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Ten years of bank stress tests in Europe and the United States

In response to the 2007-09 financial crisis, supervisory authorities reinforced bank stress tests, with the aim of safeguarding financial stability. The implementation of these tests differs in Europe and the United States. European tests cover all large and medium-sized banks. They are carried out by the banks themselves using their own internal methods under constrained rules, and the results are verified and validated by the supervisor. US tests are carried out on smaller samples of the largest banks, using models developed by the supervisor. The analysis in this *Bulletin* shows that the tests applied to European banks have increased in severity. Since 2014, European banks – including those that were initially most fragile – have increased their solvency indicators to a greater extent than their US peers. However, large banks in both monetary areas have strengthened their resilience to economic and financial shocks.

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Increase in the average regulatory solvency ratio of the ten largest banks

In the euro area:

from 10.8% in early 2014

to 14.4% in early 2023

In the United States:

from 11.4 % in early 2014 to 12.1 % in early 2023 Maximum real GDP shocks and deterioration in the average CET1 solvency ratio of the ten largest banks in European and US stress tests (2014-23) (% change; x-axis, maximum GDP shock; y-axis, CET1 ratio depletion)

European Union
 United States



Source: European Banking Authority, European Central Bank, Federal Reserve and author's calculations. Note: The CET1 solvency ratio is the highest quality of regulatory capital (CET1) divided by the value of on- and off-balance sheet assets weighted by their risk exposure (RWA). GDP, gross domestic product. CET1, Common Equity Tier 1. RWA, risk-weighted assets.



Supervisory bank stress tests are used to assess the resilience of banks to a significant deterioration in economic and financial conditions or a crisis scenario. They aim to identify vulnerabilities in individual credit institutions and in the banking system as a whole, leading to the implementation of preventive actions if necessary. The tests employ models developed by supervisors and banks to project institutions' risks, losses, revenues and expenses under a hypothetical stress scenario.

This article exploits publicly available data to examine the methodologies used for the two main comprehensive European and US stress tests – known as the EU-wide stress test and the Dodd-Frank Act Stress Test (DFAST). The study highlights some discrepancies in application methods that can affect outcomes. The severity of the adverse economic scenarios and their negative impacts on bank solvency have increased over time in Europe and are now stronger than in the United States. In the United States, the economic shocks tested are shorter in duration and notably weaker in intensity during crisis years. For comparability, we analyse the ten largest European and American banks that have participated in all stress tests since 2014.¹ The two groups have very similar total assets, amounting to around EUR 15 trillion in 2023. Since the implementation of the European Single Supervisory Mechanism (SSM) in 2014, the solvency indicators of the largest banks subject to stress testing have increased more in Europe than in the United States. As a result, even in the tested adverse scenarios, banks in both jurisdictions would generally continue to meet their core regulatory capital requirements, and would still be able to provide financing to the economy. The disclosure of the test results – which are published in greater detail in Europe than in the United States – has also created a positive incentive for banks. This is especially true for those European banks identified as fragile (undercapitalised) in the adverse scenario of the 2014 EU-wide exercise.

1 European and US stress tests have identical Basel regulatory frameworks but very different methods of application

Bank stress testing is part of the Basel international regulatory framework, which constrains banks' activities and financing structures by requiring them to hold a minimum level of capital. These capital requirements are designed to encourage banks to behave responsibly and to ensure they can absorb any losses.² In 2009, the Basel Committee on Banking Supervision (BCBS) recommended that existing stress tests be reinforced.³ However, there are significant differences in the way they are implemented in Europe and the United States.⁴

Stress test exercises in Europe are more detailed, while the US approach is more standardised

While complying with the principles of the BCBS, the stress tests conducted by European and US supervisors apply distinct methodologies and differ in the way they use the results. In the European Union (EU), tests are carried out every two years,⁵ while in the United States they are performed annually. Moreover, in years where no comprehensive testing is performed in Europe, authorities assess specific risks, such as interest rate, liquidity, climate and cyber risk.⁶

⁶ European authorities also conduct stress testing on less significant institutions (LSIs), but do not publish detailed results.



¹ Prior to 2014, the European Banking Authority conducted stress tests in 2009, 2010 and 2011 using a less exhaustive methodological framework. The US Federal Reserve conducted a DFAST stress test in 2013.

² A summary of capital adequacy regulations and the role of stress tests within this framework can be found in Appendix 1. For full texts, see BCBS (2010, 2017 and 2018), 111th US Congress (2010) and European Parliament (2013).

³ Already in 2004, the Basel II Accords on banking regulations set a requirement to develop stress tests for banks using the internal models approach to determine their risk capital. In 2009, the BCBS published recommendations on the conduct of stress tests by banks and supervisors (BCBS, 2009).

⁴ Stress tests are also carried out in other jurisdictions (Bank of England for example), and at international financial institutions such as the International Monetary Fund. The Financial Stability Institute has compiled an overview of supervisory stress tests around the world (FSI, 2018).

⁵ For a detailed description of the data used, in particular data on stress tests, see Appendix 2.

Europe tests a larger number of banks

In terms of banking sector coverage, Europe tests a larger number of banks than the United States (123 in 2014 and 70 in 2023).⁷ In 2023, the rule was to test all European banks with total assets of at least EUR 30 billion. In the United States, meanwhile, coverage is more restricted as only banks with assets of at least USD 100 billion (30 in 2014 and 23 in 2023) are subject to enhanced oversight by the US Federal Reserve (Fed).⁸ The changes in coverage and main features of the US and European exercises, together with aggregate results for participating banks, are presented in Table TA1 in Appendix 3.

Operational approaches differ in EU and US stress tests

European authorities use what is known as a "bottom-up" approach, where risk and profitability projections are made by the banks and submitted to the supervisors to be challenged and validated. European banks are allowed to use in-house models for these projections, but are obliged to comply with the methodology of the European Banking Authority (EBA) to ensure a minimum level of severity (EBA, 2022). European supervisors then use their own models and methods to verify each bank's projections (ECB, 2024). If they consider the results insufficiently prudent, they demand an explanation from the bank. As a last resort, if the explanation is not convincing enough, they ask the bank to take remedial action. The exercise is carried out with the participation of all European banking supervisors.⁹

In contrast, US stress tests apply a "top-down" approach, where the supervisor makes risk and profitability projections using its own models (Fed, 2023a). These US tests are quicker to conduct but are also more likely to be challenged by the supervised entities.

Therefore, European stress tests are, by construction, more sensitive to the specific features of bank books and the associated individual risks. Their effectiveness depends on the quality of the methodology and the supervisor's ability to encourage banks to disclose as much relevant data as possible. In contrast, the relevance of American exercises depends exclusively on the quality of the supervisor's models.

The adverse macro-financial or crisis scenarios have very different foundations in Europe and the United States

These comprehensive stress tests simulate the effect of adverse scenarios on banks' solvency over a three-year horizon.¹⁰ They measure the deviation from projections made under a baseline scenario. The baseline scenario is the expected evolution of economic and financial conditions in each of the two jurisdictions (according to the Fed for the United States, and according to EU national central banks for the EU). Each jurisdiction defines an adverse scenario, comprising projections for several macro-financial variables, applied to banks' assets and liabilities (domestic and foreign).

A comparison of the scenarios reveals divergent trends in the two main macroeconomic variables for each jurisdiction – real GDP and interest rates.¹¹ This suggests a discrepancy in the methodologies employed by the two monetary areas. For instance, in Europe in particular, the aim is to estimate the impact of an adverse scenario in the absence of any further monetary policy response, beyond that projected in the baseline scenario.

¹¹ Stress test scenarios simulate effects of multiple economic and financial variables, including inflation, the unemployment rate and indices of real estate prices, equity prices and corporate risk-returns.



⁷ In 2023, European supervisors also stressed 41 smaller institutions and published aggregate results.

⁸ In 2019, the Fed Board amended its stress test rule to test certain banks with total consolidated assets between USD 100 billion and USD 250 billion every two years.
9 For example, the Banque de France and Autorité de Contrôle Prudentiel et de Résolution (ACPR – Prudential Supervision and Resolution Authority) both contribute to the exercise by providing experts who participate in the quality assurance process of the projections and analysis of the results (see, for example, ACPR, 2016).

¹⁰ Our study takes into consideration the US "severely adverse" scenario as it is the most similar to the European "adverse" scenario.



In Europe, GDP shocks are persistent and increasingly severe, while in the United States GDP shocks are temporary with a marked rebound

European authorities simulate persistent GDP shocks, whereas in the United States, conditions return almost to their starting point after an initial severe shock. Charts 1a and 1b show the evolution of GDP and its projections under stress test scenarios in the United States and Europe. For better comparability, we use harmonised GDP data from the World Bank in US dollars.

Contrary to the first stress test exercises, the adverse GDP scenarios tested in European stress tests are now more severe than in US tests (see box). While the first tests appeared relatively mild for Europe, this is no longer the case.

C1 Gross domestic product (GDP) and path under the baseline and adverse scenarios from stress tests (2015 USD billions)



Sources: World Bank, European Banking Authority, European Central Bank, Federal Reserve and author's calculations.

BOX

Comparison of the severity of GDP shocks

US authorities define larger GDP shocks in the first year, whereas European authorities use longer and more gradual shocks (see chart).

- In Europe, the maximum projected one-year shock to GDP for all adverse scenarios in the period under consideration (-4.2% in 2023) is similar to the decline in GDP observed in 2009 during the Global Financial Crisis (-4.3%), and smaller than the decline seen in 2020 during the Covid crisis (-5.7%).
- In the United States, the maximum projected one-year shock to GDP (-5.9% in 2023) is larger than the observed GDP contractions for 2009 and 2020 (-2.6% and -2.2% respectively).

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If we look at the severity of the shocks over three years, however, the maximum cumulative GDP shock under the European scenarios has increased and become more severe than in the US scenarios since 2021 (see chart opposite).¹

- The maximum cumulative GDP shock after three years compared to the starting point increased steadily in European stress tests² from 2014 to 2023 (from -2.2% to -7.5%). The GDP shocks used after the outbreak of the Covid-19 crisis are larger than those used before the crisis.
- In US stress tests, the cumulative GDP shocks, which are identical to the maximum annual shocks, decreased between 2014 and 2021 (from -5.3% to -1%), before increasing again in 2023 (-5.9%). Adverse US GDP projections were much smaller in 2021, a crisis year.

Interest rate shocks are upward in Europe, downward in the United States

The adverse scenarios in European stress tests have generally attempted to assess the risks linked to a rapid rise in interest rates compared to the baseline scenario.¹² The aim is to envisage the consequences of a rise in financing costs for the European banking sector. In these adverse scenarios, the average EU 10-year

Maximum annual and cumulative three-year GDP shocks under European and US adverse scenarios (%)



on the lowest projected level over the three-year period.

government bond yield has always been projected as being higher than in the baseline scenarios (see Chart 2a).

Conversely, in US adverse scenarios, projections for US 10-year Treasury bond yields are lower than in the baseline scenario. The first phase of decline is due to the economic contraction, and the rise at the end of the period is linked to expectations of a post-crisis economic recovery (see Chart 2b).

12 However, an adverse scenario with EUR SWAP reference rates that are negative and lower than in the baseline scenario was tested in 2021.



¹ This finding holds true even taking into account the Fed stress tests conducted in years where there were no European tests. This observation is also made for the adverse scenarios of the 2025 exercises in progress.

² For an analysis of the French banking system, see Fourel et al. (2020).

C2 Actual 10-year government bond yields and projected yields in the stress test baseline and adverse scenarios

-- Baseline scenario

- Average observed 10-yr government bond yield for EU countries



Sources: Eurostat, European Banking Authority, European Central Bank, Federal Reserve and author's calculations.

Europe publishes more detailed results while the United States uses the results more directly

The publication of bank stress test results plays a key role in fostering market discipline. It ensures that the results can be analysed and assessed by the public, and especially by investors, market analysts and researchers. In Europe, the information collected and published is highly granular, showing a more detailed breakdown by asset and liability type, type of customer and geographical area. In 2023, for each European bank, data were published on 174 different balance sheet, profitability, risk and solvency variables.¹³ The Fed publishes more limited data. In 2023, for example, it published figures on 40 different variables for each US bank.¹⁴

The Fed uses its stress test results directly and systematically to determine the Common Equity Tier 1 (CET1) capital required to cover risks in episodes of stress.¹⁵ It also employs them in its Comprehensive Capital Analysis and Review (CCAR) of large US banks to validate their capitalisation plans and the underlying assumptions (dividend payouts and share buybacks). The capitalisation plans are based on banks' forecasts for their solvency evolution under their baseline and adverse scenarios. This quantitative analysis is supplemented with a qualitative assessment of the institutions' disclosures.

In contrast, the European supervisor does not automatically use the outcome of stress tests to determine additional capital requirements. Instead, the results are one of the inputs for the supervisor's expert judgment in the Supervisory Review and Evaluation Process (SREP). The outcomes are used to inform the individual recommendations made to banks on Pillar 2 capital requirements for overall governance and management risk (see Appendix 1). The SREP is carried out once a year to determine institutions' capital adequacy and make recommendations.

2 From 2014 to 2023: European and US banks have generally become more resilient to stress test scenarios, which have become increasingly demanding in Europe

The solvency of the largest banks has improved significantly, but more rapidly in Europe since 2014

For comparability, we focus on a sample of the ten largest banks in each jurisdiction which participated in all testing exercises covered in our study. Both samples had similar total assets in 2023, amounting to nearly EUR 15 trillion.

¹⁵ Berrospide and Edge (2024) also analyse the effects on banks' and firms' activities of a rise in capital requirements linked to the US stress tests conducted up to 2016.



¹³ See Stress test 2023 - European Banking Authority

¹⁴ See The Fed – Dodd-Frank Act Stress Tests 2023 (federalreserve.gov)

	Exercise	Europea (Top	n banks 10)		Americo (Top	an banks 5 10)	
		Amounts (euro)	Change	Amounts (dollars)	Change	Amounts (euro)	Change
Total assets	2014	11,733		11,029		8,304	
	2023	14,721	+25	15,730	+43	14,926	+80
(a) CET1	2014	444		752		566	
	2023	638	+44	991	+32	940	+66
(b) RWA	2014	4,104		6,580		4,954	
	2023	4,421	+8	8,212	+25	7,792	+57
(a)/(b) CET1 ratio 2014		10	.8		1	1.4	
	2023	14	.4		1:	2.1	

T1 Main indicators for the ten largest EU and US banks at the start of the stress tests (2014 and 2023)

Sources: European Banking Authority, European Central Bank, Federal Reserve, Moody's (BankFocus database for total assets) and author's calculations.

Note: Since 2016, CET1 ratios in US tests have been calculated based solely on RWA using standard weightings (standardised approach). European tests use RWA with standard weightings or weightings derived from bank internal models and validated by the supervisor. The CET1 solvency ratio is CET1 capital divided by the value of on- and off-balance sheet assets weighted by their risk exposure (RWA). Amounts from US bank stress tests are converted into euro using a EUR/USD exchange rate of 1.33 for 2014 and 1.05 for 2023.

Changes in capitalisation and risk-weighted assets (RWA; see glossary in Appendix 4) are measured in local currency to neutralise the amplifying effect of exchange rates (the USD appreciated by 20.7% against the euro, from USD 1.33 at the time of the first tests in 2014 to USD 1.05 in 2023).

From 2014 to 2023, the aggregate CET1 capital of the ten largest European banks increased faster than that of their US peers (+43.8% vs +31.7%). Conversely, aggregate RWA growth was stronger for large US banks (+24.8% vs +7.7%). The result was an improvement in their solvency ratio, which was particularly evident in Europe (see Table 1). This finding also holds true for European banks identified as being undercapitalised (relative to the minimum CET1 ratio requirement of $4.5\%^{16}$) under the 2014 adverse stress test scenario, and which took part in all subsequent stress testing exercises (see Table A2 in Appendix 3). The aggregate CET1 ratio of the largest European banks is now higher than that of their American peers. In addition, the increase in banks' capital can mainly be explained by their profit levels, the proportion of capital not paid out in dividends and new share issues.

European tests have become more severe since the pandemic

Projected declines in bank solvency are now more marked in Europe, in line with the GDP shocks tested

The economic and financial shocks tested in the adverse scenarios generally result in a decline in banks' regulatory capital and a rise in RWA. The analysis presented here simplifies the adverse scenarios applied in each jurisdiction. It uses the commonly agreed GDP shocks in the exercises as an indicator of the adverse scenarios' severity. The results show that, for European banks, the projected deteriorations in solvency are much greater in 2023 than in 2014. This observation is consistent with the tested GDP shocks, which have become increasingly large in Europe (see Table 2). Conversely, in the United States, the projected deteriorations in solvency are smaller in 2023. GDP shocks remained of comparable size in the United States in 2014 and 2023.

An individual analysis of the ten largest banks stressed in European and US exercises confirms the aggregate results described above, albeit with some variations in sensitivity and vulnerability to the adverse scenarios (see Tables A3 and A4 in Appendix 3).

16 This regulatory minimum requirement does not include additional precautionary requirements (see Appendix 1).



T2 Maximum GDP shocks and deterioration in solvency for the ten largest EU and US banks in the 2014 and 2023 stress tests

(maximum GDP shock and ratio in %, CET1 ratio depletion in percentage points)

	Exercise	European banks (Top 10)	American banks (Top 10)
GDP shock under the adverse scenario	2014	-2.2	-5.3
	2023	-7.5	-5.9
Starting CET1 ratio	2014	10.8	11.4
	2023	14.4	12.1
CET1 ratio depletion under the adverse scenario	2014	-2.3	-4.0
	2023	-4.8	-1.8

Sources: European Banking Authority, European Central Bank, Federal Reserve and author's calculations.

Notes: The maximum real GDP shock is calculated as the growth rate between the lowest projected level over three years in the adverse scenario and the starting point. The CET1 ratio depletion is calculated as the difference between the projected ratio at the end of the period under the adverse scenario and the starting ratio.

Banks are more resilient in 2023 to more severe GDP scenarios compared to 2021

In the United States, despite the use of larger GDP loss assumptions in 2023 than in 2021, the projected declines in solvency are comparable in both exercises (see Chart 3). These results can notably be explained by an improvement in the quality of bank books. It also reflects the appreciation of the values of securities portfolios in the scenario of a fall in interest rates tested in 2023. Nonetheless, interest income on assets is projected to decline (see Fed, 2023b). In Europe, the projected declines in solvency are higher than in the United States, both in the 2021 and 2023 tests. European institutions are more resilient in 2023 than in 2021 given a sharply increasing GDP shock. This result can be attributed to a decline in the risk exposure of bank books. In a high interest rate scenario, the tests also project an increase in the contribution from net interest income for European banks (EBA, 2023).

Despite the deterioration in their solvency position under the adverse scenarios, banks in both jurisdictions generally would continue to comply with the main regulatory capital requirements.¹⁷ They would also continue their activity of financing the economy.

C3 Maximum GDP shocks and deterioration in the average CET1 solvency ratio of the ten largest banks in EU and US stress tests (2014-23)

(% change; x-axis, maximum GDP shock; y-axis, CET1 ratio depletion) European Union United States



Sources: European Banking Authority, European Central Bank, Federal Reserve and author's calculations.

Note: The maximum real GDP shock is calculated as the growth rate between the lowest projected level over three years in the adverse scenario and the starting point. The CET1 ratio depletion is calculated as the difference between the projected ratio at the end of the period under the adverse scenario and the starting ratio. The CET1 ratio is CET1 capital divided by the value of on- and off-balance sheet assets weighted by their risk exposure (RWA). Interpretation: In the 2021 stress tests, the CET1 ratio of the ten largest EU banks fell by 5 percentage points in a scenario involving a 3.6% contraction in real GDP.

17 Tables A3 and A4 in Appendix 3 show the solvency ratios of large banks after stress. Basel III Pillar 1 minimum requirements are shown in Appendix 1.



* **

Institutions that participated in European and American stress tests have increased their capital in response to the rise in regulatory requirements. Since 2014, their solvency indicators have risen faster in Europe than in the United States. Thus, the largest institutions in both jurisdictions have increased their resilience to economic and financial shocks. Indeed, they have proved capable of withstanding the economic and financial turbulence seen since the start of the 2020s. No defaults have been observed in the euro area, and only a limited number of institutions in the United States, which did not participate in stress test exercises, have failed. Stress testing has contributed to this heightened banking system resilience, thanks to the preventive measures imposed by supervisors and the discipline effect linked to the publication of individual bank results.

That said, European and American stress testing exercises differ markedly in terms of methodology and results. In the euro area, the exercises are more exhaustive and idiosyncratic, while the approach used is becoming increasingly severe. In the United States, meanwhile, the severity of the stress depends on the economic cycle, meaning that it is higher when initial economic conditions are good. In both the euro area and the United States, the ongoing enhancement of stress testing methodologies has so far helped to increase the resilience of the entire banking system.





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Appendix 1 Stress tests and bank regulatory capital requirements

Solvency stress tests essentially simulate the impact of hypothetical scenarios on banks' ability to hold sufficient regulatory capital (Common Equity Tier 1 or CET1) to cover their regulatory risk, calculated as the value of their on- and off-balance sheet assets weighted by their estimated risk exposure (risk-weighted assets or RWA). The exercises are part of an overall regulatory framework that requires banks to hold minimum levels of capital based on their RWA.

Under Pillar 1 of the Basel III framework, banks must first hold a minimum amount of highest quality (CET1) capital to cover potential losses. This minimum is set at 4.5% of RWA. They are also required to hold additional precautionary CET1 capital buffers (capital conservation buffer, countercylical buffer and institution-specific buffers depending on the banks' size and complexity) to increase their resilience and further reduce the risk of default. The CET1 capital conservation buffer is set at 2.5% of RWA. The countercyclical capital buffer, or credit protection reserve, requires banks to build up additional capital holdings when economic conditions are good. It is set at between 0% and 2.5% of RWA. Countercyclical capital requirements can be eased when economic conditions deteriorate, to avoid any further reduction in the supply of credit to households and firms. Institution-specific capital buffers designed to increase the total loss-absorbing capacity of large banks carrying out complex activities are set at between 1% and 3.5% of RWA.

Banks are also **required to hold additional capital instruments** (additional Tier 1 and Tier 2 requirements) to cover any losses in excess of CET1 capital. Under **Pillar 2 of Basel III**, they have to hold **additional capital** to cover overall governance and management risks, in particular plausible risks identified in European stress tests. The Basel III Accords were transposed into European law under the Capital Requirements Directive (CRD). In the United States, the results of solvency stress tests are used to determine Pillar 1 capital requirements under the Dodd-Frank Act. Stress tests also measure the impact of economic and financial shocks on the regulatory leverage ratio. In the United States, banks are required to hold additional minimum amounts of CET1 and Tier 1 capital, depending on the size of their balance sheet. Under the European Basel III framework, these requirements are calculated based on balance sheet assets, and on off-balance sheet items converted into their on-balance sheet equivalents.





Appendix 2 Collection and treatment of data

This study exploits, first and foremost, historical stress test data published between 2014 and 2023 by the European Banking Authority (EBA), the European Central Bank (ECB), the US Federal Reserve (Fed) and the Federal Housing Finance Agency (FHFA). This initial dataset was supplemented with and cross-checked against publicly available historical data on economic and financial variables published since 1999 (date of the introduction of the euro, the single European currency), from the Eurostat database, the Fed, the FHFA and the World Bank (harmonised data). We also used BankFocus data from the ratings agency Moody's to examine trends in bank balance sheets in Europe and the United States. ECB data on exchange rates was used to convert dollardenominated amounts from US banks into euro.

Data from the European Banking Authority (EBA)

The data can be found here: Stress test 2023 | European Banking Authority (europa.eu).

The starting points and bank projections in the 2023 EU-wide stress test are available in Excel format on the EBA website under *Results/Stress test documents/ Full database*. Data from previous exercises can be found in the same way by selecting the exercise in the *EU-wide stress testing* drop-down. The menu also contains dictionaries of variable definitions. Stress scenarios are listed in the *Documents* section.

Data from the United States Federal Reserve (Fed)

The data can be found here: The Fed - Dodd-Frank Act Stress Tests 2023 (federalreserve.gov).

Starting points and projections (end-of-period and maximum impact) of the US DFAST stress test (from 2013) can be found in the csv file in the section *Results Data*. Dictionaries of variable definitions are also available.

Federal Housing Finance Agency (FHFA)

The data can be found here: *Stress Testing Orders* | *FEDERAL HOUSING FINANCE AGENCY (fhfa.gov).*

Excels files of DFAST 2023 stress scenario are available in the menu 2023 Orders/XLS Spreadsheets. Those from previous exercises can be found in the same way.

European Commission and European Central Bank data

Historical data on European 10-year government bond yields and exchange rates can be found here: Statistics | Eurostat (europa.eu) Reference rates | ECB Data Portal (europa.eu)

World Bank data

Harmonised European and US gross domestic product data can be found here: *GDP (constant 2015 USD)* | *Data (worldbank.org).*

Data from Moody's rating agency

Bank balance sheet data were extracted from Moody's BankFocus database here: *BankFocus (bvdinfo.com)*.



Appendix 3

Comparison of the observed and stressed solvency and balance sheet evolution of EU and US banks (2014-23)

Year	EU-wide ST/ US DFAST	Sample	Currency	Starting CET 1	Starting RWA	Starting CET1 ratio	Adv final CET1 ratio	Adv final CET1 ratio shock	Max. adv CET1 ratio shock
2014		123	EUR	1,242	11,200	11.1	8.4	-2.7	-2.7
	EO-wide ST BO	o/w top 10	EUR	444	4,104	10.8	8.5	-2.3	
	US DFAST TD	30	USD	963	8,375	11.5	7.8	-3.7	-3.9
		o/w top 10	USD	752	6,580	11.4	7.5	-4.0	
		30	EUR	725	6,305	11.5	7.8	-3.7	-3.9
		o/w top 10	EUR	566	4,954	11.4	7.5	-4.0	
	Ellusida CT DI I	51	EUR	1,238	9,388	13.2	9.3	-3.9	-3.9
	EO-wide ST BO	o/w top 10	EUR	527	4,232	12.5	9.0	-3.5	
2014		33	USD	1,180	9,595	12.3	8.4	-3.9	-3.9
2010		o/w top 10	USD	900	7,260	12.4	8.4	-4.0	
	US DFAST ID	33	EUR	1,064	8,647	12.3	8.4	-3.9	-3.9
		o/w top 10	EUR	811	6,543	12.4	8.4	-4.0	
0010	EU-wide ST BU	48	EUR	1,223	8,431	14.5	10.3	-4.2	-4.2
		o/w top 10	EUR	560	4,140	13.5	9.6	-3.9	
	US DFAST TD	35	USD	1,236	10,045	12.3	8.7	-3.6	-4.4
2010		o/w top 10	USD	900	7,382	12.2	8.5	-3.7	
		35	EUR	1,094	8,895	12.3	8.7	-3.6	-4.4
		o/w top 10	EUR	797	6,537	12.2	8.5	-3.7	
	EU-wide ST BU	50	EUR	1,115	8,152	15.3	10.3	-5.0	-5.0
		o/w top 10	EUR	614	4,215	14.6	9.7	-4.9	
0001	US DFAST TD	23	USD	1,204	9,261	13.0	11.2	-1.8	-2.4
2021		o/w top 10	USD	968	7,645	12.7	11.0	-1.7	
		23	EUR	1,055	8,114	13.0	11.2	-1.8	-2.4
		o/w top 10	EUR	848	6,699	12.7	11.0	-1.7	
0000	EU-wide ST BU	70	EUR	1,301	8,568	15.2	10.4	-4.8	-4.8
		o/w top 10	EUR	638	4,421	14.4	9.6	-4.8	
		23	USD	1,251	10,090	12.4	10.5	-1.9	-2.5
2023		o/w top 10	USD	991	8,212	12.1	10.3	-1.8	
	US DFAST ID	23	EUR	1,187	9,574	12.4	10.5	-1.9	-2.5
		o/w top 10	EUR	940	7,792	12.1	10.3	-1.8	

TA1 Samples and main aggregate results of EU and US stress tests (2014-23)

Sources: European Banking Authority, European Central Bank and Federal Reserve.

Note: The CET1 ratio is the ratio between CET1 capital and the value of on- and off-balance sheet assets weighted by their estimated risk (RWA). The adverse shock is calculated as the difference between the projected CET1 ratio (end-of-period or minimum) under the adverse scenario and the starting point. CET1 capital levels not communicated by the Federal Reserve are calculated using published CET1 ratios and RWA. Individual and detailed results have only been published for the largest European banks (Significant Institutions or SI) since 2016. Only information for years when both European and US stress tests were conducted are reported. BU and TD denote bottom-up and top-down stress tests, respectively.

Amounts from US bank stress tests are converted into euro using a EUR/USD exchange rate of 1.33 for 2014 and 1.05 for 2023. "Top 10" refers to the ten largest banks.



TA2 Evolution of the solvency and resilience of the four European banks initially identified as undercapitalised in the 2014 adverse scenario (maximum GDP shock and ratio in%; change in in percentage points)

	Exercise	4 EU banks initially identified as fragile in 2014	Top 10 European banks
Maximum GDP shock under the adverse scenario	2014	-2.2	
	2023	-7.5	
Starting CET1 ratio	2014	7.9	10.8
-	2023	15.3	14.4
CET1 ratio depletion under the adverse scenario	2014	-8.6	-2.3
	2023	-4.3	-4.8

Sources: European Banking Authority, European Central Bank and author's calculations.

Note: These banks, which participated in all European stress test exercises, were identified as fragile (undercapitalised) because their CET1 ratios were projected under the regulatory 4.5% minimum under the adverse scenario. See also Table 2. EU, European Union.

TA3 Change in the characteristics of the ten largest EU banks (constant sample) in EU stress tests (2014-23)

(amounts in EUR billions; CET1 ratio shock in percentage points)									
Bank name	Starting to	Starting total assets		Starting CET1		Starting RWA		Adv. CET1 ratio shock	
	2014	2023	2014	2023	2014	2023	2014	2023	
BNP Paribas S.A. (BNPPSA)	1,811	2,664	66	92	622	745	-2.5	-4	
Group Crédit Agricole (GCA)	1,688	2,351	59	101	545	575	-2	-7.6	
Banco Santander S.A. (BSSA)	1,116	1,735	56	74	540	610	-1.4	-1.8	
Groupe BPCE (GBPCE)	1,124	1,504	41	70	411	461	-3	-5.2	
Société Générale S.A. (SGSA)	1,214	1,485	37	49	343	360	-2.5	-5.3	
Deutsche Bank AG (DBAG)	1,611	1,337	47	48	353	360	-4.5	-5.3	
Groupe Crédit Mutuel (GCM)	660	1,108	33	63	237	334	-0.8	-7.3	
ING Groep N.V. (ING GNV)	1,081	968	30	48	299	332	-1.4	-5.5	
UniCredit S.p.A. (UCSpA)	846	858	39	51	409	309	-2.8	-4.2	
Banco Bilbao V.A. S.A. (BBVASA)	583	713	36	43	345	337	-1.6	-3	
Total	11,733	14,721	444	638	4,104	4,421	-2.32	-4.84	

Sources: European Banking Authority, European Central Bank, Moody's (BankFocus database for total assets) and author's calculations. Note: CET1 is the amount of CET1 capital. RWA is the value of on- and off-balance sheet assets weighted by estimated risks. The adverse (adv) shock is calculated as the difference between the projected CET1 ratio at the end of the period under the adverse scenario and the starting ratio. The CET1 ratio is the bank's CET1 capital divided by RWA.



TA4 Change in the characteristics of the ten largest US banks (constant sample) in US stress tests (2014-23)

(amounts in EUR billions and USD billions; CET1 ratio shock in percentage points)

Bank name	Currency	Starting total assets		Starting CET1		Starting RWA		Adv CET1 ratio shock	
		2014	2023	2014	2023	2014	2023	2014	2023
JPMorgan Chase (JPMC)	USD EUR	2,416 1,819	3,666 3,478	144 109	218 207	1,374 1,035	1,654 1,569	-3.8	-1.3
Bank of America Corp. (BOAC)	USD EUR	2,105 1,585	3,051 2,895	143 108	180 171	1,289 971	1,605 1,523	-5.1	-1.3
Citigroup Inc. (Citi I)	USD EUR	1,880 1,416	2,417 2,293	136 102	149 141	1,069 805	1,143 1,085	-5.5	-3.3
Wells Fargo & Co. (WFC)	USD EUR	1,527 1,150	1,881 1,785	120 91	134 127	1,135 855	1,260 1,195	-2.4	-2.2
Goldman Sachs Group (GSG)	USD EUR	912 686	1,442 1,368	62 47	98 93	437 329	653 620	-5	-2.4
Morgan Stanley (MS)	USD EUR	833 627	1,180 1,120	49 37	69 65	386 290	448 425	-5	-0.4
U.S. Bancorp (USB)	USD EUR	364 274	675 640	27 21	42 40	293 221	497 471	-1	-1.5
PNC Financial Services Group (PNCFSG)	USD EUR	321 241	557 529	27 21	40 38	267 201	436 413	-1.3	-1.1
Capital One Financial Corp. (COFC)	USD EUR	297 224	455 432	27 21	45 42	216 162	358 340	-4.9	-4.5
Bank of New York Mellon Corp. (BNYMC)	USD EUR	374 282	406 385	16 12	18 17	114 86	159 151	2	3.6
Total	USD EUR	11,029 8304	15,730 14,926	752 566	991 940	6,580 4,954	8,212 7,792	-3.95	-1.8

Sources: Federal Reserve, Moody's (BankFocus database for total assets), European Central Bank (for EUR/USD exchange rate) and author's calculations. Notes: See Table A3. Amounts from US bank stress tests are converted into euro using a EUR/USD exchange rate of 1.33 for 2014

and 1.05 for 2023.





Glossary

Common Equity Tier 1 (CET1) capital

The highest quality regulatory capital held by a bank.

CET1 capital requirement

Minimum amount of high-quality capital that a bank is required to hold. It is calculated as a percentage of the estimated value of the bank's on- and off-balance sheet risk exposure (see RWA). In addition to financing a portion of the bank's assets, it is designed to cover any losses and encourage banks to behave responsibly.

CET1 solvency ratio

Indicator of a bank's soundness. It is equal to CET1 capital divided by the estimated value of the bank's on- and off-balance sheet risk exposure (see RWA). It is used to assess a bank's ability to withstand adverse shocks in stress testing exercises.

Bank stress tests

Forward-looking exercises to determine whether banks can withstand a crisis or a significant deterioration in economic and financial conditions. They measure the impact of such a deterioration on banks' risk exposure and profitability. The objective is to identify weaknesses in individual institutions and in the banking system as a whole. If necessary, supervisors can then take early preventive action to protect savers and maintain lending activities in the event of a materialisation of risks.

Bank solvency

A measure of a bank's intrinsic ability to honour its commitments to its creditors over the long term. Regulations (known as capital requirements) require banks to hold a minimum capital buffer to absorb any losses.

Risk-weighted assets (RWA)

Regulatory measure of the riskiness of banks' assets and off-balance sheet exposures. RWA is equal to the amount of each type of on- and off-balance sheet item multiplied by an estimate of its risk exposure (weighting).

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