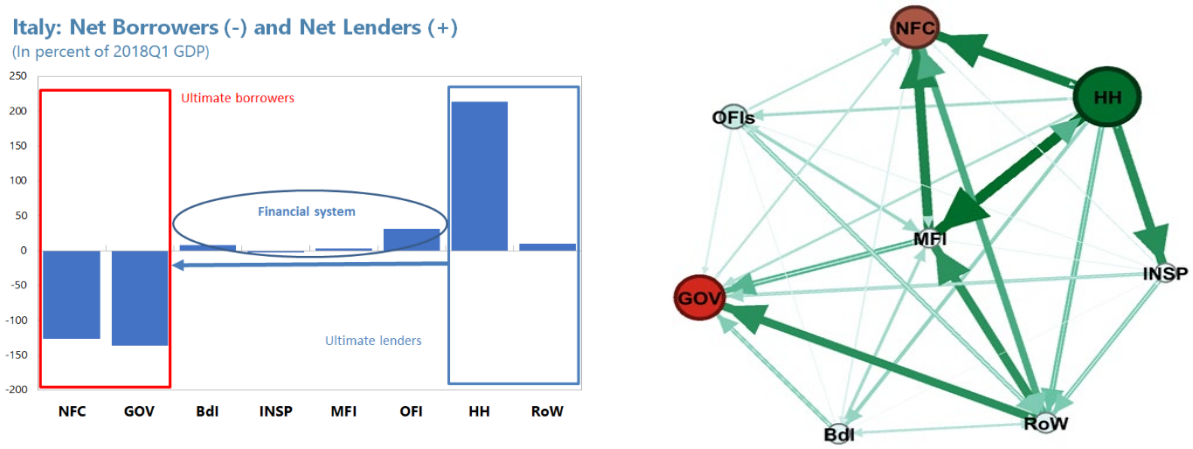
146. Driven by an increased in financial assets, the net financial position of households increased over time (Figure 31). Moreover, households shifted their asset portfolios away from deposits in banks and government bonds and towards corporate equities, insurance and pension funds, and investments abroad.

Pension funds and insurance companies mainly channel funds from households to the government and investments abroad (Figure 32). At 2018:Q1, around 87 percent of pension funds' and insurance companies' funding came from households. More than 45 percent of their

[56] The share of bonds issued by the RoW in total bonds issued is 16 percent, followed by MFI bonds at 14 percent in 2018:Q1.

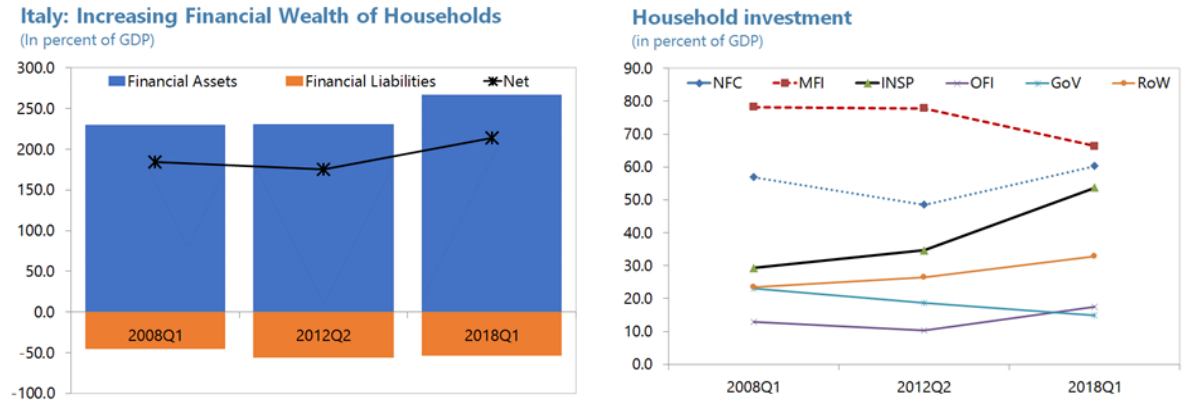
assets were invested abroad in foreign currency bonds and equities, and an additional 34 percent in domestic government securities, making Italy's insurance sector particularly exposed to sovereign risk.

Figure 31. Net Borrowers and Lenders, 2018:Q1



Source: Banca d'Italia (via Haver).
Note: In the figure on the RHS, red nodes represent net borrowers and green nodes net lenders. The diameter of nodes and thickness of arrows show the relative size of imbalances and exposures, respectively.

Figure 32. Increase in Households' Net Financial Wealth



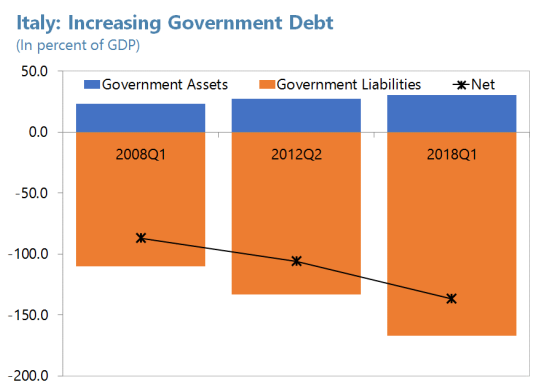
Sources: Banca d"Italia (via Haver) and IMF staff calculations.

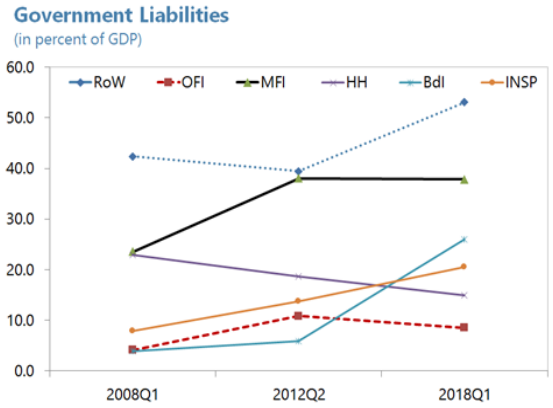
147. The flow of funds data indicates significant real-sovereign and financial sector-sovereign linkages in Italy (Figure 33).

- **Italy's financial sector holds more than half of the government's liabilities at 2018:Q1.**[57] The government's borrowing pattern has changed over time; the government's external borrowing decreased during 2008–12 while the holdings of government of the domestic financial system (MFIs and OFIs) increased, contributing to a strong sovereign-bank balance sheet nexus. Since 2012, the Bank of Italy stepped in as a major creditor through the implementation of monetary policy. Sovereign exposures of the insurance companies and pension funds has also increased from 8 percent of GDP in 2008:Q1 to 21 percent of GDP in 2018:Q1.

- **Households' direct exposure to the government has declined, although it is now intermediated through the financial system.** Households' direct exposures to sovereign debt is low (5.5 percent of households' assets), however, they are indirectly exposed to sovereign risk through their exposures to the financial sector, particularly to MFIs and insurance and pension funds.

Figure 33. Government Assets and Liabilities





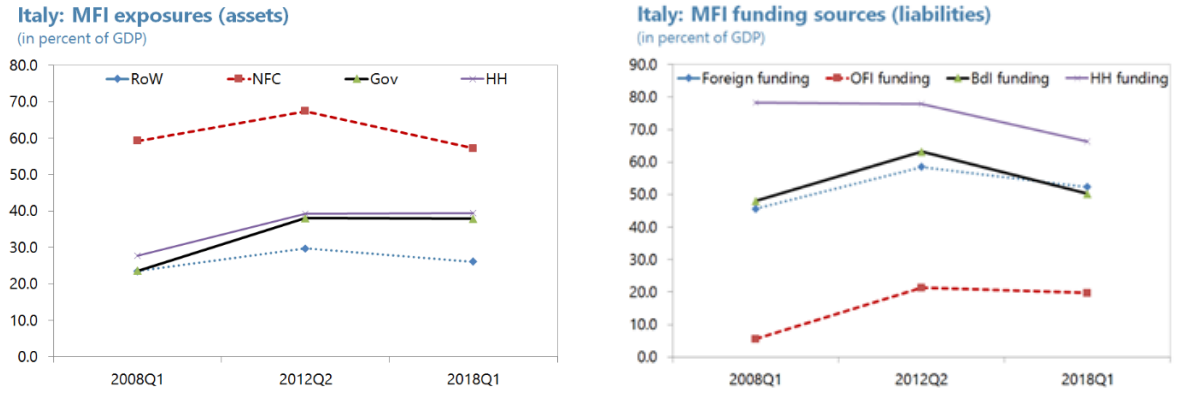
Sources: Banca d"Italia (via Haver) and IMF staff calculations.

148. The Italian banking sector remains connected to various real sector entities through financial claims and obligations. Between 2008–12, banks' balance sheets expanded supported by the monetary stimulus, whereas banks' balance sheets have shrunk since 2012. Households have large financial claims on the banking sector relative to their balance sheets (close to 25 percent). Although household deposits have increased, banks' total funding from households has declined due to a decline in investment by households in MFI bonds during 2012–18. Banks' sovereign

[57] The estimates for the gross liabilities of the government sector in the flow-of-funds is significantly larger than the official gross government public debt data because of: (i) a larger set of financial instrument included in the former; and (ii) the use of nominal valuation for the official definition of public debt versus market valuation for the flow-of-funds.

exposures and lending to the nonfinancial sector increased between 2008–12, however, given the corporate sector vulnerabilities, exposures to NFCs have declined thereafter (Figure 34). Nevertheless, financial obligations of NFCs to banks continue to be significant, constituting one quarter of banks' total assets.

Figure 34. MFIs' Assets and Liabilities



Sources: Banca d'Italia (via Haver) and IMF staff calculations.

149. NFCs' net borrowing position remained broadly unchanged but a significant disintermediation out of the bank lending channel occurred during 2012–18 (Figure 35). Despite a sustained decline of corporate bank lending between 2012–18, corporate liabilities have been rebounding with a more prominent role of funding from abroad and direct financing of corporates by households (largely in the form of shares and equities), which forms a key component of households' financial wealth.

150. Cross-border interlinkages are significant (Figure 36).

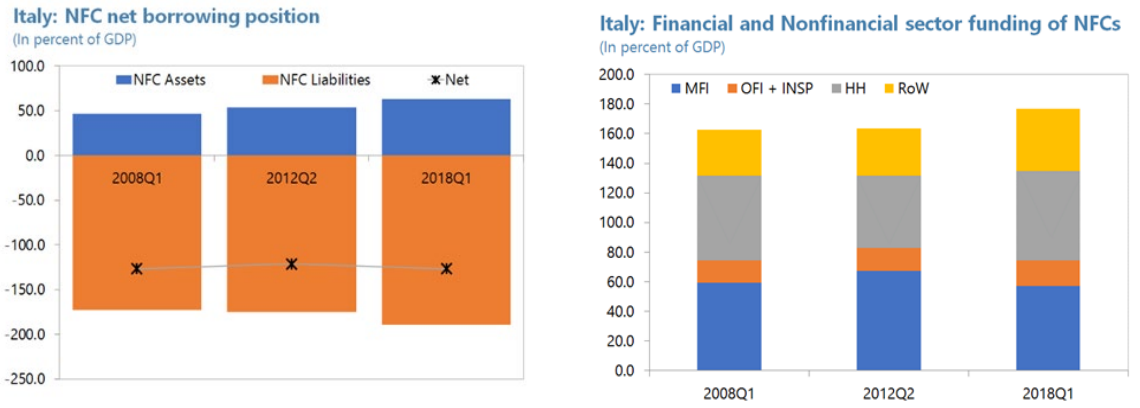
- **Cross-border integration has increased overtime, but net foreign financing has been on a downward trend.** Italy's Foreign assets increased from 107 percent of GDP in 2008:Q1 to 162 percent of GDP in 2018:Q1, whereas foreign liabilities increased from 130 percent to 171 percent.[58]

- **The composition of Italy's cross-border linkages has changed.** The increase in foreign assets since 2012 has been driven more by foreign investment of Italian nonbank institutions, including insurance and pension funds, and NFCs and households, and less by Italian banks. Similarly, the increase in foreign liabilities has been driven by an increase in foreign participation in Italian government bonds after 2012:Q2 and in NFCs, as opposed to foreign exposure to Italian banks prior to 2012.

[58] Net external financing declined from 22 percent of GDP in 2008 to close to 10 percent of GDP in 2018.

- **RoW is an important source of government funding**. While international creditors retreated from investing in Italy's sovereign debt after the GFC, their investment in Italian sovereign bonds has picked up again since 2012:Q2, increasing from 40 percent to 53 percent of GDP in 2018Q1. External financing accounts for 31 percent of the government's total funding.

Figure 35. NFCs' Funding Structure



Sources: Banca d"Italia (via Haver) and IMF staff calculations.

Figure 36. Italy: Cross-border Integration

Sources: Banca d'Italia (via Haver) and IMF staff calculations.

151. Intra-sector exposures are important for corporates. NFCs hold large amounts of equity and short-term funding in the form of trade credit from other NFCs. At 2018:Q1, close to 43 percent of total intra-corporate exposures is composed of shares and equity, and the remaining as trade credit and loans. The large balance sheet exposures (at 47 percent of GDP in 2018:Q1) within the corporate sector may represent a contagion channel if corporates fail to service reciprocal claims, possibly spilling over to the financial sector should default rates on corporate loans pick up. A corporate stress test was conducted to assess the financial resilience of Italian nonfinancial corporate sector (see Section on corporate stress test).

B. Interbank Network

152. The risk of contagion within the Italian banking system is assessed using a network model (Espinosa-Vega and Solé, 2010).[59] The starting point of the analysis is the construction of a matrix of bilateral interbank exposures. The algorithm tracks the domino effects of bank defaults triggered by hypothetical credit and funding shocks to each bank, with the round of contagion ending when there is no more bank default. A bank is assumed to default when the bank's CET1 ratio drops below 4.5 percent of risk-weighted assets, which is the regulatory requirement.[60] In the simulation, the default of a bank affects other banks through both asset and liability exposures. From the asset side, the loss given default of 100 percent is applied. On the liability side, the exercise assume that banks are forced to sell their assets at a discount to replace the lost funding, incurring additional loss. Specifically, the parameters used in the funding shock implies that only 65 percent of the lost funding can be replaced, and banks need to sell their assets with the valuation loss of 50 percent to cover the lost funding. The main advantage of this approach is that we can directly identify the sources of spillovers and estimate the impact of spillovers on the banking system. The caveat is that contagion happens instantaneously, and it assumes that there is no time for banks to take measures to mitigate the negative effects of spillovers in between each round of contagion.

153. The matrix of direct interbank exposures contains the eleven SIs and sixty-two LSIs. The interbank matrix, which includes interbank loans and securities, is based on supervisory data and covers each bank's interbank assets and liabilities vis-a-vis each of the other 72 banks as of end-June 2018 (Figure 37). Data on off-balance sheet exposures and interbank equity and capital participation is not available and therefore was not included in the analysis.

154. Interbank loans and securities exposures among the 72 banks are found to be small (1.05 percent of banking system assets and 1.6 percent of GDP; Figure 38). About half of the interbank exposures consists of interbank loans, with the other half consisting of interbank

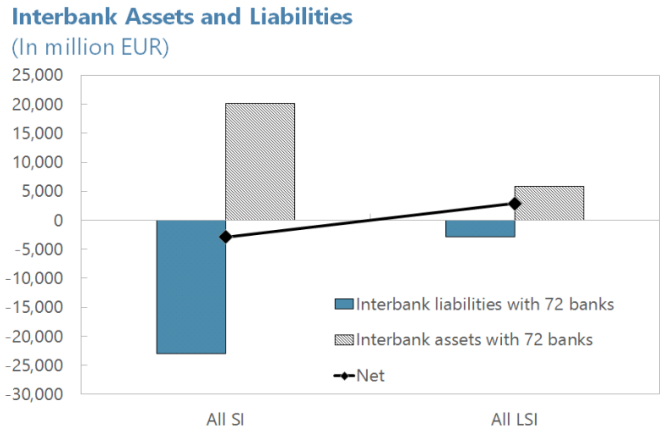
[59] The Espinosa-Vega and Solé (2010) has been used in many recent European FSAPs, including Spain (2017), Germany (2016), Ireland (2016), and Italy (2013).

[60] The objective is to resolve a bank when there is still positive equity. According to Basel III capital and liquidity rules, all banks must have a minimum CET1 to risk-weighted assets (RWA) ratio of 4.5 percent by 2019.

securities. The majority of the interbank assets and liabilities are vis-à-vis the SIs, comprising 89 percent and 78 percent of total interbank assets and liabilities, respectively.

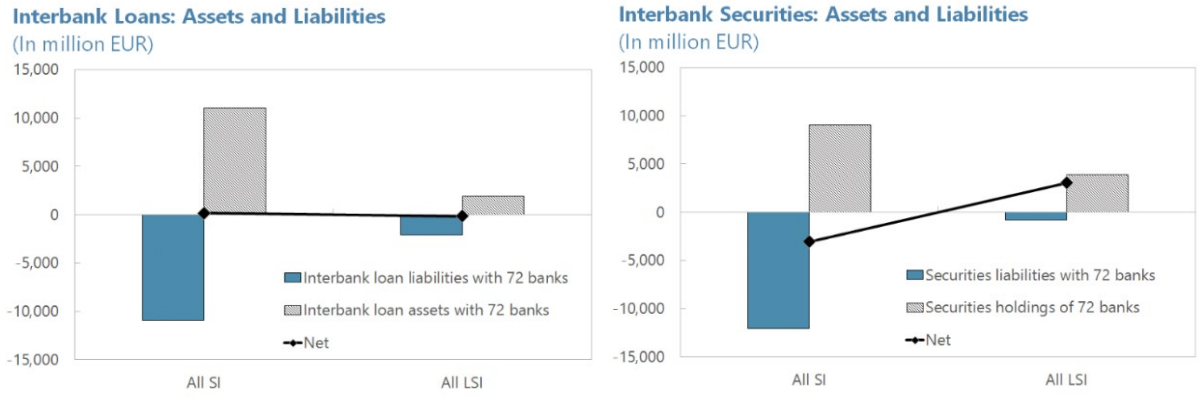
155. On an aggregate basis, LSIs are net lenders in the interbank market, while SIs are net borrowers (Figure 39). As LSIs' main source of funding is retail deposits (i.e., lower funding costs), they are the main lenders in the interbank market to SIs (85 percent of their total interbank assets), as well as to other LSIs. Looking at the interbank securities and loans market separately, LSIs hold securities issued by SIs, however, SIs are net lenders in the interbank loans market, lending mostly to other SIs.[61] By June 2018, about 28 percent of the banking system in terms of assets are net borrowers.

Figure 37. Net Lenders and Borrowers in the Interbank Market



Sources: Banca d"Italia and IMF staff calculations.

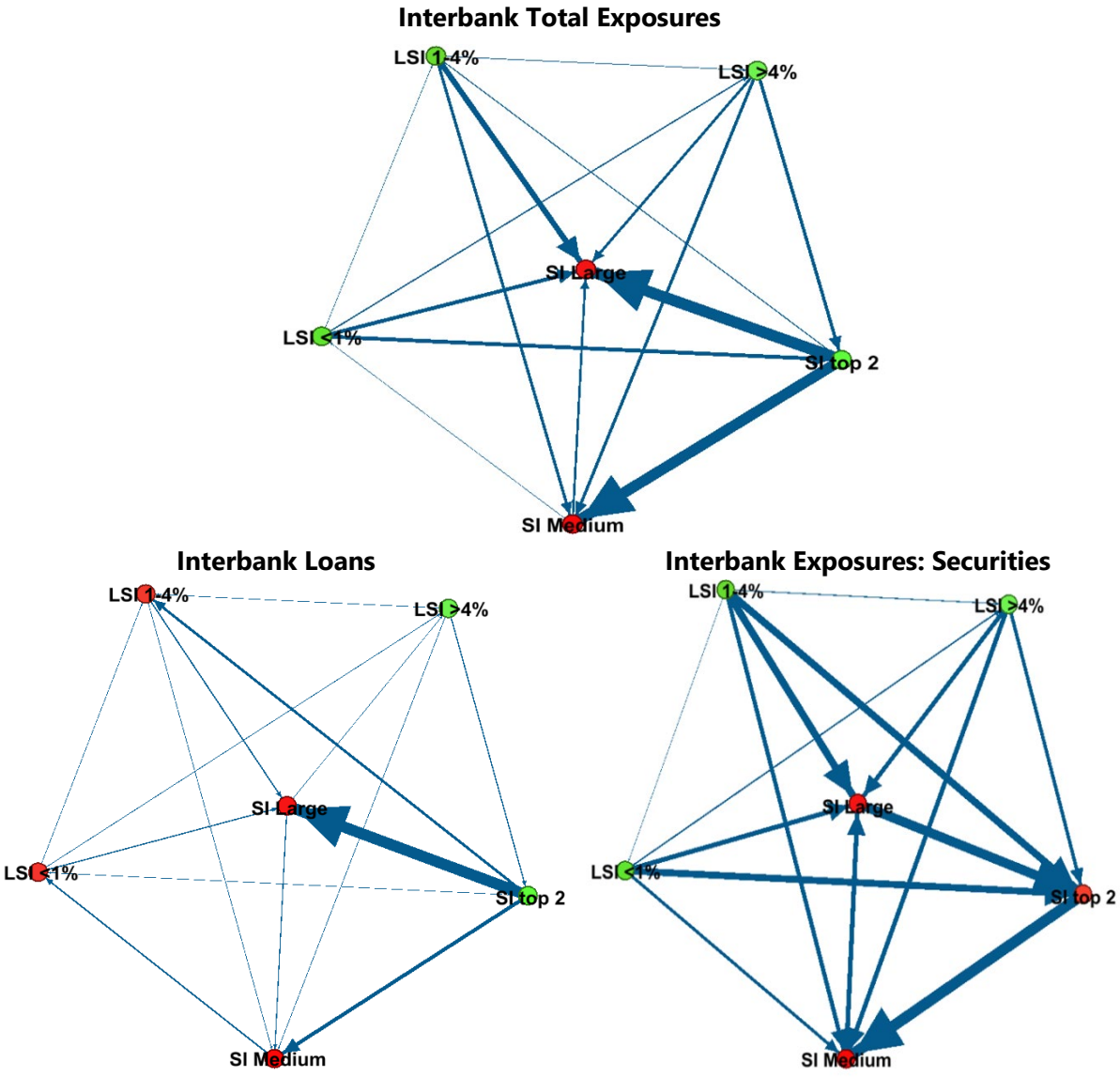
Figure 38. Net Position of Italian Banks: Interbank Loans and Securities



Sources: Banca d"Italia and IMF staff calculations.

[61] SIs also lend mostly to other SIs (90 percent of their total interbank assets), and five amongst the eleven are net lenders.

Figure 39. Interconnectedness in the Interbank Market



Sources: Banca d'Italia and IMF staff calculations.
Note: Red nodes represent net borrowers and green nodes net lenders. The thickness of arrows shows the relative size of net exposures, and the direction of the arrow captures the direction of net connectedness. LSIs are divided into three categories: '<1 percent' that have share of assets less than 1 percent in total LSI assets, '1-4 percent', and '>4 percent' with share of assets above 4 percent in total LSI assets. SIs are divided into three categories: 'top 2' with the highest share of assets, 'Large' (3 banks) that have share of assets above 5 percent in total SI assets, and 'Medium' (6 banks) that have share of assets less than 5 percent in total SI assets in the sample.

156. The balance-sheet based network analysis reveals that contagion risks stemming from interbank exposures are very limited. The results reveal that banks in general have sufficient capital to withstand interbank contagion through their direct balance-sheet exposures. However, the derivatives exposures and off-balance sheet interbank exposures were not included in the analysis (equivalent to 5.6 percent of total assets and 8.5 percent of GDP). The general results are robust to the changes in the parameter values and different combination of shocks (i.e., credit only, or credit

plus funding shocks). These simulations consider only effects arising from individual bank defaults, and do not measure the larger systemic implications arising from simultaneous distress in many banks.

157. The smaller LSIs are most vulnerable to interbank spillovers (Table 17). The smaller LSIs—with less than 1 percent asset share in total LSI assets—are most vulnerable to interbank spillovers because of their relatively low level of capital against interbank exposures. As SIs play a significantly larger role in interbank exposures, they are the most systemically important—a hypothetical default of a SI could, on average, reduce the capital of other banks by 9.3 percent (Figure 40).[62] LSIs, in contrast, are the most vulnerable, as they would lose the highest share of initial capital (on average, across all simulations) due to interbank contagion. In eleven simulations where each of the SIs defaulted, four SIs triggered the default of one LSI, and one SI triggered the default of 3 LSIs.[63] In sixty-two simulations where each of the LSIs defaulted, one LSI triggered the default of another LSI.

Table 17. Italy: Average Loss in Capital Under Shock Scenario
(Group Maximum)

	# banks	aggregate share in total assets (%)	Index of contagion 1/	Index of vulnerability 2/
LSIs	62			
<1 percent	37	14	0.36	4.94
1-4 percent	18	37	0.24	1.39
>4 percent	7	49	0.49	0.6
SIs	11		9.26	1.84

Note: LSIs are divided into three categories: '<1 percent' that have share of assets less than 1 percent in total LSI assets, '1-4 percent', and '>4 percent' with share of assets above 4 percent in total LSI assets.
1/ It measures how much the hypothetical default by a bank in the group could reduce the capital of other banks on average (i.e., the average loss for other 72 banks following the default of a bank in the group).
2/ It measures how much a bank in the group could lose on average from the hypothetical defaults of other 72 banks (i.e., the average loss for a bank in the group across 72 simulations).

[62] The index of vulnerability, which is the percentage point of average capital loss due to the default of all other institutions, would be 5 percent at most.

[63] One LSI defaulted in two simulations.

Figure 40. Results: Interbank Exposures

Figure 1. Network Analysis - Number of Induced Failures

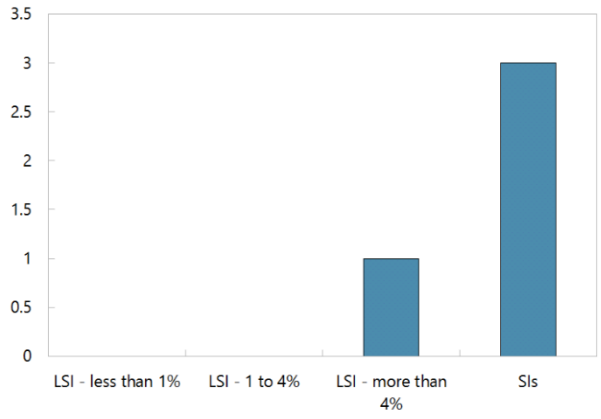


Figure 2. Network Analysis - Vulnerability Level 1/

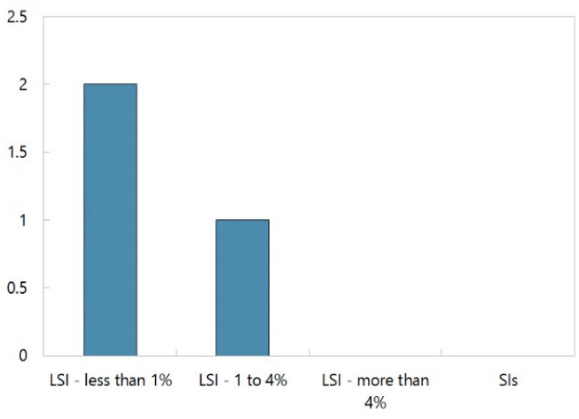


Figure 3. Index of Contagion 2/

(In percent)

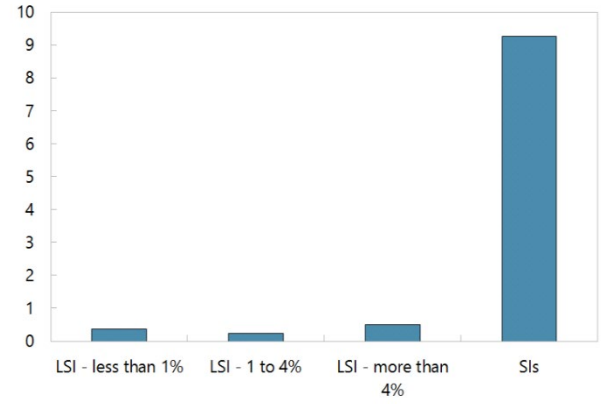
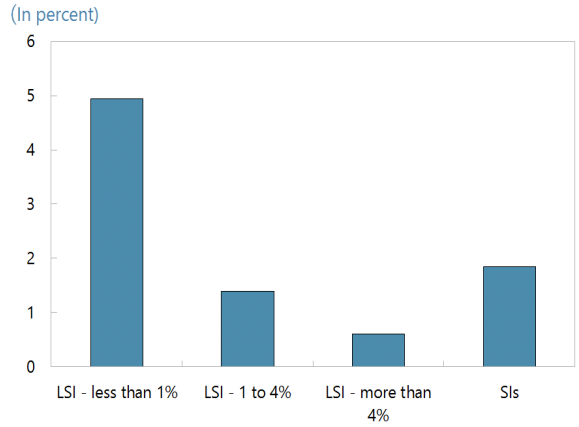


Figure 4. Index of Vulnerability 3/

(In percent)



Sources: Banca d'Italia and IMF staff calculations.

Note: The 62 LSIs have been aggregated into 3 categories: (i) 'LSI—less than 1 percent' are those LSIs that have share of assets at less than 1 percent of total LSI assets (consisting of 37 banks and constitute 14 percent of total LSI assets); (ii) 'LSI—1 to 4 percent' with asset share between 1 to 4 percent of total LSI assets (consisting of 18 banks and constitute 37 percent of total LSI assets); and (iii) 'LSI—more than 4 percent' with asset share more than 4 percent of total LSI assets (consisting of 7 banks and constitute 49 percent of total LSI assets).

1/ Number of simulations in which each bank fails.

2/ Total capital impairment in other banks due to the failure of each bank (percentage of the original total capital in other banks).

3/ Average capital impairment of each bank due to the failure of other banks (percentage of the original capital in the banks).

C. Cross-border Interconnectedness

158. Contagion risks and cross-border interconnectedness are assessed using two complementary approaches. The first approach applies the Espinosa-Vega and Solé (2010) methodology to examine cross-border bank exposures and direct banking sector linkages, using the BIS Consolidated Banking Statistics (CBS). The second approach uses the Diebold and Yilmaz (2014) methodology with daily equity returns of stock price indices (total market and banking sector

indices) and sovereign CDS, to examine the interconnectedness between Italy and countries with strong financial and trade linkages with Italy, capturing potential indirect channels of contagion through market prices.

Network Analysis Based on BIS CBS

Evolution of Italy's Cross-Border Exposures

159. Among Italian banks, the largest bank, UniCredit, has more than half of its financial assets abroad, whereas the second largest bank, Intesa Sanpaolo has close to one-fifth of its assets abroad (Figure 41). Italian subsidiaries are systemically important for some banking systems across Europe. UniCredit Banca SPA is highly reliant on revenues from its international operations. In 2017, 53 percent of UniCredit's net revenues were generated by its international operations, and 21 percent of Intesa Sanpaolo's net revenue also came from abroad. The high reliance on foreign subsidiaries in revenue generation could imply significant vulnerabilities if the economic and financial conditions in host countries were to deteriorate.

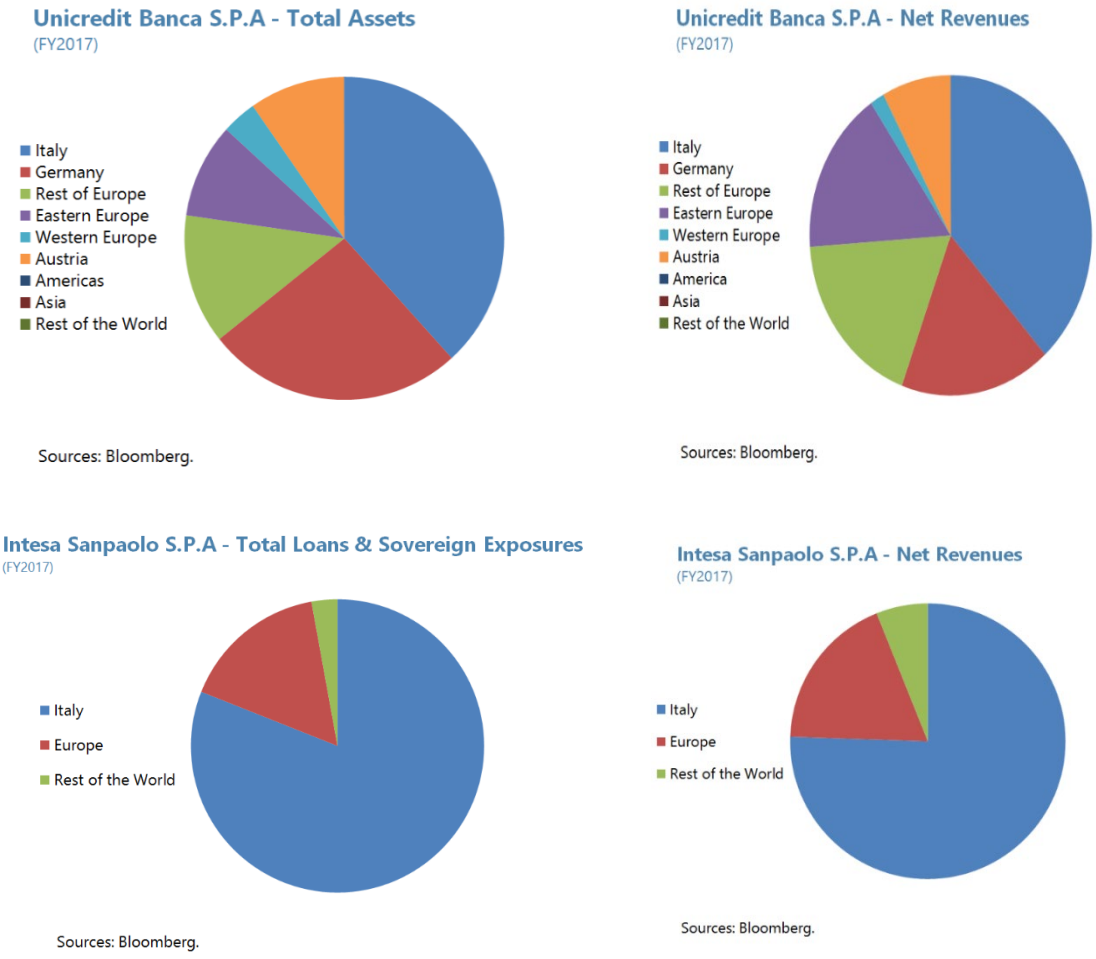
160. The FSAP team used the CBS data from the BIS to analyze the nature of foreign exposures of Italian banks. The CBS cover reporting banks' worldwide consolidated international claims, both on an "immediate borrower" and an "ultimate risk" basis (Appendix VIII).[64] The latter considers risk transfers, such as hedges and other guarantees. The CBS is informative on the type of exposures by sector, the extent of pure cross-border claims versus local claims, and the funding patterns for the local operations for banks.

161. Italian banks' foreign claims are concentrated in Germany, Austria, Spain, France, the United States and the United Kingdom, with exposures mostly to households and corporates. Total consolidated foreign claims of Italian banks stood at US$0.65 trillion in 2018:Q2, with 53 percent of the claims against foreign nonbank private sector, followed by the public sector (22 percent) and banks (Figure 41). While Italian banks' claims on Germany are highest based on total exposure, their claims on the public sector are highest in Spain.

162. Claims on Italy are concentrated in banks headquartered in France, Germany, Spain, the Kingdom of the Netherlands-Netherlands and the United States (Figure 42). Total foreign banks' claims on Italy stood at about US$0.66 trillion in 2018:Q2, about 53 percent of which are against Italian nonbank private sector with the remaining against the public sector (30 percent) and banks. French banks' claims on the Italian nonbank private sector, Italian banks, and public sector is significantly larger than others, at close to 62 percent, 42 percent, 32 percent of total foreign claims in these sectors of Italy.

[64] This includes the following: (i) cross-border claims booked by banking offices outside the counterparty country, (ii) local claims booked by banking offices inside the counterparty country in foreign currency, and (iii) local claims booked by banking offices inside the counterparty country in local currency.

Figure 41. Geographical Breakdown of Italian Global Banks

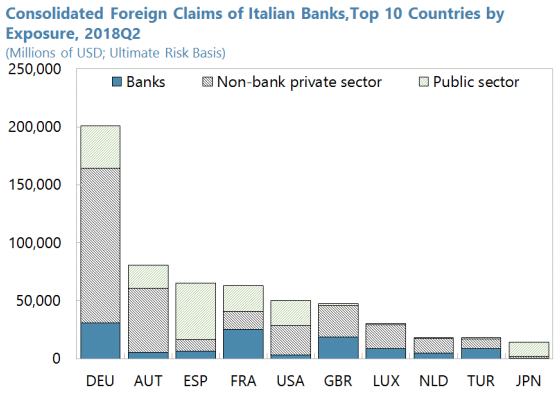


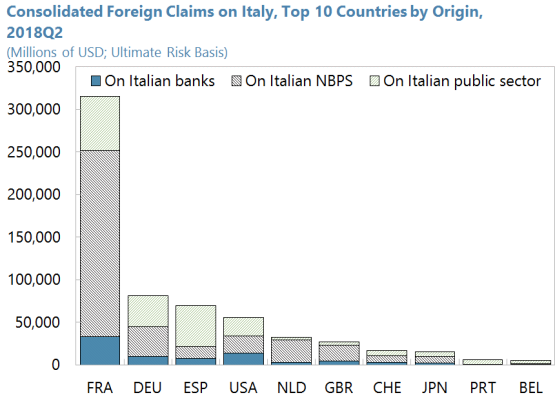
Source: Bloomberg, Annual Reports.

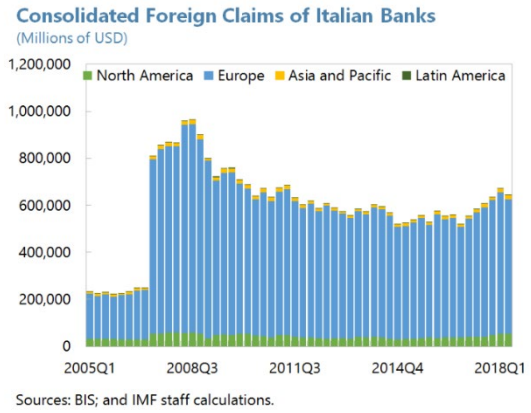
163. In line with the total exposures, German, Spanish and French banks hold largest positions in Italy's official sector, while Dutch bank investments are concentrated in other sectors. Moreover, a few EA-significant institutions hold extremely large positions in Italian sovereign assets. Aside from Italian banks, SFIL (France), Dexia NV (Belgium) and Caixa Central de Crédito Agrícola Mútuo (Portugal) display the largest exposures relative to their CET1 equity. In absolute terms, Dexia NV (Belgium) and BNP Paribas (France) have the largest exposures, with around 20 billion euros each. Moreover, a few EA insurers, topped by Italy's Generali, also feature large exposures to Italian sovereign debt.

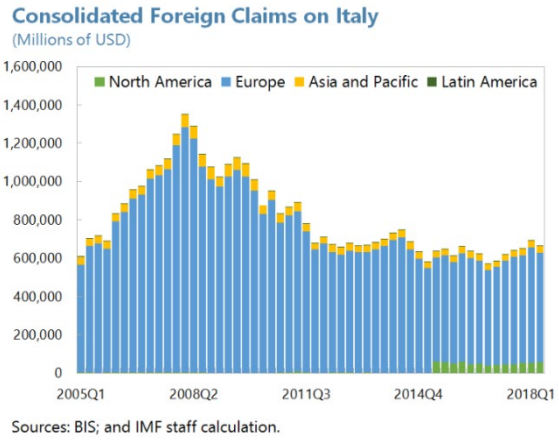
164. Both Italian banks' international claims as well as foreign banks' claims on Italy have declined since the GFC and the European Sovereign Debt Crisis. The largest declines in these claims were vis-à-vis Europe (Figure 42), with declines in the consolidated foreign claims on Italy related largely to cuts in foreign banks' debt exposures to Italian banks and the sovereign.

Figure 42. Consolidated Foreign Claims of Italian Banks and on Italy, 2018:Q2









Source: BIS Consolidated Banking Statistics (Ultimate Risk Basis).

Methodology

165. The network analysis by Espinosa-Vega and Solé (2010) tracks the cross-border reverberation of a credit event or liquidity squeeze from a country's banking system via bilateral claims across countries. The Espinosa-Vega and Solé (2010) methodology can provide useful insights on the resilience or vulnerability of Italy's banking system in relation to other banking systems, capturing the impact of both outward and inward spillovers.

166. Two sets of simulations are conducted using the BIS-CBS for 2018:Q2.[65] The first simulation applies to reporting banks' exposure to foreign banks only, considering both credit and funding shocks. The second considers the impact of credit shock to the total exposure of the

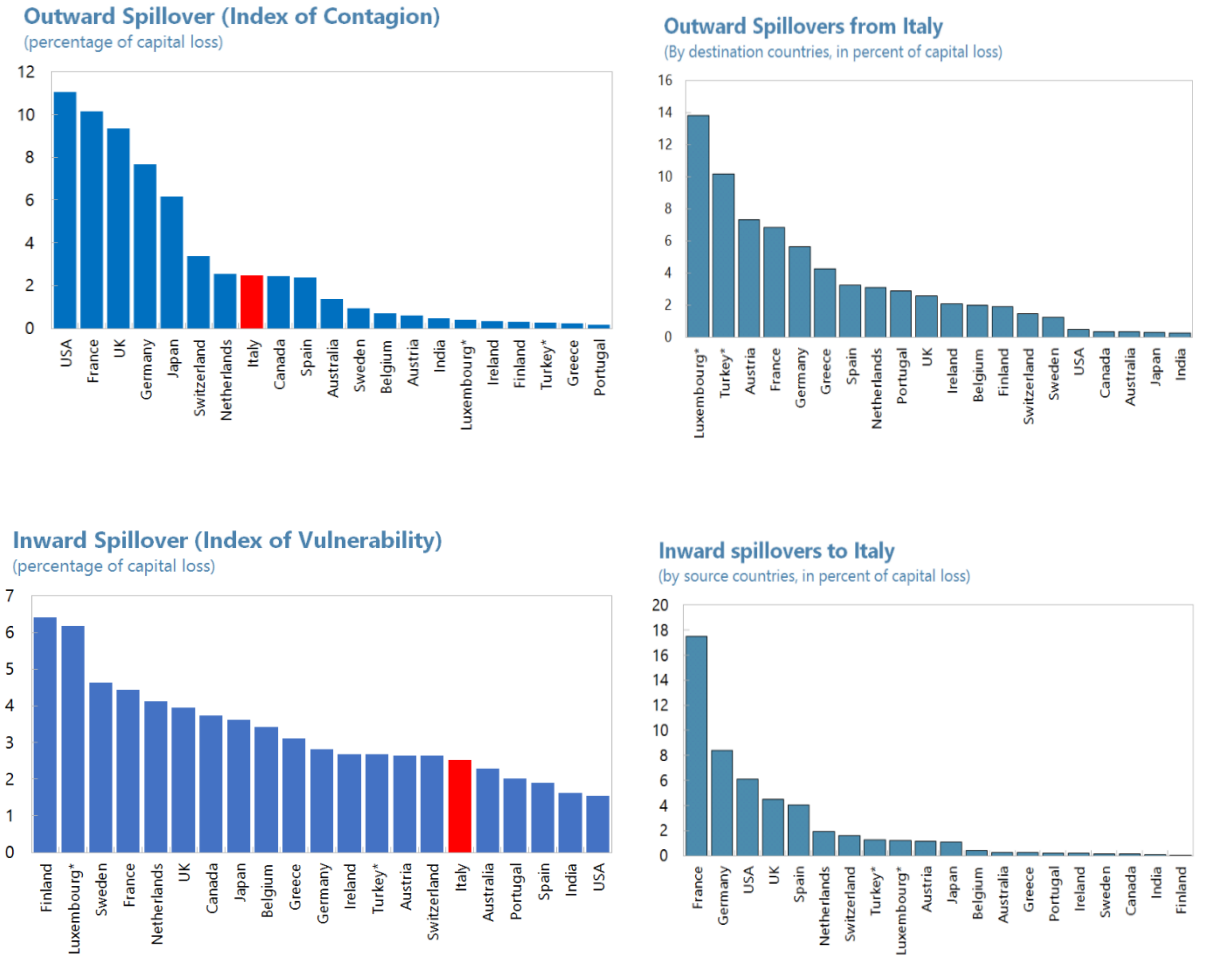
[65] The simulation sample consists of 21 countries: Austria, Australia, Belgium, Canada, Switzerland, Germany, Spain, Finland, France, the United Kingdom, Greece, Ireland, India, Italy, Japan, Luxembourg, The Kingdom of the Netherlands-Netherlands, Portugal, Sweden, Turkey and the United States. Please note that the data availability for Luxembourg and Turkey is relatively low.

banking sector, including claims to banks, government and the nonfinancial sector. The assumptions and the parameters used in the test are same as in the interbank network analysis.

167. Network analysis (the first simulation) suggests that the Italian banking sector is closely linked to other European banking systems through interbank exposures (Figure 43). Credit and funding shocks in the Italian banking sector have the largest outward spillover to banks in Luxembourg, Turkey and Austria, as measured by the percentage of capital loss in a banking system due to the default of all bank-to-bank exposures. In terms of inward spillovers, banks in France, Germany, the United States, the United Kingdom, and Spain have the largest impact on the Italian banking sector.

Figure 43. Outward and Inward Spillover of the Italian Banking Sector[1]

(Simulation 1: Bank Exposure, Credit and Funding Shocks, Consolidated Banking Statistics)



Source: IMF staff calculations. Results are based on the Espinosa-Vega and Solé (2010) approach and BIS Consolidated Banking Statistics (ultimate risk basis) for 2018:Q2.

[1] Index of contagion is the percent of total capital losses in the system due to the failure of each country's banking, while index of vulnerability shows the average of capital losses of each country's banking system due to the failure of all other banking systems. *Limited data availabilities for Luxembourg and Turkey, which may underestimate the impact for these two countries.

168. The second simulation with total exposures shows that credit shocks originating from France, Germany, Spain and the United States would have the largest impact on Italian banks (Figure 44). As seen in Figure 43, most of Italian banks' foreign claims are against the nonbank private sector. In this case, France remains an important source of credit shock for Italian banks. In addition, Italian banks' exposures in Germany, Spain, and the United States could also be significant for the transmission of credit shocks, due to the large claims on the nonbank private sector and the public sector in these countries. Not surprisingly, the degree of inward spillover to Italian banks is higher when all exposures are considered, compared to bank exposure only.[66] Similarly, countries with sizable exposures to Italy are affected most by outward spillover from Italy.

Contagion Analysis using Market Data

Methodology

169. The connectedness measure developed by Diebold and Yilmaz (2014) decomposes the variation in an asset's volatility into contributions from shocks to other assets.[67] A financial market spillover from country A to country B is broadly defined as the share of the variation in country B's equity return shocks that can be attributed to *contemporaneous* or *preceding* shocks in country A's equity returns. The pattern and direction of transmission of financial stress among countries is analyzed using measures of *gross* contribution and *net* contribution.[68] A higher size of *gross* contribution indicates greater transmission of financial spillovers (i.e., higher interconnectedness). A negative value of *net* contribution indicates that the bank is a net recipient of financial spillovers.

170. The analysis uses daily market information on stock (total market and banking sector) and sovereign CDS and covers 19 countries, containing those with strong financial and trade linkages with Italy.[69] Stock prices reflect a forward-looking assessment of agents who monitor, and are possibly well-informed about, fundamental linkages and interconnections among banks and other FIs. Therefore, the analysis of stock returns' (or their volatilities') co-movement reflects market perceptions about risks and their transmission. The analysis quantifies three types of linkages: (i) the

[66] In the last few years, there has been an increasing investment by Italian households and insurance and pension funds in foreign investment fund shares, where close to 3/4 of these are concentrated in Luxembourg due to regulatory and tax advantages.

[67] The Diebold and Yilmaz (2014) approach has been used widely in recent European FSAPs, including Spain (2017), Germany (2016), Ireland (2016), United Kingdom (2016) and Norway (2015) and in the April 2016 Global Financial Stability Report (GFSR).

[68] Gross contribution of each country is a total (average) of the country's outward spillovers to the global financial system and the inward spillover to the country from the global financial system. Net contribution of each country is a difference between the country's total outward spillover to the global financial system and the inward spillover to the country from the global financial system.

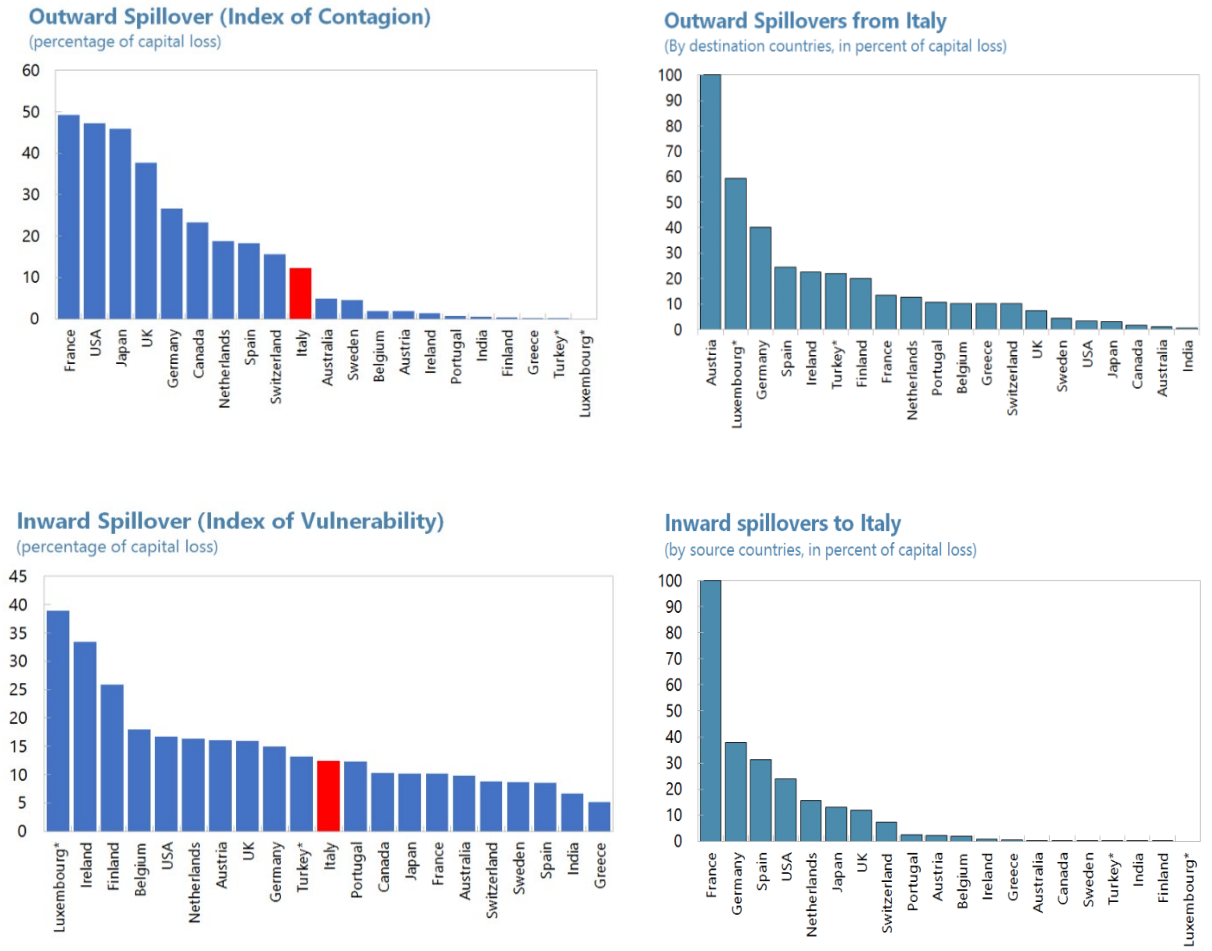
[69] The empirical sample consists of Australia, Brazil, Chile, China, France, Germany, India, Italy, Japan, Mexico, the Kingdom of the Netherlands-Netherlands, Portugal, Spain, Switzerland, Sweden, Turkey, Russia, the United Kingdom and the United States.

cross-border interconnectedness across different countries' banking sectors; (ii) the interlinkages across stock indices; and (iii) cross-border interlinkages between sovereign CDS.

171. The data source was the MSCI and the DataStream indices from July 2005 to October 2018 at daily frequency (Appendix IX). To control for the differences in trading hours due to time zones, equity returns are computed as the average two-day log returns for equity prices (see, for example, Forbes and Rigobon, 2002; and GFSR, April 2016b).[70]

Figure 44. Outward and Inward Spillover (Total Claims)[1]

(Simulation 2: All Exposures, Credit Shock, Consolidated Banking Statistics)



Source: IMF staff calculations. Results are based on the Espinosa-Vega and Solé (2010) approach and BIS Consolidated Banking Statistics (ultimate risk basis) for 2018:Q2.

[1]Index of contagion is the percent of total capital losses in the system due to the failure of each country's banking, while index of vulnerability shows the average of capital losses of each country's banking system due to the failure of all other banking systems. * Limited data availabilities for Luxembourg and Turkey, which may underestimate the impact for these two countries.

[70] We treat holidays and missing observations as follows: we remove a day if more than half of the entities have missing data. We then interpolate the remaining missing observations. Due to many missing observations, we had to exclude Netherlands from the banking sector equity spillover analysis.

172. While the methodology can capture linkages from various channels, it cannot identify causality and sources of spillovers. The methodology has advantages that the necessary data are publicly available, and it is easy to incorporate other financial assets into the analysis. The key caveats are that the methodology cannot identify causality or the source(s) of spillovers. In addition, the methodology does not distinguish the direction of co-movement in equity prices; negative and positive equity price responses to shocks are measured in the same way based on this methodology. However, this methodology is meant to complement the analysis based on balance sheet data. The convergence between the results of the two sets of analysis is a reassuring factor.

Results

173. Italian banks are highly connected with European banks from Spain, France, Germany, the United Kingdom, and Portugal (Figure 45). Both inward and outward spillovers between Italy and these countries is significant. The strong linkages could be attributed to the strong balance sheet linkages as shown in the BIS exposure data and macroeconomic, monetary policy, and financial regulations interlinkages. The banking indices from Spain, France, and the United Kingdom appear to be the source of return connectedness for Italian banks, while Portugal, Germany and Sweden are found to be the recipients.

174. Italian banks appear to be an important source of net return connectedness in the global banking system (Figures 46 and 47). The net directional connectedness of equity returns is captured by the difference between the outward spillover to the global banking system from the country's banking index and the inward spillover to the country from the system. Together with France, Spain and the United Kingdom, Italian banks are found to be an important net contributor to return connectedness in the global banking system. The bank equity indices in the United States, Sweden, Brazil and Germany also appear to be important sources of return connectedness, while banks in Asia and Latin America (other than Brazil) tend to be the recipients of return connectedness.

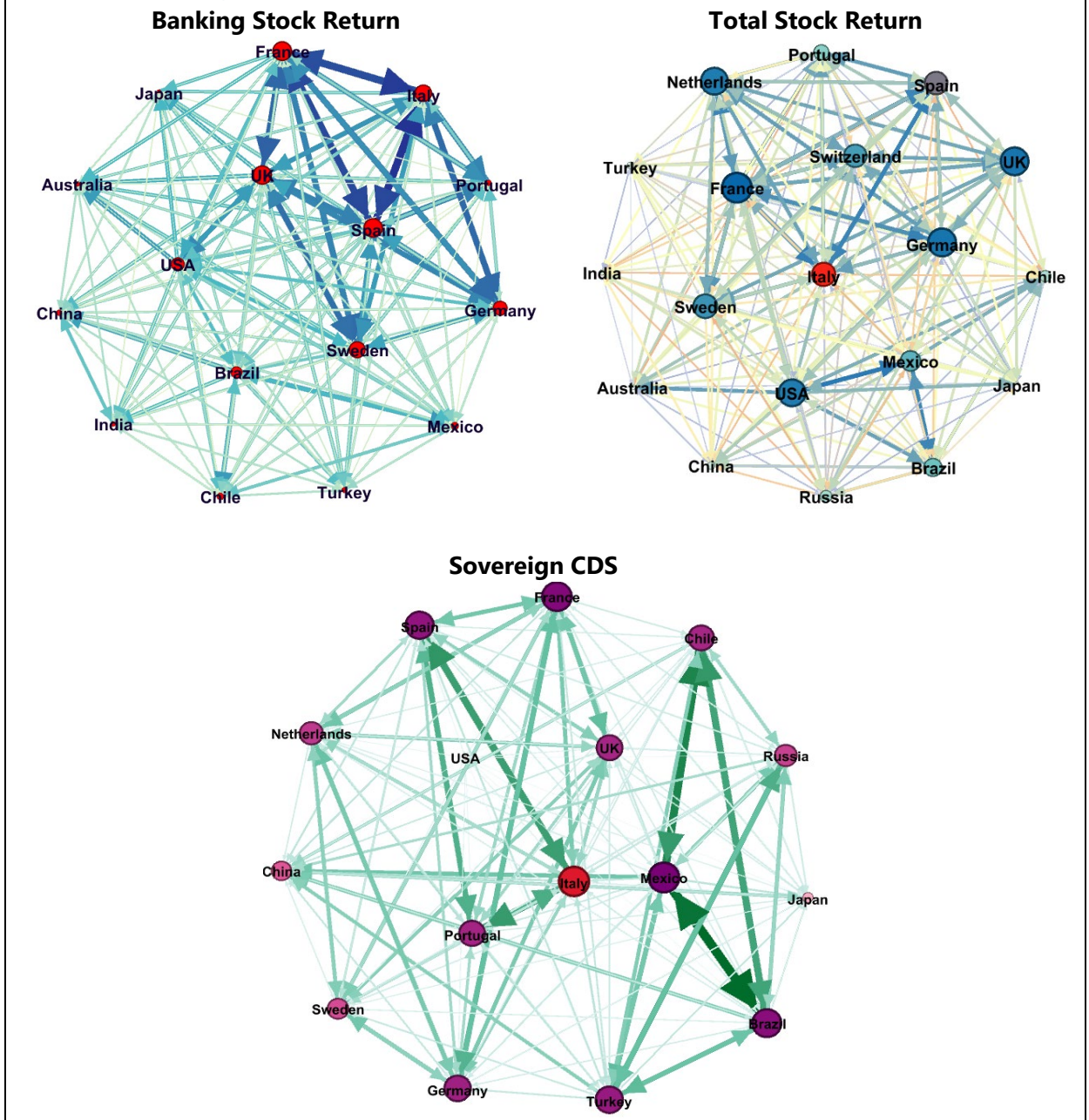
175. Italy's net outward spillovers to total stock market prices is also significant, but relatively lesser than across the global banking system. France, the United States, Germany, the United Kingdom and the Kingdom of the Netherlands-Netherlands are the largest net contributors to return connectedness in global stock markets, followed by Sweden and then Italy. Italy's financial markets are important net contributors to stock markets in Asia, as also seen for the Italian banking sector.

176. The spillover matrices do not differ significantly when applied to the total stock market index or to the bank stock indices. This may reflect that the financial sector plays an important role in country indices, but mainly that international spillovers may not significantly differentiate between sectors and their idiosyncrasies, creating implicitly intersectoral contagion.

177. Italy's sovereign credit risk is a major source of spillover to global CDS markets. Italian sovereign CDS is the second largest net contributor to sovereign CDS markets, only after Mexico. Italian sovereign CDS appears to be the source of net spillovers to all countries in the sample and

shows very tight inward and outward spillover connections to its neighbors, particularly to Spain and Portugal, in CDS markets.[71] There is strong regional clustering, as the inward and outward sovereign credit risk spillovers from Italy are likely to spread mainly within the EA.[72]

Figure 45. Cross-Border Interconnectedness Across Sectors



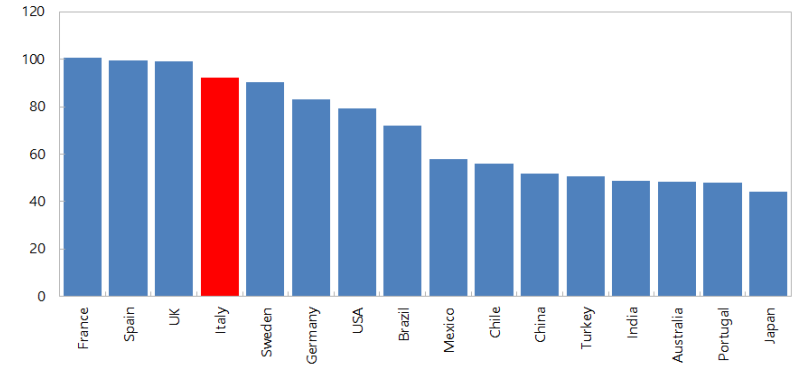
Note: Full sample return connectedness. The thickness of the edges reflects the size of both inward and outward spillovers. The size of the nodes reflects total connectedness in the respective sector.

[71] Except for Brazil and Mexico, where the net spillover (outward minus inward spillovers) is close to zero.

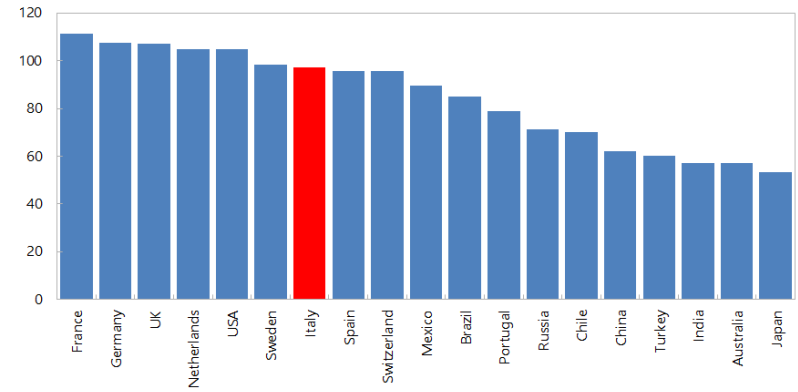
[72] Regional clustering is a common feature in this literature and other market-based network analysis applications.

Figure 46. Gross Contributions to Systemic Risk

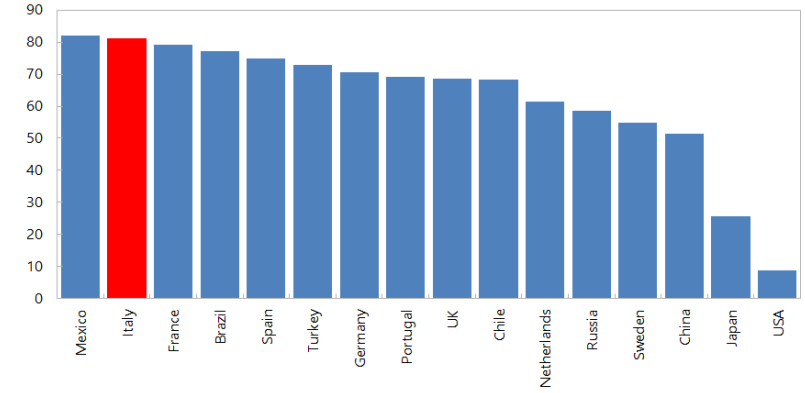
Gross Connectedness: Equity Returns of Banking Indices



Gross Connectedness: Equity Return on Total Stock Market Index

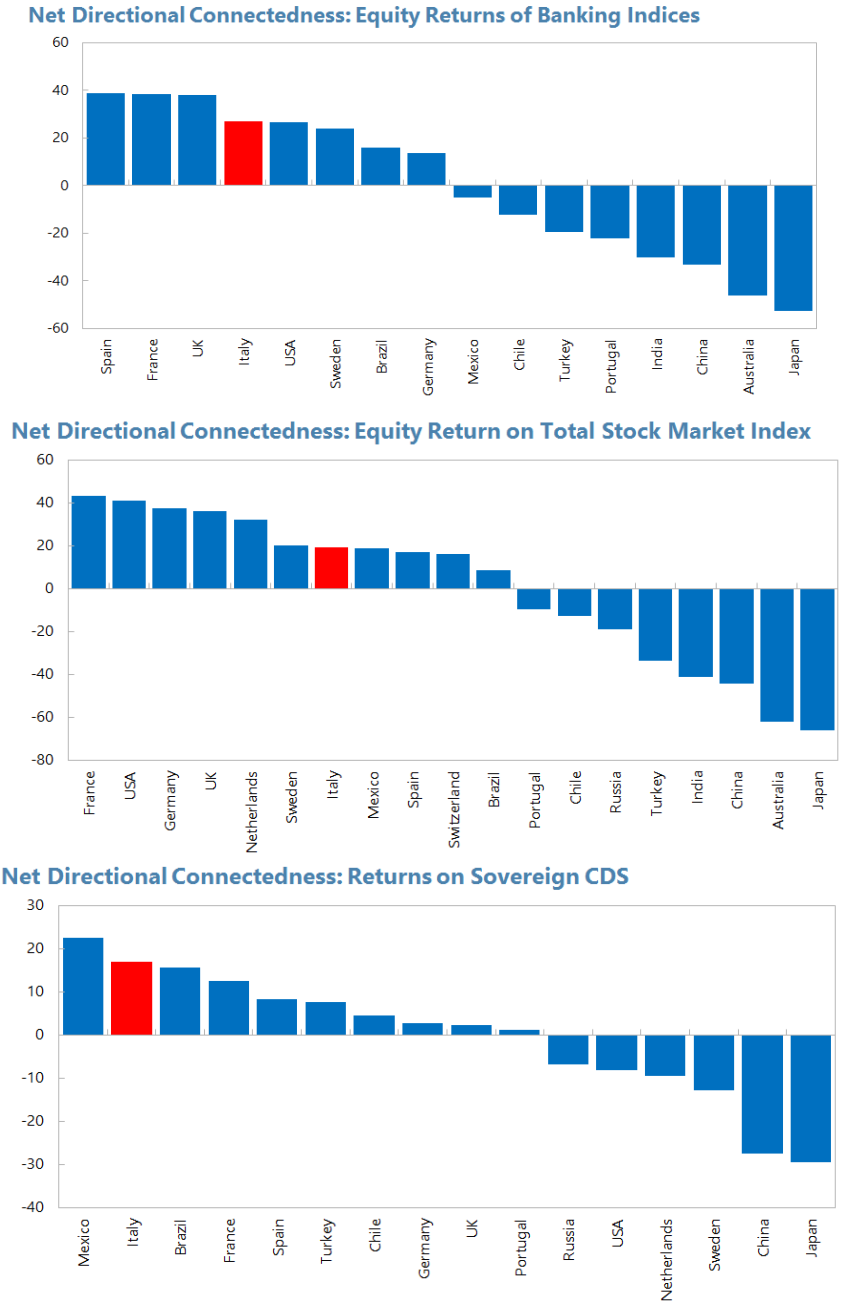


Gross Connectedness: Returns on Sovereign CDS



Source: IMF staff calculations. Results are based on the Diebold and Yilmaz (2014) approach using daily (log) returns in stock indices (total and banking) and sovereign CDS from July 2005 to October 2018.
Note: Gross contribution of each country is a total of the outward spillover to the system from the country and the inward spillover to the country from the system.

Figure 47. Net Contributions to Systemic Risk

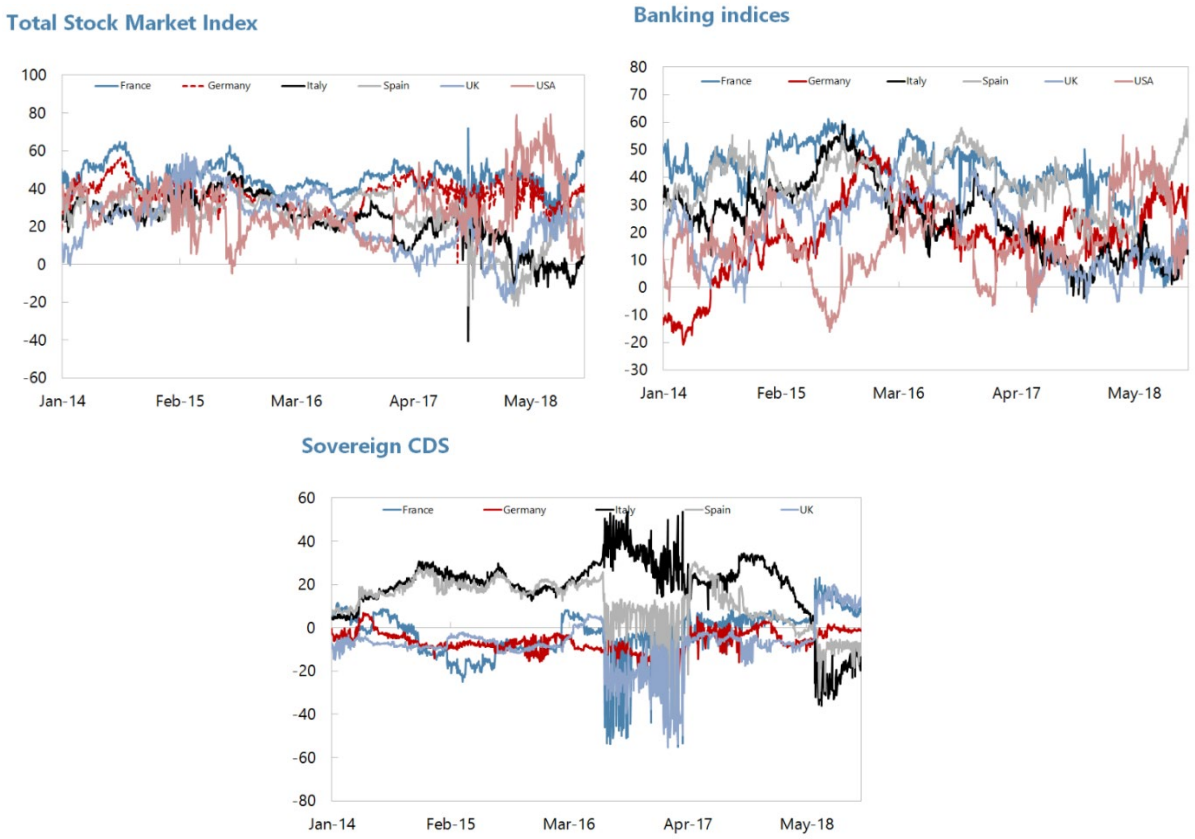


Source: IMF staff calculations. Results are based on the Diebold and Yilmaz (2014) approach using daily (log) returns in stock indices (total and banking) and sovereign CDS from July 2005 to October 2018.
Note: Net contribution of each country is a difference between the outward spillover to the system from the country and the inward spillover to the country from the system.

178. Net outward spillovers from Italy have been on a decline since early 2018 (Figure 48). Italian stock markets, banks and sovereign CDS have historically been net shock transmitters to stress in the financial system. However, since May 2018, there is a growing importance of the returns on Italian stocks and sovereign CDS as net shock receivers and less as net shock originators, suggesting that externally originating shocks, particularly shocks from Spain, the United Kingdom,

France and Germany, are becoming stronger and increasingly more relevant to the Italian financial system as sources and conduits of financial shocks. However, net outward spillovers from the Italian banking sector remained positive during the Italian election period in the first half of 2018 and have also started to pick up in other markets since September 2018.

Figure 48. Dynamics in Net Return Connectedness



Source: IMF staff calculations. Results are based on the Diebold and Yilmaz (2014) approach using daily (log) returns in stock indices (total and banking) and sovereign CDS from July 2005 to October 2018.
Note: Net contribution of each country is a difference between the outward spillover to the system from the country and the inward spillover to the country from the system.

Appendix I. Risk Assessment Matrix

Table AI.1. Italy: Risk Assessment Matrix

Risk	Overall Level of Concern	
	Relative Likelihood	Expected Impact if Materialized
Sharp rise in risk premia. An abrupt deterioration in market sentiment (e.g., prompted by policy surprises, renewed stresses in emerging markets, or a disorderly Brexit) could trigger risk-off events such as recognition of underpriced risk. Higher risk premia cause higher debt service and refinancing risks; stress on leveraged firms, households, and vulnerable sovereigns; disruptive corrections to stretched asset valuations; and capital account pressures—all depressing growth.	High	High • Significantly higher borrowing costs for the sovereign leading to devaluation of sovereign bonds and bank losses . • Commensurate rise in banks funding, further squeezing profitability and leading to a forced deleveraging or further underprovisioning.
Weaker-than-expected global growth. Idiosyncratic factors in the U.S., Europe, China, and stressed emerging markets feed off each other to result in a synchronized and prolonged growth slowdown. In Europe, weak foreign demand, Brexit, or concerns about some high-debt countries makes some euro area businesses delay investment, while faltering confidence reduces private consumption. Inflation expectations drift lower, and the region enters a prolonged period of anemic growth and low inflation.	High	Medium • Slower output growth, slow-down in potential output. • Lower growth weakening public debt sustainability • Weaker investment and persistent long-term employment further damaging private balance sheets, leading to further formation of NPLs.
An increase in Italy-specific risk premia and a widening of spreads relative to other Euro-area sovereigns, due to continued political uncertainty harming confidence and reducing investor appetite.	Medium	High • Higher borrowing costs for the government, with little support from the ECB as the rest of the Euro Area emerges from the crisis. • Large losses on bank balance sheets due to their sovereign exposures, leading to deleveraging and exacerbating the downturn. • Higher borrowing costs for the private sector, as banks shift higher costs to customers.

Appendix II. Stress Testing Matrix (STeM)

Banking sector: Solvency Stress Test		
Domain	Assumption	
1. Institutional Perimeter	Exercise	• Top-Down by FSAP team.
	Institutions included	• All SIs (9) in the sample and select LSIs (62 institutions). The latter are only subject to sensitivity analysis.
	Market share	• Total coverage is around 76 percent, with 68 percent for SIs and 8 percent for LSIs.
	Data and baseline date	• Latest data: December 2018 for SIs and June 2018 for LSIs. • Supervisory data: balance sheet information, COREP and FINREP, Short Term Exercise (STE), Expected Default Frequency sourced from Moody's Analytics and large exposure (LE) templates provided by the authorities. Also provided was further supervisory information, among others, non-performing loans by portfolio, PDs by portfolio (excluding consumer loans) from credit register, PDs for consumer loans from CRIF (an Italian private company specializes in provision, management and operation of credit bureau) and details of funding and lending rate by type of asset and funding portfolios. The data also includes transparency templates for banks in the 2019 EBA stress test sample and the equivalent data for banks not in the EBA sample but which underwent a similar stress test by ECB. • Market and publicly-available data. • Scope of consolidation: banking activities of the consolidated banking group for banks having their headquarters in Italy. • Coverage of sovereign and non-sovereign securities exposures: fair value accounts (FVTPL and FVTOCI) and valued respectively at amortized cost (AC).
2. Channels of Risk Propagation	Methodology	• FSAP team satellite models and methodologies. • Balance-sheet regulatory approach. • Baseline and adverse scenario use fully load IFRS 9 capital ratios, i.e., the capital ratios used for the stress tests reflect banks capital ratios as if transitional arrangement for IFRS 9 had not been applied. • Market risk is treated as an add-on component, with a separate calibration. The market risk stress scenario has an impact on both capital resources (either via profit and loss or via Other Comprehensive Income (OCI)) and capital requirements (RWA). The impact on capital resources comprise of positions in the trading book as well as other fair

		valued items in the banking book. The impact on RWA for market risk evolve with balance sheet assumptions. • The losses for securities portfolios are based on duration approach. For equities and associated hedges, we utilize the floor as set by the EBA methodology: ΔEq=1.5*(-0.20%(〖Eq〗^Long+〖Eq〗^Short)) • For the IRB portfolios, provisions are calculated for all major asset classes. These include mortgage, financial institution, corporate large firms, corporate SMEs, and consumer loans. Expected losses are equal to the product of projected point-in-time PDs and LGDs, and projected exposure at defaults. Point-in-time PDs are projected using regression models with macro variables as independent variables. The PDs used for provisioning (impairment charges) are PiT whereas PDs used to project RWAs are TTC. The credit risk for standardized exposures is estimated by projecting new flows of NPL using PD projection. The PiT LGD is based on historical recovery rates of NPLs, both from internal workout and disposal. The provisioning rates for standardized exposures are also calculated based on the LGD estimation from this analysis. The same PiT LGD is used for baseline and adverse scenario, which represented a conservative assumption during the baseline. • For credit risk associated with fixed-income instruments, we differentiate between amortized cost (AC) and fair value holdings. The credit risk associated with fair value holdings are embedded in the market risk methodology: The change in a security's price (and the resulting capital impact) reflects changes due to risk-free rate movement or changes in credit risk premia. For AC securities, provision is calculated for any increase in credit risk associated with a security.
	Stress test horizon	• 2018:Q4–2021:Q4 (3 years)
3. Tail Shocks	Scenario	• A baseline scenario based on the April 2019 WEO macroeconomic projections; • An adverse scenario that captures the key risks in the RAM. This scenario is designed using staff's Global Macrofinancial Model (GFM) and feature the risks discussed in the text.
	Sensitivity analysis	• Single-factor sensitivity tests further assess the resilience of the banking sector to shocks. These include concentrations risk for SIs, where the banks' top 3 to 5 exposures are assumed to fail, and three factors shocks for LSIs: interest rate risks (IRRBB), a decrease in the prices of sovereign bonds, as well as credit losses associated with asset quality deterioration.

		• Sensitivity analysis on the increase in the RWA of SME loans (SIs only).
4. Risks and Buffers	Risk covered	• Risks covered include credit, market (equity, exchange rate and interest rate risks), sovereign (repricing and spread risks) and funding risks, and interest rate risk on the banking book. • Concentration risks by sensitivity analysis.
	Behavioral Adjustment	• For the growth of the banks' balance sheet over the stress-test horizon, a quasi-static approach is used. Asset allocation and the composition of funding remain the same, whereas the balance sheets, which are based on total assets amount net of provision, grew in line with the nominal GDP path specified in the stress test scenario. However, to prevent the banks from deleveraging, the rate of change of balance sheets was set at a floor of zero percent. This constraint is binding in the adverse scenario. • In projecting RWAs, standardized and IRB portfolios were differentiated. For the standardized portfolios, RWAs changed due to the balance sheet growth, 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, the projected through-the-cycle-PDs for each asset class/industry was used to calculate new average risk weights. • Interest income from non-performing loan is not accrued. • We assume that banks do not issue new shares or make repurchases during the stress test horizon. Dividends are assumed to be paid out at 30 percent of current period net income after taxes (i.e., only if net income is positive) by banks that were in compliance with supervisory capital requirements.
5. Regulatory and Market-Based Standards and Parameters	Calibration of risk parameters	• Based on credit models estimated by IMF staff. • The stress test made use of satellite models to project credit risk by portfolio for exposures in Italy. PiT PDs of each assets classes are projected using the PDs series from credit register at system wide level (except PD for consumer loans which is sourced from CRIF, a private company specializes in provision, management and operation of credit bureau). The PDs are the flow of new nonperforming loan from outstanding performing loan in the previous position. The projected PDs are attached to each bank using the last point PDs as starting point. TTC PDs was estimated using the average PDs over 8 quarters. For standardized banks, the projected PDs are used to estimate the projected NPLs of each bank.

		• For exposure outside Italy, the stress test made use of satellite models to project credit risk for corporate (including SME and specialized lending), mortgage, and consumer loans portfolios for certain countries where Italian banks have significant exposures. The Moody's EDF data was used to project the PDs.
	Regulatory/ Accounting and Market-Based Standards	• National regulatory framework. • Basel III regulatory minima on CET1 (4.5 percent) and include any requirements due to systemic buffers for three other systemically important institution (O-SII). • In addition to the CET1, we evaluated the banks' total capital adequacy ratio against the 8 percent level, their Tier 1 capital ratio against the 6 percent benchmark and the leverage ratio during the stress test horizon against the 3 percent Basel III minimum requirement. • The same hurdle rate was used for baseline and adverse scenario. The hurdle rate for CET1, T1 and total capital adequacy do not include capital conservation and capital countercyclical buffers as well as pillar 2 requirement. • For sensitivity test of LSIs, the established hurdle rate is 7 percent CET1 ratio. • Banks that end the stress test horizon with a capital level or a leverage ratio below the relevant hurdle rates, are considered to have failed the test.
6. Reporting Form for Results	Output presentation	• The results of the stress tests are reported using a variety of charts and tables. These potentially include: Evolution of capital ratios for the system as a whole. • For LSIs, the results are reported based on regional groups. • Outputs also include information on impact of different result drivers, including profit components, losses due to realization of different risk factors; capital shortfall as sum of individual shortfalls; in euros and in percent of nominal annual GDP; number of banks and corresponding percentage of assets below the regulatory minimum (or below the minimum leverage ratio).
Banking sector: Liquidity Stress Test		
1. Institutional Perimeter	• Exercise	• Top-Down by FSAP team.
	• Institutions included	• All SIs (11) and select LSIs (62 institutions). The latter are only subject to sensitivity analysis.
	• Market share	• Total coverage is around 82 percent, with 74.1 percent for SIs and 8 percent for LSIs.
	• Data and baseline date	• Latest data: October 2018 for SIs and end-June 2018 for LSIs

		• Source: supervisory data (LCR, NSFR and ALMM Maturity Ladder template) • Scope of consolidation: banking activities of the consolidated banking group for banks having their headquarters in Italy.
2. Channels of Risk Propagation	Methodology	• Basel III LCR and NSFR, cash-flow based liquidity stress test using maturity buckets by banks, incorporating both contractual and behavioral (where available) with assumption about combined interaction of funding and market liquidity and difference level of the central bank support. • Liquidity test in total currency. • Liquidity test for large depositors' withdrawals.
3. Risks and Buffers	Risks	• Funding liquidity. • Market liquidity. • Counterparty/depositor concentration risk, i.e., withdrawal of top 1, 3 and 5 depositors.
	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.
4. Tail shocks	Size of the shock	• The run-off rates are calibrated to reflect scenarios of system-wide deposit runs and dry-up 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. • Retail scenario key assumptions are: (i) 10 percent run-off rates for stable retail deposits and 15–20 percent for less stable retail; (ii) 75 percent (40 percent) run-off rates for non-operational (operational) deposits not covered by Deposit Guarantee Scheme; and (iii) 10 percent haircut on government securities for the calculation of high-quality liquid assets (HQLA). • Wholesale scenario key assumptions are: (i) 100 percent run-off rates for wholesale funding from other financial institutions; (ii) 50 percent run-off rates for operational deposits not covered by Deposit Guarantee Scheme; and (iii) 50 percent run-off by non-operational deposits not covered by Deposit Guarantee Scheme; (iv) 10 percent haircut on government securities for the calculation of HQLA • The liquidity shocks will be simulated for 1-month for both LCR and cash-flow based approaches, and 5-day and 3-months for cash-flow based approach.

		• The haircut of high quality liquid assets (HQLA) are calibrated consistent with market shock for investment securities and money market instruments in solvency stress test.
5. Regulatory and Market-Based Standards and Parameters	Regulatory standards	• Consistent with Basel III regulatory framework (LCR and NSFR). • Liquidity shortfall by bank.
6. Reporting Format for Results	Output presentation	• Liquidity ratio or shortfall by groups of banks and aggregated (system wide). • Number of banks that still can meet or fail their obligations.
Bank and non-bank sector: Contagion Analysis		
1. Institutional Perimeter	Institutions included	• All SIs (11) and select LSIs (62 institutions).
	Market share	• Total coverage is around 82 percent, with 74.1 percent for SIs and 8 percent for LSIs.
	Data and baseline date	• Supervisory as of end-June, 2018; and market data • BIS consolidated banking statistics • Flow-of-funds quarterly data (2008:Q1-2018:Q1), for analysis of cross-sectoral linkages.
2. Channels of Risk Propagation	Methodology	• Balance-sheet model: Interbank and cross-border network model by Espinosa-Vega and Solé (2010). • Market-based model: Diebold-Yilmaz (2014) generalized forecast variance decomposition approach.
3. Tail shocks	Size of the shock	• Pure contagion: hypothetical default of institutions. • Default threshold: banks would default if their CET1 capital ratios fall below 4.5 percent (regulatory minimum).
4. Reporting Format for Results	Output presentation	• Number of undercapitalized institutions in distress; • Capital shortfall systemwide, by bank and by group: contagion and vulnerability scores; • Amplification and cascade effects, direction and size of spillovers within the network. • Net spillovers due to interconnectivity (market-based). • Market-based analysis: Varian Decomposition (spillover contribution to equity prices).

Appendix III. PD Estimation Models

1. The ratio of new non-performing loans to total performing loans was used as a proxy for probability of default (PD) in the estimation of the credit risks. Specifically, separate satellite models were estimated for the PDs of corporate large firms, corporate SME, mortgage, consumer loans and financial institution. Point-in-time (PiT) PDs are projected using regression models with macro variables as independent variables. The data provided by Banca d'Italia on a quarterly and aggregate basis, from 2006:Q1 to 2018:Q4. The conditional PD forecasts for each segment were then attached to the starting point of each individual bank's PDs to generate full path under both the baseline and the adverse scenarios. The satellite models for PDs as a dependent variable were constructed as follows:

- To ensure that the models only produce PD predictions between 0 and 1 (or, equivalently, between 0 and 100 percent) and to capture nonlinearities in the relationship between the dependent and explanatory variables, the following logit transformation was applied to the original PD:

$$Y_{it} = ln\left(\frac{PD_{it}}{1 - PD_{it}}\right)$$

- To estimate impact of shocks of macrofinancial variables on PDs, the logit-transformed PDs were modeled as a linear function of different exogenous macroeconomic and financial factors (regressors). Therefore, the estimated model for the PDs can be expressed as:

$$Y_{it} = \alpha + \boldsymbol{\beta} Y_{i,t-k} + \boldsymbol{\delta} \boldsymbol{X}_{i,t-s} + \varepsilon_{i,t}$$

  where $Y_{i,t}$ is the logit transform of the PD for asset class i at time t, $\boldsymbol{X}_t$ is a vector of macroeconomic and financial variables; $Y_{i,t-k}$ is vector of the lagged dependent variable ($k = 1\ to\ N$). $\varepsilon_{i,t}$ is an independent and identically distributed error-term, and α, and vectors $\boldsymbol{\beta}$, and $\boldsymbol{\delta}$ are parameters to be estimated;

- The projected logit PDs for each of the exposure classes were transformed back to PD space.

2. The satellite models for credit risk were estimated using linear Bayesian Model Averaging (BMA) framework to remove model uncertainty. BMA overcome the issue of over-confident inferences in a single model estimation by averaging over the best models in the model class according to approximate posterior model probability. The framework also enables sign restriction in the estimation process to ensure reasonable relationship among input variables and the robustness of out-of-sample forecast conditional on a constrained sample size.

3. The model selection for the BMA follows several criteria. A unique benefit of the BMA approach is for the users to select different model specifications, such as the number of autoregressive lags, number of explanatory variables under permutation, and number of lags for each explanatory variable. Staff used the following five information criteria to determine the best

specification for each model: R-square, the Durbin Watson statistics, number of significant variables with high posterior inclusion probability, the quality of in-sample forecast, and ultimately, the size of the impact in the forecasting horizon. The ideal candidate would have a relatively high R-square, a DW statistics between 1.5 to 2.5, a small root-mean-square-error and a historically coherent size of impact under stress.

4. Real domestic output, unemployment rate, inflation, short-term and long-term interest rate prove to be relevant for the buildup of credit risks (Table 1). This is reflected in the higher-than-prior posterior inclusion probability and sizable long run multiplier estimate (i.e., coefficients for both the contemporaneous and lagged terms of the independent variables) for the sectoral PDs. It is worth noting that the type and number of significant variables varies distinctly across segments, as manifested by the individual characteristics of their historical PDs. Specifications of selected equations are provided in the Table 1 below.

Table AIII.1. Italy: Estimation of Probability of Default by Segments
(Dependent variable: probability of default, percent)

	Mortgage	Financial Insitution	Large Firms	SME	Consumer Loans
	Normalized posterior long-run multiplier with sign restriction				
GDP growth, percent, yoy	-0.01	-0.52*	-0.52*	-0.01	-1.03*
Exchange rate (against USD), percentage change, yoy	0.08	0.02	0.03	0.00	0.02
Unemployment rate, percentage point change, yoy	0.29*	0.01	0.63*	0.99*	0.02
Inflation rate, percent, yoy	0.00	-0.17*	0.00	0.00	0.00
Sovereign long term yield spread against German bund, percent	0.01	0.00	0.09	0.07	0.00
Short term interest rate spread against refinancing rate, percent	0.00	0.00	0.09	0.05	0.00
Short term interest rate, percent	0.9*	0.00	0.09	0.32*	0.79*
Long term sovereign bond yield, percent	0.07	0.15*	0.07	0.01	0.00
Nominal wage, percentage change, yoy	0.00	0.00	0.00	0.00	0.00
Number of observations	52	52	52	52	60
Number of lags of independent variables	2	2	2	2	2
R square	0.91	0.56	0.91	0.91	0.99
Durbin Watson Statistics	1.78	1.91	2.35	2.11	2.23

Source: IMF staff calculations.
Note: 1. * denotes a higher posterior inclusion probability than the prior, which indicates variable statistical significance.
2. For many of the portfolio segments presented here, the equations do contain lags of either the dependent variable or the exogenous right hand-side variables (beyond their contemporaneous inclusion) or both.
3. A long run multiplier is defined as the sum of all coefficients of a given right hand-side variable on its contemporaneous and lagged terms. The long run multiplier is normalized, moreover, by multiplying it by the ratio of the standard deviation of the left hand-side and the respective right hand-side variable that is concerned.
4. The interpretation of the normalized long run multiplier: a one standard deviation change in the concerned right hand-side variable induces the normalized multiplier times the historical standard deviation of the left hand-side variable. Note that the default rates on the left hand-side have been included in the equation in logit format. The normalized multipliers can be compared across variables and equations.

Appendix IV. Funding and Lending Rate Estimation

1. Bank funding costs were estimated based on funding rate for new deposits (front book) for each bank. The data was provided by the authorities on a quarterly basis from 2006:Q1 to 2018:Q4. The macroeconomic data was sourced from IMF International Financial Statistics, the IMF World Economic Outlook (WEO) database, Bloomberg, and Haver Analytics. The macroeconomic series for the adverse scenario followed the scenario set for this stress test.

2. Bank interest rates on new business were estimated and used as the input for interest risk assessment on the banking book. Using BMA methodology, the satellite models estimates aggregate funding and lending rates on the portfolio level, which include interest rates on retail and whole deposits (both term and overnight), debt securities as well as household and corporate loans. Subsequently, the model outputs were used to project bank specific interest rate paths by attaching the period changes of the aggregate rates in the forecasting horizon to the bank specific starting point.

3. The input for interest rate models bears close resemblance to that of credit risk models. Most of the input for the credit risk model were kept for use in the interest rate models, such as GDP growth, inflation, exchange rate, unemployment rate, short term and long-term interest rates. As interest rates were received in a blended form and reflect both domestic and foreign exposures (mainly from the EA and the United States), most explanatory variables came under the form of Italy specific as well as EA- and U.S.-based indicators, to account for country specific interest risk associate with both the domestic and foreign creditors/borrowers.

4. Interest rate passthrough. To simulate bank specific risk behavior and allow for a partial passthrough of the rising funding cost to the lending rate, staff includes banks' funding cost as an additional explanatory factor in the projection of the lending rate. Therefore, the model was performed sequentially by first estimating the funding rate, which was then used as input for the projection of the lending rates.

5. The model also allows for the inclusion of the PDs to bridge credit risk with banks' interest rate behavior, particularly for asset side. The household and corporate PDs were mapped into respective lending rate categories to capture banks' higher interest charge on borrowers with high default risk.

6. The projected interest rates paths were broadly in line with banks' portfolio characteristics. On the liability side, this is reflected by a more severe impact on the long term and unsecured debt portfolios as opposed to highly liquid and short-term funding. On the asset side, the increase on the lending rate could be hindered by a potential rise in the PDs of the existing borrowers. To be conservative, a lower bound (5th percentile for the adverse and 25th percentile for the baseline) within the forecasted confidence band were selected to factor in the constrain faced by the banks. The resulting average decline on the net interest margin amounts to 0.07 percent under the baseline and 0.18 percent under the adverse scenario, respectively.

7. Variables related to money market rate and long-term sovereign yield are the main contributors in the projections of bank interest income and funding costs (Table III.1). The long run multiplier for variables associated with short term and long-term interest rate turn out to be sizable in the determination of both the lending and funding rate. Specifically, on the funding side, 3-month money market rate and 10-year domestic sovereign bond yield spread explain majority of the movement in the interest expense; On the lending side, almost identical set of variables play significant roles, with additions of U.S. long term sovereign bond yield as well as funding cost associated with retail term deposits. The long run passthrough from Italy sovereign bond yield and short-term interest rate on funding rates appears to be large, particularly from government bond yield to retail term deposit and from short term rate to wholesale term deposits, retail and wholesale overnight deposits.

Table AIV.1. Italy: Estimation of Interest Rate by Portfolios

(Dependent variable: Interest rates on new business, percent)

	Funding rate					Lending rate		
	Retail term deposit	Wholesale term deposit	Debt securities	Retail overnight deposit	Wholesale overnight deposit	Lending rate,consumer loans	Lending rate, mortgage	Lending rate, nonfinancial corporations
	Normalized posterior long-run multiplier with sign restriction							
GDP growth, Italy, yoy	0.00	0.00	0.00	0.00	0.00	-0.12*	0.00	0.00
GDP growth, Euro Area, yoy	0.00	0.00	0.00	0.00	0.00	-0.13*	0.00	-0.01
Exchange rate against US dollar, percentage change, yoy	0.00	0.04*	0.00	0.00	0.00	0.00	0.01	0.00
Inflation, yoy	0.00	0.00	-0.01*	0.00	0.00	0.00	-0.09*	0.00
Unemployment rate, Italy, percentage point change, yoy	0.00	0.01	0.01	0.06*	0.02	0.00	0.00	0.00
Unemployment rate, Euro Area, percentage point change, yoy	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Italy sovereign long term yield spread against German bund, percent	0.9*	0.16*	0.08*	0.6*	0.43*	0.00	0.09*	0.09*
Euro Area short term interest rate spread against main refinancing rate, percent	0.75*	0.00	0.03	0.4*	0.08*	0.03	0.01	0.00
Italy sovereign long term yield, percent	0.00	0.02	0.65*	0.00	0.00	0.01	0.00	0.05*
Euro Area short term interest rate, percent	0.7*	0.98*	0.44*	1.18*	1.18*	0.03	0.54*	0.46*
U.S. short term interest rate, percent	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
U.S. Long term sovereign bond yield, percent	0.00	0.00	0.00	0.00	0.00	0.43*	0.11*	0.02
Probability of default, household, percent						0.00	0.00	
Probability of default, nonfinancial corporation, percent								0.01
Interest rate, retail term deposit, percent						0.67*	0.6*	0.63*
Interest rate, wholesale term deposit, percent						0.02	0.00	0.00
Interest rate, retail overnight deposit, percent						0.02	0.00	0.00
Interest rate, wholesale overnight deposit, percent						0.02	0.00	0.01
Number of observations	52	52	52	52	52	52	52	52
Number of lags of independent variables	2	2	2	2	2	2	2	2
R square	0.98	0.97	0.96	1.00	1.00	0.96	1.00	0.99
Durbin Watson Statistics	1.82	2.32	1.74	1.64	1.78	1.93	1.79	2.24

Source: IMF staff calculations.

Notes: 1. * denotes a higher posterior inclusion probability than the prior, which indicates variable statistical significance.

2. For many of the portfolio segments presented here, the equations do contain lags of either the dependent variable or the exogenous right hand-side variables (beyond their contemporaneous inclusion) or both.

3. A long run multiplier is defined as the sum of all coefficients of a given right hand-side variable on its contemporaneous and lagged terms. The long run multiplier is normalized, moreover, by multiplying it by the ratio of the standard deviation of the left hand-side and the respective right hand-side variable that is concerned.

4. The interpretation of the normalized long run multiplier: a one standard deviation change in the concerned right hand-side variable induces the normalized multiplier times the historical standard deviation of the left hand-side variable. The normalized multipliers can be compared across variables and equations.

Appendix V. Characteristics of Effective Interest Rates in Micro-Data

Table AV.1. Italy: Characteristics of Effective Interest Rates in Micro-Data

	Effective interest rate on financial debt			Effective interest rate on total debt			Effective interest rate on effective debt		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Lending rate on new NFC loans	0.735*	0.081	0.432	0.493***	0.299***	0.291***	0.925***	0.844***	0.840***
	(0.43)	(0.51)	(0.47)	(0.11)	(0.03)	(0.03)	(0.05)	(0.05)	(0.05)
Lagged dependent variable (t-1)		0.191*	0.190*		0.058***	0.058***		0.044***	0.044***
		(0.10)	(0.10)		(0.02)	(0.02)		(0.02)	(0.02)
Real GDP log-deviation			-0.000			-0.000			-0.000
			(0.00)			(0.00)			(0.00)
Constant	0.186***	0.157***	0.386	0.012***	0.016***	0.021	0.028***	0.027***	0.020
	(0.02)	(0.02)	(.)	(0.00)	(0.00)	(.)	(0.00)	(0.00)	(4.98)
Observations	6252407	4624013	4616826	10016044	8132506	8103984	9613093	7721758	7700734

Source: IMF staff calculations.
Note: standard errors in parentheses, ***, **, and * denote significance at 1, 5, and 10 percent, respectively. Columns 3, 6, and 9 include a full set of fixed effects for the firm size, economic sector, and geographic area.

Appendix VI. Non-Financial Corporate Stress Test Results

Table AVI.1. Italy: Non-Financial Corporate Stress Test Results

	Median	Share of Firms			Share of Debt		
	ICR	ICR < 1	ICR < 2	ICR < 3	ICR < 1	ICR < 2	ICR < 3
Baseline	3.3	26	39	47	23	40	47
Adverse scenario							
Profit shock	2.7	32	44	52	25	42	49
Interest shock	1.8	36	52	61	36	52	62
Combined shock	1.5	40	55	63	38	54	63
Medium scenario							
Profit shock	3.2	28	41	49	24	41	48
Interest shock	2.4	30	46	55	31	47	56
Combined shock	2.2	32	48	56	32	47	56

Source: IMF staff estimates.

Appendix VII. Cross-Sectoral Interconnectedness

Table AVII.1. Italy: Grouping of Sectors

Original sectors in the data	Coding
Nonfinancial Corporations (S.11)	NFC
Monetary Financial Institutions Excluding Central Bank (S.122+123)	MFI
Bank of Italy (S.121)	BdI
Other Financial Intermediaries (S.125) Excluding non-MMF Investment Non-MMF Investment Funds (S.124) Captive financial institutions & money lenders (S.127) Financial Auxiliaries (S.126)	OFI
Insurance Companies (S.128) Pension Funds (S.129)	INSP
Central Government (S.1311) Local Government (S.1313) (S.13 – General Government) Social Security Funds (S.1314)	GOV
Households (S.14) and Nonprofit Institutions Serving Households (S.15)	HH
Rest of the World (S.2S)	RoW

Source: IMF staff calculations.

1. **Data are presented and analyzed as cross-sectoral networks by financial instrument and on a non-consolidated basis to highlight relevant intra-sector exposures.** Cross-sectoral exposures are presented as adjacency matrices to illustrate the origin of the financing instrument and the destination of the same financial instrument to show how sectors allocate financing. Holding sectors are presented in rows and issuing sectors in columns. Non-consolidated data allows us to identify and analyze relevant intra-sectoral activity to be used for financial stability monitoring.

2. **In the financial account framework, each financial claim has a corresponding liability, so that the sum of all net borrowing is zero by construction**. Garcia-Macia (2018) describes the steps and necessary assumptions to infer sectoral exposures from the Italian flow-of-funds data.

Table AVII.2. Italy: Financial Network Matrix

(Gross Bilateral Exposures, as of 2018:Q1)

Unit: Percent of GDP		Liabilities							
		NFC	MFI	BdI	OFI	INSP	GOV	HH	RoW
Assets	NFC	47	15	7	1	2	6	5	27
	MFI	57	50	5	14	1	38	39	26
	BdI	1	17	0	1	0	26	0	14
	OFI	13	20	2	2	0	9	4	27
	INSP	5	3	1	3	0	21	0	27
	GOV	12	5	2	1	1	5	4	6
	HH	60	66	22	17	54	15	4	33
	RoW	42	52	13	7	3	53	1	3

Unit: Percent of total assets in each		Liabilities							
		NFC	MFI	BdI	OFI	INSP	GOV	HH	RoW
Assets	NFC	42.6	13.8	6.6	1.0	1.7	5.3	4.3	24.6
	MFI	24.7	21.7	2.2	6.2	0.6	16.3	17.0	11.2
	BdI	0.9	29.4	0.0	0.9	0.1	44.4	0.1	24.2
	OFI	16.7	25.6	2.8	2.8	0.4	11.1	5.3	35.3
	INSP	7.7	4.4	0.9	4.7	0.8	34.8	0.4	46.5
	GOV	34.1	13.8	4.4	2.8	1.9	14.2	11.0	17.6
	HH	22.3	24.5	8.0	6.4	19.8	5.5	1.4	12.1
	RoW	24.2	30.1	7.3	4.0	1.6	30.5	0.5	1.9

Unit: Percent of total liabilities in		Liabilities							
		NFC	MFI	BdI	OFI	INSP	GOV	HH	RoW
Assets	NFC	19.9	6.6	14.2	2.4	3.1	3.4	8.3	16.5
	MFI	24.2	22.0	10.2	31.2	2.4	22.0	69.1	15.9
	BdI	0.2	7.6	0.0	1.1	0.1	15.1	0.1	8.7
	OFI	5.5	8.6	4.2	4.6	0.5	5.0	7.2	16.6
	INSP	1.9	1.1	1.0	6.0	0.7	12.0	0.4	16.7
	GOV	5.1	2.1	3.1	2.2	1.1	2.9	6.8	3.8
	HH	25.5	29.0	42.4	37.5	87.5	8.7	6.5	20.0
	RoW	17.8	22.9	24.8	15.0	4.6	30.9	1.7	2.0

Source: Banca d'Italia (via Haver) and IMF staff calculations.

Appendix VIII. BIS International Banking Statistics

1. The BIS collect two types of international banking statistics: the CBS and Locational Banking Statistics (LBS). These data are aggregated at the level of national banking systems and track developments in banks' foreign positions and cross-border financial linkages.

2. The LBS focus on all banking offices (both domestic- and foreign-controlled ones) resident in the reporting country and cover unconsolidated cross-border and local positions of these banks. These data are based on either residence or nationality of the reporting institution. For example, Italian resident banks include both Italian-owned banks and foreign-owned branches and subsidiaries resident in Italy (Coates and others, 2015). These data correspond to the compilation of national accounts, balance of payments, and external debt statistics.

Figure VIII.1. Italy: Structure of BIS Consolidated Banking Statistics

Claims on residents of the reporting country		Claims on non-residents of the reporting country		
Cross-border claims booked by banking offices outside the reporting country (A)	Local claims booked by banking offices inside the reporting country (B)	Cross-border claims booked by banking offices outside the counterparty country (C)	Local claims booked by banking offices inside the counterparty country in foreign currency (D)	Local claims booked by banking offices inside the counterparty country in local currency (E)
Total domestic claims (A+B)		Total foreign claims (C+D+E)		
		Total international claims (C+D)		

Source: Bank for International Settlements (BIS).

3. The CBS focus on banks headquartered in the reporting country and cover banks' consolidated on-balance sheet claims and selected off-balance sheet exposures to counterparty countries and sectors. Positions are reported by head offices in their home country and include all branches and subsidiaries on a worldwide consolidated basis, net of inter-office accounts. This dataset is available on an immediate borrower basis (CBS-IBB) based on the country of the first counterparty exposure, and an ultimate risk basis (CBS-URB) based on the country where the final risk resides after taking into account risk transfers. Three different types of claims are included in the CBS: C, D, and E in the following text table. Total foreign claims are divided into international claims and local claims in local currency under the CBS-IBB, while they are categorized into cross-border claims and local claims under the CBS-URB.

4. The LBS are used to analyze capital flows between countries, while the CBS are used to measure the country risk exposures of internationally active banking groups. Because the note focuses on "risks" that banks transfer in and out of the Italian economy, rather than their role as a conduit, it uses the CBS, instead of the LBS.

Appendix IX. Market-based Spillover Analysis

1. This appendix explains the data and methodology used in the interconnectedness analysis using market data.

2. The methodology employed to measure connectedness draws from Diebold and Yilmaz (2014) for market-data analyses. The measurement of spillovers using market data starts with estimating a Vector Auto Regression (VAR) based on the following specification:

$$A(L)Y_t = \varepsilon_t$$
$$D^H = \left[d_{i,j}^H\right] \text{ is the H-step ahead variance decomposition matrix.}$$

where Y is a vector of daily range-based volatility in equity returns, A(L) is the lag polynomial, and ε_t is an error term. [1]

3. Pairwise bilateral linkages between any of two data series are calculated from the fitted VAR model, using the Generalized Variance Decomposition (GVD), based on Pesaran and Shin's (1988) methodology.[2] The spillover measures consist of the percent contribution of entity A to the H-step-ahead forecast error variance of entity B, where the entities are banks and NBFIs for our analysis. The advantage of this approach relative to the more standard Cholesky ordering or a more structural approach is that it does not require any assumption on the order of the variables.[3] The horizon H allows one to capture the dynamic connectedness (analogous to contagion) as opposed to purely contemporaneous connectedness. To take a simple pairwise example, shocks to Bank A may impact the forecast error variance of Bank B only with a lag, so that spillover from Bank A to B may be small for small H but nevertheless larger for larger H.

4. On aggregate, the *from-degree* measure captures exposures of individual firms to shocks from the network (inward spillover), in a fashion analogous to Marginal Expected Shortfalls (MES). The *to-degree* measure captures contributions of individual firms to network events (outward spillover), in a fashion analogous to Delta CoVaR (see Diebold and Yilmaz, 2014). In addition, the *net-degree* measure (the difference between to- and from- measures) describes the relative contribution to financial stress from each financial firm.

5. The results reported in the main text are based on generalized impulse response functions, and the VARs are estimated with three lags (which capture the lagged co-

[1] Diebold and Yilmaz (2009) highlight the difference between equity returns and volatilities connectedness. Unlike dynamic returns connectedness measures which generally display smooth upward trending behavior without bursts or spikes, dynamic volatilities connectedness measures display spikes, along with the trend.

[2] The VAR model turns to LASSO to estimate the long-run correlation network.

[3] Although, in some cases market size may be a natural order, experiments based on trying different ordering showed that results were moderately sensitive to the choice of ordering.

movements among equity return volatilities), and the connectedness is calculated for a 10-day horizon. The spillover measures are found to be robust to the choices of lag, forecast horizon, as well as to equity returns obtained from H-shares and A-shares of dual-listed FIs.

Table IX.1. Italy: Diebold-Yilmaz Spillover Analysis Sample and VAR Specifications

Market	Source	Period	Sample
Stock index (Total market)	MSCI	07/12/2005-10/31/2018	19
Stock index (Bank index)	Datastream	07/12/2005-10/31/2018	18
Sovereign CDS	Datastream	01/05/2009-10/31/2018	16

Source: MSCI, Datastream.
Note: For the dynamic version, the rolling sample windows size is set to 150 for equity indices and bank stock returns and 200 for sovereign CDS and FX series. Number of lags in the VAR is set to 3 and the forecast horizon is 10 for all series. The sample includes all countries for total market stock indices. For banking indices, Netherlands, Switzerland and Russia are excluded due to data constraints. Australia, India and Switzerland are excluded from the CDS exercise due to similar constraints.

References

Accornero, Matteo, Piergiorgio Alessandri, Luisa Carpinelli and Alberto Maria Sorrentino. 2017. "Non-performing loans and the supply of bank credit: evidence from Italy," Banca d'Italia Occasional Papers No. 374.

Albertazzi, Ugo, Tiziano Ropele, Gabriele Sene, and Federico Maria Signoretti. 2014. "The Impact of the Sovereign Debt Crisis on the Activity of Italian Banks," *Journal of Banking & Finance* 46: 387–402.

Anderson, Gareth and Mehdi Raissi. 2018. "Corporate Indebtedness and Low Productivity of Italian Firms," IMF Working Paper 18/33, International Monetary Fund, Washington DC.

Banca d'Italia. 2019."Financial Stability Report," No. 1, May 2019, Rome, Italy.

Banca d'Italia. 2018a. "Financial Stability Report," No. 2, November 2018, Rome, Italy.

Banca d'Italia. 2018b. "Annual Report 2017 – 124th Financial Year," May 2018, Rome, Italy.

Banca d'Italia. 2018c. "Financial Stability Report," No. 1, April 2018, Rome, Italy.

Banca d'Italia. 2015. "Household Wealth in Italy, 2014" Supplements to the Statistical Bulletin, Monetary and Financial Indicators, Volume XXV, No. 69.

Belhocine, Nazim, Daniel Garcia-Macia, and José Garrido. 2018. "The Insolvency Regime for Large Enterprises in Italy: An Economic and Legal Assessment," IMF Working Paper 18/218, International Monetary Fund, Washington DC.

Bredl, Sebastian. 2018. "The Role of Non-performing Loans for Bank Lending Rates," Discussion Paper, Deutsche Bundesbank No 52/2018.

CERVED. 2017. "2017 Cerved SMEs Report."

Cucinelli, Doriana. 2015. "The Impact of Non-performing Loans on Bank Lending Behavior: Evidence from the Italian Banking Sector," *Eurasian Journal of Business and Economics* 8 (16): 59–71.

De Socio, Antonio and Valentina Michelangeli. 2015. "Modelling Italian Firms' Financial Vulnerability," Banca d'Italia Occasional Papers Number 293.

Diebold, Francis X., and Kamil Yilmaz. 2014. "On the Network Topology of Variance Decompositions: Measuring the Connectedness of Financial Firms," *The Economic Journal* 119 (January), 158–171.

EBA Report, "EBA Report on Net Stable Funding Requirements under Article 510 of the CRR", EBA/OP/2-15/22.

EBA Document, "2018 EU-Wide Stress Test, Methodological Note", January 31, 2018

EIB. 2014. "Unlocking lending in Europe," EIB – 10/2014.

Espinosa-Vega, Marco A., and Juan Solé. 2011. "Cross-Border Financial Surveillance: A Network Perspective," *Journal of Financial Economic Policy* 3 (3): 182–205.

Garcia-Macia, Daniel. 2018. " Household Wealth and Resilience to Financial Shocks in Italy," IMF Working Paper 18/196, International Monetary Fund, Washington DC.

_____. 2019. "Corporate Profitability and Investment in Italy," IMF Working Paper (*forthcoming*).

Gross, Marco and Javier Población. 2017. "Implications of Model Uncertainty for Bank Stress Testing" *Journal of Financial Services Research* DOI: 10.1007/s10693-017-0275-4.

International Monetary Fund (IMF). 2013. "Making the Transition to Stability," in *Global Financial Stability Report*. Washington, DC, October.

_____. 2015. Guidance Note on Stress Testing, "Treatment of Liquidity Risks in Stress Tests," Number 15/11.

_____. 2019. "Late-Cycle Corporate Sector Risks in Advanced Economies," in *Global Financial Stability Report: Vulnerabilities in a Maturing Credit Cycle*, Chapter 2, April 2019, Washington DC.

_____. 2018a. "Technical Note – Systemic Risk Analysis", Euro Area Financial Sector Assessment Program, IMF Country Report No. 18/231 July 2018, Washington D.C.

_____. 2017. "Technical Note—Financial Stability and Stress Testing of the Banking, Household, and Corporate Sectors," IMF Country Report No. 17/95 "Kingdom of the Netherlands. Financial Sector Assessment Program".

Kangur, Alvar. 2018. "Competitiveness and Wage Bargaining Reform in Italy," IMF Working Paper 18/61, International Monetary Fund, Washington DC.

Koske, Isabell, Isabelle Wanner, Rosamaria Bitetti, and Omar Barbiero. 2015. "The 2013 Update of the OECD's Database on Product Market Regulation–Policy Insights for OECD and non-OECD countries," OECD Economics Department Working Papers No. 1200.

OECD. 2017. "OECD Economic Surveys: Italy 2017" (OECD Publishing: Paris). http://dx.doi.org/10.1787/eco_surveys-ita-2017-en

OECD. 2019. "Non-financial corporations debt to surplus ratio" (indicator), https://doi.org/10.1787/dc95ffa7-en

Pellegrino, Bruno and Luigi Zingales. 2017. "Diagnosing the Italian Disease," NBER Working Paper No. 23964.

Vitek, Francis. 2018. The Global Macrofinancial Model, International Monetary Fund Working Paper, 81