



BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM
WASHINGTON, DC 20551

Supervisory Stress Test Model Documentation

Operational Risk Model

Fall 2026

This document summarizes the Operational Risk Model that the Board of Governors of the Federal Reserve System (Board) intends to use in the 2027 Supervisory Stress Test. The following sections provide a summary of the model, model components, and alternatives considered, along with other model-specific details. Documentation on the other models that the Board intends to use in the 2027 Supervisory Stress Test is available at the following link:
<https://www.federalreserve.gov/supervisionreg/dfa-stress-tests-2027.htm>.

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A. Operational Risk Model

i. Statement of Purpose

The operational-risk loss model (Operational Risk Model) is a component model that estimates potential operational losses over the hypothetical stress scenario.¹ Operational risk is a noninterest expense component of pre-provision net revenue. As operational losses tend to exhibit distinct characteristics—such as a heavy-tailed distribution—they are estimated separately from other components of pre-provision net revenue.²

Operational losses include losses stemming from events such as fraud; computer system failures; process errors; and lawsuits by employees, customers, or other parties.³ Operational losses are large and pervasive in the banking sector. According to supervisory data, firms subject to the Board's stress test experienced nearly \$450 billion in realized operational losses between 2000 and 2023. Many of these losses originated from the 2008 financial crisis. For instance, five of the largest U.S. banking organizations arrived at a \$26 billion settlement related to foreclosure abuses during the 2008 financial crisis (Schwartz and Dewan, 2012).⁴ Separately, many large

¹ This documentation reflects the implementation of two changes that the Board proposed to implement in the 2025 Proposed Model Documentation. First, the Board proposed to discontinue using a macroeconomic regression model to project operational losses, and to instead primarily use the distributional model to produce operational loss projections. Second, the Board proposed to subtract several highly liquid assets from total assets for purposes of scaling historical operational losses. The 2025 Proposed Model Documentation is available at <https://www.federalreserve.gov/supervisionreg/dfa-stress-tests-2026.htm>.

² Because of the distinct characteristics of operational-risk losses, a set of modeling approaches evolved over time for this specific risk area. For an introductory overview of the characteristics of operational loss distributions and approaches to modeling operational risk, see Lewis, N.D.C., 2004. *Operational Risk: Applied Statistical Methods for Risk Management*. John Wiley & Sons.

³ See Basel Committee on Banking Supervision (BCBS), 2024. International Convergence of Capital Measurement and Capital Standards: A Revised Framework. <https://www.bis.org/publ/bcbs107.pdf>.

⁴ See Schwartz, N.D., and Dewan, S. (Feb. 9, 2012). *States Negotiate \$26 Billion Agreement for Homeowners*. New York Times. <http://www.nytimes.com/2012/02/09/business/states-negotiate-25-billion-deal-for-homeowners.html>.

banking organizations took sizable losses by repurchasing troubled mortgages from Fannie Mae and Freddie Mac (Protess and Dash, 2011).⁵

Projected operational losses from the stress test contribute to firms' regulatory capital requirements, which are designed to ensure that the banking sector is well-positioned to withstand hypothetical adverse events. The 2008 financial crisis is a concrete example of an economic crisis that is associated with heightened operational risks and highlights the importance of accounting for potential operational losses in a hypothetical stress scenario. In addition to operational losses associated with the 2008 financial crisis, firms have experienced large operational loss events that affected several firms or specific to individual firms. While some of these loss events are not associated with macroeconomic shocks, they potentially may occur during stressful periods. Therefore, the Operational Risk Model stress tests firms' operational risks comprehensively and produces stressful operational losses that could be systemic for many firms, correlated in several firms, or specific to individual firms. The Operational Risk Model is designed to project quarterly losses over the projection horizon for each supervisory stress test scenario. Key firm characteristics that affect projected losses include the size of the firm measured by total assets, with an adjustment as described in Section A.iii.b, and the firm's historical operational losses by operational-risk loss category.

⁵ Mortgages repurchased from government sponsored enterprises during and following the 2008 financial crisis were often accompanied by claims that lenders misrepresented the quality of these mortgages. As such, losses associated with these repurchases are considered operational losses, rather than credit losses. See Protess, B., and Dash, E. (Jan. 3, 2011). *Bank of America Buys Back \$2.5 Billion in Mortgage Debt*. New York Times. <https://archive.nytimes.com/dealbook.nytimes.com/2011/01/03/fannie-and-freddie-continue-to-collect-on-bad-loans/>.

ii. Model Overview

Operational loss projections are primarily produced by a distributional model⁶ that uses a historical simulation to create an unconditional distribution of operational loss amounts. An unconditional distribution is one that is not restricted by or contingent on firm-specific characteristics or environmental factors. Projections are based on a selected tail percentile of the distribution which is informed by the frequency of historical recessions. An additional model component generates projections for smaller losses that are excluded from the distributional model.

The distributional model and the small-loss component both produce single 9-quarter loss projections for each firm, which the Board then allocates evenly over the stressed projection horizon. Final operational loss projections for each firm and each quarter of the projection horizon are the sum of the projections produced by the distributional model and the small-loss component model.

a. Overview of Distributional Model

The Board has determined that the use of a distributional model is appropriate given the properties and characteristics of operational losses, which have a wide range of causes and can be influenced by many different economic and non-economic factors. For example, the widespread system outages caused by a faulty CrowdStrike update in 2024 is an example of an operational event caused by non-economic factors that was felt concurrently by firms across the country (Rothenberg, 2024).⁷ As the distributional model is driven by the unconditional properties of the

⁶ A “distributional model” is a generic name for a class of models or a framework describing how economic values or outcomes are distributed across units of observations within a population.

⁷ The CrowdStrike incident created transactions processing problems at some financial firms. See Rothenberg, E. (Jul. 20, 2024). *Timeline: How the CrowdStrike outage unfolded*. CNN. <https://edition.cnn.com/2024/07/20/tech/timeline-crowdstrike-system-outage/index.html>; Saeedy, A. (Jul. 19, 2024). *Banks Grapple with Technical Difficulties Following CrowdStrike Outage*. Wall Street Journal. <https://www.wsj.com/livecoverage/stock-market-today-dow-sp500-nasdaq-live-07-19-2024/card/banks-grapple-with-technical-difficulties-following-crowdstrike-outage-ZQAY4mQ7okOmCkam0CIY?>

historical operational loss event distribution—that is, properties that are not contingent on any specific risk factors—the model’s loss projections reflect a severe and rare outcome that could result from a broad range of different loss events. As discussed in Section A.v, the Board has determined that a distributional model is appropriate given the idiosyncratic nature of operational risk and the ability of the distributional approach to capture loss events with a wide range of underlying causes. The Board further believes the distributional model best accounts for large loss events that might arise from a number of different factors, and which may coincide with a severe macroeconomic downturn.

b. Overview of Small-Loss Component Model

In addition to the distributional model, the Board uses a small-loss model component to project loss events of less than \$20,000. Firms have different operational loss collection and reporting thresholds. To treat all firms consistently, the Federal Reserve excludes loss events of less than \$20,000 from the distributional model and projects these losses using a separate model component. Losses projected from this separate component are then added to the projections from the distributional model to produce final operational loss projections.

c. Application of the Federal Reserve’s Principles

The Operational Risk Model is consistent with the Board’s policies and procedures that guide stress testing model development, as outlined in the Stress Testing Policy Statement.⁸

One supervisory modeling policy of particular importance for operational risk is the emphasis on an industry-level approach⁹ and the calibration of parameters using data from many institutions.¹⁰ Given the idiosyncratic nature of operational risk, a firm’s loss history may not fully

⁸ For the full statement, see 12 CFR 252, Appendix B.

⁹ Throughout this section, the term “industry” is used to refer to the set of covered firms subject to the stress test.

¹⁰ See 12 CFR 252, Appendix B, part 2.4(d).

capture the firm's susceptibility to future operational risks. Throughout the modeling suite, parameters are informed by industry experience rather than exclusively firm-specific historical experience. By employing an industry-level approach, the model assumes that operational losses experienced by some firms could be applicable to other institutions in the future. The emphasis on industry-level parameter estimation is consistent with the modeling principles of comparability of results and limiting reliance on individual firms' past outcomes, as a firm's projections depend heavily on industry data. Using an industry-focused model also promotes stability and robustness—two key modeling objectives—as parameters are estimated on a large dataset that is generally stable from cycle to cycle.

Further, though model parameters are estimated on historical data, using a simulation limits the reliance of loss projections on past outcomes. The simulated distribution is the product of 250,000 random draws from loss frequency and severity distributions. As such, the aggregate distribution reflects a range of plausible loss realizations, not just those with historical precedent.¹¹

Each component of the operational risk modeling suite is discussed in detail below.

iii. Data Sources

The Operational Risk Model primarily uses two types of data: historical operational loss data from the FR Y-14Q, Schedule E.1 and firm asset size data sourced primarily from the FR Y-9C.

¹¹ While the distributional model is based on historical data, the model is not constrained by historical precedent. For instance, it has the ability to produce simulated nine-quarter loss projections that are larger than the firm's historical maximum nine-quarter loss amount.

a. FR Y-14Q Schedule E.1 Data¹²

All firms subject to the Federal Reserve’s stress test are required to report a complete history of their operational loss events. Firms submit their historical individual loss events quarterly on Schedule E.1 of the FR Y-14Q reporting form. As operational loss events have a wide range of causes, the reporting form requires firms to sort operational losses into seven standard categories consistent with the loss categories defined by the Basel Committee on Banking Supervision (BCBS).

Table A1 below shows the percentage of total reported operational loss amounts by these Basel event types.¹³

Table A1 - Percentage of Total Reported Gross Operational Losses by Event Type

Event Type	% of Total Losses
Clients, Products, and Business Practices (CPBP)	72.5
Execution, Delivery, and Process Management (EDPM)	14.8
External Fraud (EF)	4.9
Employment Practices and Worker Safety (EPWS)	3.0
Internal Fraud (IF)	2.3
Business Disruption and System Failures (BDSF)	1.3
Damage to Physical Assets (DPA)	1.2

Note: This table shows the proportion of gross operational losses by event type incurred between 2000 and 2022 by firms subject to the 2024 stress test.

As explained below in Section A.iv.a and A.iv.b, each event type category is modeled separately in the distributional model. The separate treatment reflects different distributional properties for each event type. For instance, loss events related to fraud would be expected to have

¹² The Board has made clarifications to the text of this 2026 model documentation compared to the model documentation proposed in 2025. The model documentation proposed in 2025 continues to be available on the Board’s website, at <https://www.federalreserve.gov/supervisionreg/dfa-stress-tests-2026.htm>.

¹³ The Basel Event Type refers to the Level 1 Basel Event-Type Category reported on Field Reference J of the Schedule E.1 of the FR Y-14Q reporting form. Throughout the remainder of this section, the variable will be referred to simply as an event type.

a different frequency from legal events. The event type with the largest share of industry-aggregate operational losses is Clients, Products, and Business Practices. Firms often categorize legal events in this event type, particularly those related to improperly marketed products that were prevalent during the 2008 financial crisis.

Other key fields in the Schedule E.1 reporting form used throughout the model suite are the Gross Loss Amount and the Accounting Date (the date a given loss event was reflected in the firm's financial statements). Often, when a loss event unfolds over time, firms will report different accounting dates for different loss impacts.¹⁴ In such situations, the Board assumes that the full financial impact of a loss event is realized within the first quarter in which a loss impact was reported. As firms have different loss collection and reporting standards, this assumption allows for interpretability and consistency across firms. The assumption is discussed further in Section A.vii.a.

All historical events are considered in the Operational Risk Model, subject to exclusions discussed in Section A.iv.c. Including all losses is appropriate because it assumes that the severity and frequency of historical losses represent the severity and frequency of losses that could occur in different businesses in the future, even if the specific source of the future loss is not tied directly to the source of the historical loss event. The entire historical loss distribution best considers all future potential losses, including potential losses from newly emerging or expanding business or risks that have not yet experienced losses.

For a small share of operational loss events, firms recover a portion of the loss amount. In these cases, firms separately report the gross loss amount and recovered amounts. Given the lower

¹⁴ The term "impact" refers to a portion of an operational loss event. For instance, a lawsuit might constitute a single operational loss event, but it may involve several distinct loss impacts that occur at different points in time, such as the settlement or payments to outside counsel.

chance of recovery during stressful periods,¹⁵ and the uncertainty over when recoveries will materialize, the Operational Risk Model conservatively estimates losses using the gross loss amount rather than losses net of recoveries. Staff analyzed Schedule E.1 data for all events with recoveries. This data indicated there are about 16 quarters, on a gross loss-weighted average, between the first accounting date of an event and the date of the first recovery for that event. This supports use of the gross loss amount, as most of the beneficial impact of recoveries occurs beyond the nine quarters that is the length of the projection period.

b. FR Y-9C Data¹⁶

The Operational Risk Model uses firm asset size to normalize operational losses across firms and over time. Asset size is primarily measured by total assets as reported on the FR Y-9C reporting form.¹⁷ As discussed in Section A.vii.b, the Board subtracts certain high quality liquid assets from total assets, such as cash and balances due from depository institutions, U.S. Treasury securities, and U.S. Government agency and sponsored agency obligations excluding mortgage-backed securities (MBS).¹⁸ This calculation will be referred to as “adjusted total assets” or “adjusted assets” for the rest of this document. When FR Y-9C data are unavailable for a firm,¹⁹ the Federal Reserve will source data from either the Reports of Condition and Income (Call

¹⁵ See Frame, W.S., et al., 2024. Operational loss recoveries and the macroeconomic environment: Evidence from the U.S. banking sector. *Journal of Banking & Finance*, 107220. The authors show that recoveries diminish during periods of stress.

¹⁶ The Board has made clarifications to the text of this 2026 model documentation compared to the model documentation proposed in 2025. The model documentation proposed in 2025 continues to be available on the Board’s website, at <https://www.federalreserve.gov/supervisionreg/dfa-stress-tests-2026.htm>.

¹⁷ Total Assets is reported on Schedule HC, line 12 of the FR Y-9C reporting form.

¹⁸ These are reported on Schedule HC, line 1, HC-B lines 1 and 2, and HC-D lines 1 and 2 of the FR Y-9C reporting form. For HC-B and HC-D, the fair value of AFS securities and amortized cost of HTM securities are excluded from total assets.

¹⁹ Data may be unavailable during historical periods when the covered entity was not required to report the FR Y-9C.

Reports), the OTS 1313 reporting form, or financial statements sourced from a third party data vendor. Scaling historical loss events by asset size is discussed further in Section A.vii.b.

iv. Model Specification²⁰

As described above, the Operational Loss Model primarily produces operational loss projections with a distributional model that uses a historical simulation to create an unconditional distribution of operational losses. The operational risk modeling suite also includes an additional component to generate projections for small loss events excluded from the distributional model.

The distributional model uses a historical simulation that produces a nine-quarter aggregate loss distribution. Projections under the severely adverse scenario are based on a tail percentile of that distribution. As discussed above and in more detail in Section A.v, the distributional model is appropriate given the idiosyncratic nature of operational risk and wide range of causes that underlie operational losses.

The model simulates a nine-quarter loss distribution by modeling loss event severity and frequency separately and combining them through a Monte Carlo simulation. Loss event severity defines how large a given operational loss event might be. Loss event frequency defines how many times individual loss events might occur in a given period of time.

The body and tail of the loss event severity distribution are defined based on the distribution across all covered firms of the ratio of historical loss event amounts scaled by historical firm asset size. The body-tail cutoff point is set at the 99th percentile of the entire loss-to-adjusted assets distribution for each event type.²¹ Tail losses have a loss-to-adjusted assets ratio equal to or greater

²⁰ The Board has made clarifications to the text of this 2026 model documentation compared to the model documentation proposed in 2025. The model documentation proposed in 2025 continues to be available on the Board's website, at <https://www.federalreserve.gov/supervisionreg/dfa-stress-tests-2026.htm>.

²¹ The Board's approach to calculating adjusted assets is discussed in Section A.iii.b above and A.vii.b below.

than the body-tail cutoff point, and body losses have a loss-to-adjusted assets ratio less than the body-tail cutoff point. As detailed below, projected losses from the body and tail of the loss event severity distribution are modeled differently and separately.

a. Tail Loss Event Modeling

The Board uses a simulation-based approach to model projected losses from the tail of the loss event severity distribution. This simulation model follows a common approach in operational risk modeling known as the Loss Distribution Approach (LDA).²² In this application, the approach models tail loss frequency and tail loss severity separately and combines them to produce an unconditional aggregate loss distribution. The process has two steps:

- First, calculate a firm-specific parameter representing the frequency of tail loss events for each firm j and event type e (tail frequency parameter).
- Second, use a Monte Carlo simulation to select random draws from the pool of tail loss ratios for event e (those in the top 1% of the industry loss severity distribution) and create an aggregate 9-quarter loss distribution (Monte Carlo simulation).

(1) Step 1: Tail Frequency Parameter

The initial step in this model is the calculation of a parameter for each firm and event type that represents the frequency of tail loss events over a 9-quarter horizon. This parameter is, for each event type, the simple average of a firm-specific parameter and, given the stress test modeling principles' emphasis on industry-level modeling, an industry-specific parameter. The firm-specific tail frequency parameter λ for firm j and event type e is calculated as:

Equation A1 – Firm-Specific Tail Frequency Parameter

$$\lambda_{j,e}^{individual} = \frac{\#Tail\ Events_{j,e}}{\#Quarters_{j,e}} \times 9$$

²² LDA models are commonly used in actuarial science. For an overview and applications to the insurance industry, see Klugman, P., et al. (1998). *Loss Models: From Data to Decision*. Wiley-Interscience.

where $\#Tail\ Events_{j,e}$ is the number of historical tail loss events for firm j within event type e , and $\#Quarters_{j,e}$ is the number of quarters of historical operational loss data available for firm j within event type e .

The industry-specific tail frequency parameter for each firm j and event type e is calculated as:

Equation A2 – Industry-Specific Tail Frequency Parameter

$$\lambda_{j,e}^{industry} = \frac{\ln(TotalAssets_{j,t=0})}{\sum_j \ln(TotalAssets_{j,t=0})} \times \sum_{j,e} \lambda_{j,e}^{individual}$$

where $TotalAssets_{j,t=0}$ are the adjusted total assets of firm j as of the quarter prior to the first quarter of the projection horizon of the stress testing exercise. The intent of the industry-specific tail frequency parameter is to sum individual tail parameters ($\lambda_{j,e}^{individual}$) across all firms for a given event type and then apply a weight for firm j according to its relative asset size. In applying a weight based on asset size, the Board takes the natural logarithm of adjusted total assets in the numerator and denominator because the Board has observed that tail loss frequency is concave in asset size.

The tail loss event frequency parameter for each firm and event type used in the Monte Carlo simulation is the average of the firm-level frequency parameter and the industry parameter:

Equation A3 – Tail Loss Event Frequency Parameter

$$\lambda_{j,e}^{tail} = \frac{\lambda_{j,e}^{individual} + \lambda_{j,e}^{industry}}{2}$$

(2) Step 2: Monte Carlo Simulation

The next step in this model is to run a Monte Carlo simulation to produce an aggregate nine-quarter loss distribution. The simulation follows the steps below for each firm j and event type e :

1. Randomly draw from a Poisson distribution with expected value $\lambda_{j,e}^{tail}$. The drawn value is denoted as m .
2. Make m random draws from the pool of tail loss event ratios (the top 1% of historical loss amount-to-asset size ratios across covered firms).
3. Convert the drawn ratios to dollar values by multiplying the ratios by the adjusted total assets of firm j as of the quarter prior to the first quarter of the projection horizon of the stress test exercise.
4. Sum the converted draws. The summation represents one plausible realization of operational losses from 9-quarter tail loss events for firm j in event type e .

The simulation is performed 250,000 times per firm j and event type e to create a distribution of tail loss events for each firm-event combination.

b. Body Loss Event Modeling

The Board uses a simpler approach to model the body of the loss event distribution. The body of the loss event distribution constitutes all those loss events outside the top one percent of the distribution of industry loss-to-adjusted assets ratios. For these loss events, the Board's loss projections under supervisory scenarios reflect the expected body loss, defined as the average number of historical loss events multiplied by the average historical loss event amount for each firm and event type. Relative to a simulation, this expected loss approach is simpler and does not require as many assumptions. The approach also produces loss projections similar to that of a simulation.

For these loss events, the Board calculates the frequency ($\lambda_{j,e}^{body}$) as the historical average of the number of quarterly body loss events, multiplied by nine, for each firm j and event type e :

Equation A4 – Average Body Loss Event Frequency

$$\lambda_{j,e}^{body} = \frac{\#Body\ Events_{j,e}}{\#Quarters_{j,e}} \times 9$$

where $\#Body\ Events_{j,e}$ is the number of historical body loss events for firm j within event type e , and $\#Quarters_{j,e}$ is the number of quarters of historical operational loss data available for firm j within event type e .

The nine-quarter average body loss event frequency is multiplied by the average inflation-adjusted loss amount for a given firm j and event type e ; the product represents expected operational losses from body loss events for that firm and event type ($BodyLoss_{j,e}$):

Equation A5 – Expected Operational Losses from Body Loss Events

$$BodyLoss_{j,e} = \lambda_{j,e}^{body} \times \frac{\sum_1^{\#Body\ Events_{j,e}} Loss_{j,e}}{\#Body\ Events_{j,e}}$$

where $Loss_{j,e}$ is the loss amount from an event in the body of the loss event distribution for firm j in event type e .

Expected body losses are added to modeled tail losses for each of the 250,000 simulations to produce an aggregate loss distribution for each firm j and event type e .

c. Data and Ad-Hoc Adjustments for the Distributional Loss Model

The following adjustments are made to the data prior to estimation:

- As discussed in Section A.ii.b, loss events with a gross loss amount below \$20,000 on an inflation-adjusted basis are removed from the estimation sample for the distributional model.
- As firms report the historical operational losses of acquired entities, asset size is constructed to include the adjusted assets of acquired entities.
- For the body and tail frequency models, the estimation dataset excludes loss events from the two most recent reporting quarters. As the frequency parameters are calibrated based on the average number of events over the reporting period, the two most recent quarters are omitted to prevent underestimation that might occur from a reporting lag. The data sample, however, is not truncated for purposes of constructing the severity distribution; the Board seeks to capture as many tail loss events as possible for this model component, and

there would be no benefit from excluding the severity of loss events from the last two quarters.

- The tail frequency calculations use data starting from 2000:Q1 or the first available date to mitigate data collection issues in the earliest periods of the submission.

d. Percentile Selection

The distributional model produces distributions of potential aggregate nine-quarter tail event losses for each firm j and event type e where a tail event is defined as a loss event in the top 1 percent of the industry loss-to-adjusted assets distribution. The Board uses the 93rd percentile from the simulated distributions to represent the magnitude of tail losses that might occur under stressed conditions, and this percentile is used to determine the distributional model's operational loss projections under the severely adverse scenario. The 93rd percentiles from each simulated event type distribution are added together, with the expected body losses from each event type, to form the loss projection for the distributional model. The Board does not model the diversification benefit to maintain simplicity of the model. While literature has shown notable diversification benefits at the 99.9th percentile of an annual loss distribution,²³ the Board's analysis suggests these benefits are not notably impactful at the 93rd percentile of the nine-quarter distribution. This decision of which percentile to use is discussed further in Section A.v.a.(3) below.

e. Treatment for firms with insufficient historical data

The distributional model requires that firms have collected historical operational loss data to calculate the individual firm tail loss frequency as shown in equation A1. However, in certain instances, firms may have a short time series of operational loss data, making it difficult to draw

²³ See Abdymomunov, A and Ergen, I. Tail Dependence and Systemic Risk in Operational Losses of the U.S. Banking Industry. *International Review of Finance*. 17(2), 2017, 177-204.

inferences from the frequency of historical tail loss events.²⁴ For a firm j under such circumstances, the Board does not use the distributional model but instead projects losses under the severely adverse scenario using the distributional model output based on the firm's adjusted asset size. In particular, nine-quarter operational loss projections for a new firm j , NF_j , are calculated as:

Equation A6 – Operational Loss Projections for a New Firm

$$NF_j = \frac{\sum_i \left(\frac{Loss_i^D}{TotalAssets_{i,t=0}} \right)}{N} \times TotalAssets_{j,t=0}$$

where $TotalAssets_{j,t=0}$ is the adjusted total assets as of the quarter prior to the first quarter of the projection horizon of the exercise for firm j ; $TotalAssets_{i,t=0}$ are the adjusted total assets as of the quarter prior to the first quarter of the projection horizon of the exercise for a firm i that is modeled by the distributional model; $Loss_i^D$ is the nine-quarter operational loss projection under the severely adverse scenario for firm i produced by the distributional model, and N is the number of firms for which projections are produced by the distributional model.

f. Adjusting for Loss Events Below the Modeling Threshold

As discussed above, the distributional model only projects operational loss events above the \$20,000 modeling threshold. As loss data collection and reporting thresholds vary, this modeling threshold is necessary to ensure consistency in data inputs across firms. The Board chose the \$20,000 threshold because it exceeds the vast majority of reporting thresholds across firms and business lines.

²⁴ The Board typically follows the requirement that firms recently subject to the supervisory stress test have five years of data by event type to be included in the distributional model. This requirement is consistent with the Bank for International Settlements requirement for firms using the standardized approach for capital modeling. See BCBS (2026). *OPE Calculation of RWA for Operational Risk: Standardised Approach*, Paragraph OPE25.15. https://www.bis.org/basel_framework/chapter/OPE/25.htm#fn_OPE_25_10_3.

To account for losses that are not included in the input data for the distributional model, an additional model—the small-loss component model—estimates losses below the \$20,000 threshold. Several firms report operational loss data without any threshold or one that is lower than this threshold. The Board utilizes these data to estimate loss events below \$20,000. The small-loss component model is based on the observation that the share of smaller loss events does not vary much between firms, but that firms’ total losses below this threshold are proportional to firm size, as measured by total assets. The small-loss component model averages adjusted asset-scaled aggregate losses from below-threshold events over time and across firms to project associated loss events based on asset size.

The small-loss component model consists of three steps. The first step is the calculation of the average quarterly ratio of below-threshold loss events scaled by adjusted total assets for each firm j and event type e reporting losses below the threshold:

Equation A7 – Firm-Level Average Quarterly Ratio of Below-Threshold Loss Events

$$BT_{j,e} = \frac{\sum_t \left(\frac{Loss_{j,e,t}}{TotalAssets_{j,t}} \right)}{\#Quarters_{j,e}} \times 9$$

where $Loss_{j,e,t}$ is the aggregated amount of loss dollars from loss events below \$20,000 for firm j in quarter t and event type e ; $TotalAssets_{j,t}$ are the adjusted total assets of firm j in quarter t ; and $\#Quarters_{j,e}$ is the number of quarters where firm j reported below-threshold loss events.

The next step is to average firm-specific below-threshold ratios across firms within each event type:

Equation A8 – Average Below-Threshold Ratio

$$BT_e = \frac{\sum_j BT_{j,e}}{N_e}$$

where N_e is the number of firms that report below-threshold loss events for event type e .

Finally, projected loss events below the modeling threshold for each firm and within each event type under the severely adverse scenario are calculated as the average below-threshold ratio multiplied by the adjusted total assets of firm j as of the quarter prior to the first quarter of the projection horizon of the stress testing exercise, $TotalAssets_{j,t=0}$:

Equation A9 – Below-Threshold Adjustment

$$BTAdjustment_{j,e} = TotalAssets_{j,t=0} \times BT_e$$

In general, the $BTAdjustment_{j,e}$ is relatively small. In the 2024 stress test, the small-loss component accounted for about 2 percent of total projected losses across covered firms.

v. Model Rationale

A key feature of operational risk is the presence of large financial losses that stem from systemic events as well as idiosyncratic loss events that are specific to a single firm. The objective of the distributional model is to produce stressed operational loss projections that could be either systemic, correlated across several firms, or specific to individual firms. Examples of systemic loss events are those associated with the 2008 financial crisis. Examples of correlated events are litigation losses related to the London Interbank Offered Rate (LIBOR) manipulation and imposed on several firms at the same time. Finally, examples of loss events that are specific to individual firms include cybersecurity attacks that impact only a single firm. As the distributional model relies on the unconditional distribution of operational losses, it is sensitive to loss events that arise

under a variety of circumstances. Loss projections are informed by idiosyncratic, correlated, and systemic loss events, all of which may coincide with severe macroeconomic deterioration.²⁵

The distributional model is derived from a class of models known as the LDA. Unlike the methodologies that many covered companies use to project their own operational losses, the distributional model is not meant to capture exposures to specific operational loss events of individual firms. Covered companies are encouraged to engage in risk identification and produce loss projections that reflect the types of operational risks specific to their business models.²⁶ The distributional model, by contrast, is informed by industry experience across firms; consistent with the stress testing principles of simplicity, consistency and comparability, a standard set of assumptions apply to all firms and differences in outcomes are explained by differences in input data. By taking a tail percentile of the unconditional aggregate loss distribution, the model produces a conservative loss estimate that accounts for a range of different risks that firms may face.

Some of the key decisions related to the operational loss distributional model are explained below.

a. Modeling the Body and Tail of the Severity Distribution Separately

As discussed above, the Board models the body and tail of the loss event severity distribution separately and differently. This separation is appropriate for two reasons. First, frequency is significantly different for body losses and tail losses. Body losses occur frequently, which enables the use of individual firm data to model severity reliably. In contrast, tail losses are

²⁵ The Board has explored alternative models that explicitly incorporate macroeconomic factors. One such alternative was described in Section A.vi.a of the 2025 Operational Risk Model Documentation at <https://www.federalreserve.gov/supervisionreg/dfa-stress-tests-2026.htm>.

²⁶ The Board provides guidance to firms for capital planning purposes. See Board of Governors of the Federal Reserve System (Dec. 18, 2015, rev. Jan. 15, 2021), *SR 15-18*, https://www.federalreserve.gov/supervisionreg/srletters/sr1518_pw.pdf

infrequent and severe. Thus, modeling tail severity using each individual firm's own loss data is highly sensitive to the addition of a few tail losses. As such, tail severity is modeled using loss data from all firms, which enables a more stable model output. Second, the correlation between firm size and operational loss magnitude is different for body losses and tail losses. The literature shows that tail losses correlate with firm size (Cope and Labbi, 2008; Abdymomunov and Curti, 2020).²⁷ As such, the model uses tail losses scaled by firm size to obtain a severity ratio, which enables comparison of tail loss severity across firms of different sizes. On the other hand, the literature also shows that body losses do not directly relate to firm size (Abdymomunov and Curti, 2020). Thus, body losses are not scaled by asset size and are instead projected based on average historical body loss severity.

The body-tail cutoff point is based on the findings of Abdymomunov and Curti (2020), who show that, starting from the 99th percentile of the pooled industry loss distribution, total assets correlate significantly with the size of operational losses.

(1) Rationale for Using a Poisson Distribution for Frequency Modeling

As discussed above, the Board uses a Poisson distribution to model tail loss event frequency. The Poisson distribution is a standard distribution used to model count processes²⁸ and is suitable in this context as the historical data fit the distributional properties well. Alternative distributions that are commonly used to model count processes, such as the negative binomial distribution, would increase the complexity of the model without significantly improving model outcomes. In particular, the Poisson distribution involves fitting a single parameter, while alternatives often

²⁷ See Cope, E., and Labbi, A., 2008. Operational loss scaling by exposure indicators: Evidence from the ORX database. *Journal of Operational Risk*, 3(4), 25–46; Abdymomunov, A., and Curti, F., 2020. Quantifying and Stress Testing Operational Risk with Peer Banks' Data. *Journal of Financial Services Research*, 57(3), 287–313.

²⁸ A count process refers to a data-generating process that produces non-negative, integer outcomes. The frequency of operational loss events in a given time span is an example of a count process.

involve fitting several parameters. The Board tested more complex alternatives and found that they did not fit the historical data better across the range of covered firms. Consistent with the principle of simplicity as stated in the Stress Testing Policy Statement, the Board determined that the potential benefits of using an alternative frequency distribution were not sufficient to justify the added complexity.

(2) Using Historical Loss Events for the Severity Distribution

The Board also explored alternative distributional models in which loss severity is assumed to follow a known parametric probability distribution. In these models, a heavy-tailed probability distribution—such as the log-normal or Pareto distribution—is parameterized based on historical data. During the Monte Carlo simulation, draws are made from the parameterized distribution rather than from the pool of realized historical tail events, as is done with the chosen model.

A limitation of the chosen distributional model is that severity draws are made from a fixed pool of realized loss events, which can limit the range of possible outcomes. Making a distributional assumption about loss event severity could help overcome this limitation, as there would be no upper limit on the size of drawn loss events. In practice, however, parameterized severity distributions are unstable over time; when distributions are fit to heavy-tailed data, the parameterization is very sensitive to the introduction of new data, particularly new tail loss events. The sensitivity to new data translates to model loss projections that can change substantially from stress testing cycle to cycle. Stress test modeling principles emphasize the importance of stability in loss projections over time; stability is important for ensuring that changes in stress loss estimates reflect underlying risk factors rather than sudden changes in data inputs. As the parameterized severity distributions tended to produce excessive year-over-year variation in stress loss projections, the Board determined it was appropriate to use the more stable distributional model.

(3) Using the 93rd Percentile of the Aggregate Loss Distribution for the Severely Adverse Scenario

The Board uses the 93rd percentile of the distributional model's aggregate loss distribution to represent projected operational losses under the Severely Adverse Scenario. The 93rd percentile is chosen based on the frequency of the start of severe recessions. More specifically, in the 60 years from 1956 to 2015, when this practice was first adopted, four years saw the start of a severe recession.²⁹ Thus, the calculated frequency of severe recessions is 4 in 60 years or roughly an event that happens once every 15 years. This frequency suggests a draw from the 93rd percentile of the aggregate loss distribution.³⁰ In this calculation, the Board considers all four severe recessions equally, rather than calibrate the severity based on the one recession, the 2007-2009 financial crisis, to which the severity of macroeconomic scenario narratives is most closely aligned.

vi. Alternatives to the Distributional Model

Alternative model structures and specifications were considered by the Board when issuing the proposed model changes for the 2026 stress test. Discussion of these alternatives continues to be available on the Board's website, at <https://www.federalreserve.gov/supervisionreg/dfa-stress-tests-2026.htm>.

vii. Assumptions and Limitations

For the reasons set forth in Section A.v, the Board believes that the Operational Risk Model is a reasonable method for projecting operational-risk losses for the firms subject to the supervisory

²⁹ The timeframe and recession classification are consistent with those used to formulate scenario design policy. See 12 CFR 252, Appendix A.

³⁰ The 93rd percentile is derived as follows: $1 - \frac{4}{60} \approx 0.93$.

stress test. Nevertheless, the Operational Risk Model relies on certain key assumptions, which are discussed below.

a. Loss Timing and Recognition³¹

The Board makes certain assumptions about the timing of each loss event. In particular, the Board uses the reported accounting date for purposes of timing loss events and assumes, for a loss event with several reported accounting dates, that the full financial impact occurs within a single quarter.³² The Board found this assumption reasonable and conservative, as it assumes firms may need to incur the full financial cost of an operational event within a single quarter. The assumption is also practical, as it yields consistent data across firms that report their loss events differently.

The Board uses the reported accounting date in the Schedule E.1 submissions to timestamp loss events because it is more reflective of the financial impact of operational loss events than other reported dates. According to the Schedule E.1 reporting instructions, covered firms are required to report an occurrence date as well as an accounting date for each loss event. The occurrence date is meant to capture when the event that resulted in a financial loss began, and the accounting date reflects when the financial impact was reflected on the firm's financial statements. While for most loss events the occurrence and accounting dates are close in time to each other, some types of losses can have long time lags between the two dates. The Board believes that using the accounting date is more consistent with the primary goal of the stress test, which is to, "evaluate

³¹ The Board has made clarifications to the text of this 2026 model documentation compared to the model documentation proposed in 2025. The model documentation proposed in 2025 continues to be available on the Board's website, at <https://www.federalreserve.gov/supervisionreg/dfa-stress-tests-2026.htm>.

³² Specifically, for instances where firms report several accounting dates for a loss event, the financial impacts from the loss event are assumed to be experienced as of the first reported accounting date. For the distributional model, the decision on where to timestamp an aggregated loss event determines which value of adjusted total assets is used to scale the aggregated loss amount. Outside of this, the timestamping has no other impact on model outputs.

the financial resilience of banks by estimating losses, revenues, expenses, and resulting capital levels under hypothetical economic conditions” (Board of Governors, 2024).³³ Unlike the occurrence date, the accounting date captures when the loss event was recorded on firms’ financial statements and thus is the better date from which to assess the financial impact of operational loss events.

Some firms report more than one accounting date for loss events that unfold over time. For these loss events, the Board assumes that the full financial impact occurred within a single quarter. The Board makes this assumption for practical reasons and for conservativeness.

From a practical standpoint, firms have different standards for establishing legal reserves and different loss reporting practices; rather than reflecting the dates that legal reserves were established or increased, the accounting date might reflect the settlement or payment date for some firms. In such instances, the reported accounting date may not represent the dates the firm was impacted financially. Additionally, some firms submit legal losses aggregated to one accounting date in their Schedule E.1 submissions. Without an aggregation assumption, there would be reduced comparability of projections between these firms and those firms that do not aggregate legal losses in their submission. As such, aggregating the full impact of a historical loss event to a single quarter standardizes data across firms, improves interpretability, and mitigates issues with heterogenous reporting practices.

Finally, the practice of aggregating historical loss events to a single quarter is conservative, as it assumes the financial burden of an event may be experienced all at once, rather than smoothed over time. While operational loss events can, in the extreme, take several years to be fully realized,

³³ See Board of Governors of the Federal Reserve System, *2024 Supervisory Stress Test Methodology* (March 2024), <https://www.federalreserve.gov/publications/files/2024-march-supervisory-stress-test-methodology.pdf>.

most of the financial impact from most loss events occurs within a relatively short period of time. Specifically, on a loss-weighted average, most of the financial impact of a loss event occurs within a nine-quarter window. This average is skewed downward by large legal events, which can occur over a longer time period and thus see more of their impact occur outside a nine-quarter window; for the vast majority of loss events, the full financial impact is realized within a nine-quarter period. Additionally, though the historical input data is aggregated to one quarter, the distributional model projections assume that all loss impacts for simulated events occur within the nine quarters of the projected period, not within a single quarter. This approach, which distributes the model's impacts evenly across the projected period, is consistent with the assumption that losses for a simulated event could happen in any of the nine quarters. Further, the distributional model is generally less sensitive than the alternative regression model³⁴ to the timing of losses in the historical data, including the aggregation assumption.

b. Total Assets without Significant High-Quality Liquid Assets (Adjusted Total Assets) as Scaling Variable³⁵

Adjusted total assets is used throughout the Operational Risk Model as a proxy measure for firms' exposure to operational risks. For each modeling component, adjusted total assets is used as a scaling variable to normalize historical operational losses across firms and over time.

The Board chose to use the adjusted total assets calculation after exploring alternative operational risk indicators that included total assets, total income, total assets without cash

³⁴ Discussion of this alternative continues to be available on the Board's website, at <https://www.federalreserve.gov/supervisionreg/dfa-stress-tests-2026.htm>.

³⁵ The Board has made clarifications to the text of this 2026 model documentation compared to the model documentation proposed in 2025. The model documentation proposed in 2025 continues to be available on the Board's website, at <https://www.federalreserve.gov/supervisionreg/dfa-stress-tests-2026.htm>.

equivalents and other liquid assets, and risk-weighted assets.³⁶ The Board finds total assets, and variations of it that were explored, a suitable scaling variable for several reasons. First, total assets is a broad measure of the size and extent of business activities, which is desirable given that operational risk is prevalent throughout nearly every business line of a banking organization. Additionally, asset size is a proxy measure for firm complexity; larger banking firms tend to engage not only in a broader volume of business activities but also in a broader range of more sophisticated types of business activities, making them more prone to operational risk. Thus, total assets serves as an indicator not only of business volume but also of the risk that arises with increasing business complexity.

Academic research supports the use of total assets in the Operational Risk Model. Curti et al. (2022)³⁷ show that the relative size of a banking organization is related to operational risk exposure and that the largest firms have higher operational losses per dollar of assets. Abdymomunov and Curti (2020) show that asset size is significant in explaining large operational loss realizations, and scaling by asset size across firms with different characteristics can increase the stability of loss estimates relative to estimates produced for a firm using only its own data. This finding motivates the scaling of loss events in the distributional model and the production of a simulated aggregate loss distribution for each firm based on an industry pool of tail loss events.

The adjusted total assets calculation removes major components of assets defined as Level 1 high-quality liquid assets (HQLA) for purposes of calculating the Liquidity Coverage Ratio

³⁶ Discussion of these alternatives continues to be available on the Board's website, at <https://federalreserve.gov/supervisionreg/dfa-stress-tests-2026.htm>.

³⁷ See Curti, F., et al., 2022. Are the largest banking organizations operationally more risky? *Journal of Money, Credit and Banking*, 54(5), pp. 1223–1259.

(LCR)³⁸ from total assets. Level 1 HQLA includes cash and those assets that are generally most easily converted into cash. For purposes of subtracting Level 1 HQLA from total assets, the Board generally uses a proxy measure for ease of implementation; the proxy includes cash and cash equivalents, U.S. Treasury securities, and U.S. government agency obligations, excluding MBS, which collectively comprise most of Level 1 HQLA. As described above, cash and cash equivalents can be volatile and may fluctuate based on policy circumstances without much relevance to operational risk. One may further argue that cash and U.S. government securities are not complex assets and may not confer much operational risk to covered companies. For instance, it could be argued that there is little legal risk or potential for fraud when transacting in U.S. Treasury securities. Further, hypothetical analyses do show greater stability of operational loss projections when subtracting out the proxy for Level 1 HQLA currently in use. As loss projections tend to move proportionately with the chosen scaling variable, using a more stable scaling variable tends to result in more stable loss projections. In this instance, subtracting the proxy for Level 1 HQLA would have yielded more stable loss projections in recent stress testing cycles, particularly through the COVID-19 pandemic period. However, similar to the outcomes when subtracting only cash and cash equivalents, this measure tends to exhibit similar goodness-of-fit performance compared to total assets for predicting future operational losses.

Other alternative calculations had weaker conceptual support or were judged to add unnecessary volatility to projections.³⁹

³⁸ The Liquidity Coverage Ratio is a measure of the liquidity of a firm's holdings, or the ability of a firm to quickly convert its holdings to cash. For more information on the LCR and HQLA, see Bank for International Settlements, 2013. *Basel III: The Liquidity Coverage Ratio and liquidity risk monitoring tools*. <https://www.bis.org/publ/bcbs238.pdf>.

³⁹ Discussion of these alternatives continues to be available on the Board's website, at <https://federalreserve.gov/supervisionreg/dfa-stress-tests-2026.htm>.