



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

Supervisory Stress Test Model Documentation

Pre-Provision Net Revenue (PPNR) Models

Proposed Noninterest Income Model

Fall 2026

Request for Public Input

This document summarizes the noninterest income model in the pre-provision net revenue (PPNR) model suite that the Federal Reserve Board of Governors (Board) proposes to use in the 2027 Supervisory Stress Test. Consistent with the requirement that the Board invite public input on any material model changes before implementing them, the Board is proposing this aspect of the PPNR model suite for public input prior to implementation.¹

The Board will consider comments on the proposed noninterest income model before implementing it for the 2027 stress test cycle, and will also consider comments on any complementary changes to other models that are necessary or appropriate to implement the proposed noninterest income model. Any final model documentation that adopts the proposed noninterest income model may include clarifications to the proposed specifications and supplemental rationale in consideration of public input, as appropriate. If all or a portion of this proposal is not adopted, the Board will use all or a portion of the models described in the 2026 PPNR Model Documentation, available on the Board's website at the following link:

<https://www.federalreserve.gov/supervisionreg/dfa-stresstests-2027.htm>.

The following sections provide a summary of the proposed model, model components, and alternatives considered, along with other model-specific details. Documentation for all of the models that have been proposed and finalized by the Board for the 2027 stress test cycle are available at the following link: <https://www.federalreserve.gov/supervisionreg/dfa-stresstests-2027.htm>.

¹ See 12 CFR 238.132(e)(2); 12 CFR 252.44(e)(2). Beginning with the 2028 stress test cycle, the Board will publish any material model changes for public comment by August 31, 2027.

Comment Submission

You may submit comments by any of the following methods:

- **Agency website:** <https://www.federalreserve.gov/apps/proposals/>. Follow the instructions for submitting comments, including attachments. *Preferred method.*
- **Mail:** Benjamin W. McDonough, Secretary, Board of Governors of the Federal Reserve System, 20th Street and Constitution Avenue NW, Washington, DC 20551.
- **Hand delivery/courier:** Same as mailing address.
- **Other means:** publiccomments@frb.gov. You must include the docket number in the subject line of the message.

Comments received are subject to public disclosure. In general, comments received will be made available on the Board's website at <https://www.federalreserve.gov/apps/proposals/> without change and will not be modified to remove personal or business information, including confidential, contact, or other identifying information. Comments should not include any information such as confidential information that would be not appropriate for public disclosure. Public comments may also be viewed electronically or in person in Room M-4365A, 2001 C St. NW, Washington, DC 20551, between 9 a.m. and 5 p.m. eastern time during federal business weekdays.

Comment Deadline

The Board requests that interested parties submit comments within 60 days of the publication of the accompanying notice in the Federal Register.

Contact for Further Information

Division of Supervision and Regulation: Doriana Ruffino, Associate Director, (202) 452-5235; Hillel Kipnis, Assistant Director, (202) 452-2924; John Simone, Manager, (202) 245-4256, and Alice Moore, Senior Financial Institution Policy Analyst II, (202) 360-0155. Legal Division: Asad Kudiya, Deputy Associate General Counsel, (202) 360-6887; Julie Anthony, Senior Special Counsel, (202) 658-9400; Brian Kesten, Senior Counsel (202) 843-4079; and Leah Kazar, Attorney (240) 653-2896. For users of TDD-TYY, please call 711 from any telephone, anywhere in the United States. Board of Governors of the Federal Reserve System, 20th Street and Constitution Avenue NW, Washington, DC 20551.

Table of Contents

Request for Public Input	2
I. Proposed Model for Noninterest Income - Introduction	6
II. Overview of Proposed Model.....	7
A. Questions.....	10
B. Proposed Volume-Based Models	10
C. Proposed Regression Models	23
D. Proposed Flatline Models	30
E. Proposed Distribution-Based Haircut Models	33
III. Noninterest Income Models By Business Line	40
A. Noninterest Income on Credit Card Fees.....	40
B. Noninterest Income on Mortgages and Home Equity.....	54
C. Noninterest Income on Deposit Fees	81
D. Noninterest Income on Investment Banking.....	107
E. Noninterest Income on Asset Management	136
F. Noninterest Income on Wealth Management.....	150
G. Noninterest Income on Investment Services.....	175
H. Noninterest Income on Other Retail Lending.....	183
I. Noninterest Income on Treasury Services	192
J. Noninterest Income on Insurance Services.....	200
K. Noninterest Income on Commercial Lending, Merchant Banking and Private Equity, and Miscellaneous.....	207
L. Noninterest Income on Sales and Trading	219
IV. Treatment of Outliers and Non-Recurring Revenues	235
V. Analysis of Proposed Model Changes	236
Appendix A	239
Appendix B	242

I. Proposed Model for Noninterest Income - Introduction

The Board is proposing to use a new methodology to project the components of noninterest income for the 2027 stress test cycle. The new proposed framework is intended to replace the noninterest income discount factor models that were finalized in the 2026 PPNR Model Documentation published on the Board's website.² These specifications were initially proposed in September 2025 and received public input prior to finalization. The Board requests public input on the new proposed models for noninterest income, as well as on the alternatives discussed below.

The new framework models most of the components of noninterest income using a structural, volume-based approach, which utilizes granular information about each component retrieved from the FR Y-14Q. The volume-based models are motivated by the observation that noninterest income across many business lines consists of fee-based revenue based on the volume of business conducted. Compared with the discount factor models proposed in 2025, these models are expected to better capture the underlying mechanisms driving firm revenue generation. In instances in which appropriate volume data is not available, noninterest income components are modeled using regressions, flatline projections, or a distribution-based haircut approach.

The next section provides an overview of the proposed noninterest income models. A detailed description of each component model is provided in the subsequent sections, including alternatives considered and questions for public input.

² Model documentation is available at <https://www.federalreserve.gov/supervisionreg/dfa-stress-tests-2026.htm>.

II. Overview of Proposed Model

The Board is proposing a new suite of models for all noninterest income components of pre-provision net revenue for use in the 2027 stress test (Proposed 2027 NII Model). The new model departs from the current discount factor model approach described in the 2025 PPNR Model Documentation and in the Final PPNR Model Documentation. The new model aims to capture firm-specific business practices by using granular data to model noninterest income. In developing this proposal, the Board considered comments received on the 2025 PPNR Model.³ The Proposed 2027 NII Model is more granular in that the model components have a larger number of modeled segments; use FR Y-14Q data; mitigate potential double counts where there is overlap with other stress test models; are largely structural approaches, and where possible, reflect the underlying mechanisms for firm revenue generation. For most components and whenever possible, the Proposed 2027 NII Model incorporates relevant macroeconomic variables to project the path of income under stressed economic conditions. The Board is seeking public input on the Proposed 2027 NII Model for the 2027 supervisory stress test cycle.

The Board is proposing to use four main model types in the Proposed 2027 NII Model. The model types are (i) structural/volume-based, (ii) regression, (iii) flatline projection, and (iv) distribution-based haircut. First, the Board proposes to use a type of structural model denoted as the volume-based approach to project a number of noninterest income components. The volume-based approach for noninterest income projects revenue by estimating two distinct components: the volume of business activity that generates the revenue, and the average revenue (fee) earned on each unit of that activity. The product of the two components is projected noninterest income.

³ See 90 FR 51856 (Nov. 18, 2025).

The structural, or volume-based, models are estimated and projected at the most granular level feasible given available data, except when the simplicity and fit of additional aggregation provide benefits compared to more granular models.

Second, the Board proposes to use regression models when there is insufficient data on the level of activity for a particular business line for a structural, volume-based approach. Third, the Board proposes to apply a flatline projection in cases in which it was not possible to identify a statistical relationship with scenario variables, when flatlining mitigates potential double counting, or when the component revenue is robust under stress. Under a flatline projection, the projection for a firm for a particular component is held constant at the firm's liftoff value for every projection quarter. Finally, for one component, noninterest income on sales and trading, the Board proposes to use a distribution-based haircut approach, in which a historical data-calibrated haircut is applied to the starting revenue-to-assets ratio of that component in order to reflect outcomes under stress.

As described in the subsections below, for each component of noninterest income, the Board proposes to use the modeling approach that is most appropriate given firm-specific business practices and available granular data. In designing the Proposed 2027 NII Model, the Board's Stress Testing Policy Statement provided the guiding principles that supported the selection of the specifications described in this proposal.⁴

Table A1 summarizes the proposed model type for each component of pre-provision net revenue noninterest income.

⁴ See 12 CFR 252, Appendix B.

Table A1 – Proposed Model Components for Noninterest Income

Component	Submodels	Approach
Credit Card Fees	Credit Card Interchange Fees	Volume-Based
	Other Credit Card Fees	Flatline
Mortgages and Home Equity (MHE)	MHE Production	Volume-Based
	MHE Servicing Fees	Volume-Based
	MSR Value Changes	Regression
	MHE Other	Flatline
Deposit Fees	Debit Interchange Fees	Volume-Based
	Non-sufficient Funds Fees	Regression
	Other Deposit Fees	Regression
Investment Banking	Advisory	Volume-Based
	Equity Capital Markets (ECM)	Volume-Based
	Debt Capital Markets (DCM)	Volume-Based
	Syndicated/Corporate Lending (SCL)	Volume-Based
Wealth Management	Equities	Volume-Based
	Fixed Income	Volume-Based
	Other Wealth Management	Volume-Based
	Net Incoming Flows	Regression
Asset Management	Total	Volume-Based
	Net Incoming Flows	Regression
Investment Services	Total	Volume-Based
Other Retail Lending	Total	Regression
Treasury Services	Total	Regression
Insurance Services	Total	Regression
Commercial Lending	Total	Flatline
Merchant Banking/Private Equity (MBPE)	Total	Flatline
Miscellaneous	Total	Flatline
Sales and Trading	Total	Distribution-Based Haircut

A. Questions

The Board is requesting public input on the Proposed 2027 NII Model, including, but not limited to, input on the following questions:

Question 1: The Board seeks input on the Proposed 2027 NII Model. Are the chosen levels of granularity and the model structures sufficient to capture heterogeneity in firm business models and business practices? If not, what specific changes should the Board consider? What are the advantages and disadvantages of these changes?

Question 2: The Board is proposing four different model approaches (volume-based, regression, flatline, and distribution-based haircut) to project different aspects of noninterest income. What alternative modeling approaches, or changes to the proposed modeling approaches, if any, should the Board consider, and why? What are the advantages and disadvantages of these alternative modeling approaches or changes? Should any of the proposed approaches (e.g., distribution-based haircut) be considered for categories of noninterest income other than those for which they are already being proposed, and why?

Question 3: What are the advantages and disadvantages of the Proposed 2027 NII Model relative to the noninterest income model that the Board has adopted in the 2026 PPNR Model Documentation? If the Board should adopt only a portion of the Proposed 2027 NII Model, which portions of the 2026 PPNR Model should the Board retain?

B. Proposed Volume-Based Models

The Board proposes to model many of the subcomponents of noninterest income using the volume-based approach, which generates projections by multiplying an estimate of the volume of business activity by the revenue earned per unit of business. This approach was

selected based on the observation that noninterest income across many business lines consists of fee-based revenue connected to the volume of business conducted. The volume-based models for noninterest income therefore project revenue by forecasting two distinct components, the volume of fee-generating business activity and the average fee earned on each unit of that activity, which are multiplied to project noninterest income for a particular business line.

The two components of volume-based noninterest income are estimated at different levels of aggregation. The growth of the volume of business activity is modeled at the industry level using its historical relationship to macroeconomic conditions. The modeled industry growth path is then applied to a firm's individual volume of business as observed at the start of the projection. By contrast, the firm-specific fee earned per unit of volume is held constant at its recent historical level. The use of a constant fee isolates the volume-driven component of revenue that the model is designed to explain. Holding the fee constant at a recent historical level captures recent pricing for the relevant business line without projecting pricing changes under stress. Noninterest income is then estimated by multiplying the firm-specific projection of business volume by the firm-specific fee rate.⁵ The scenario, in conjunction with historical data, thus determines how fast business volume grows, while a firm's recent activity determines the dollar scale of the business and associated noninterest income.

This structure reflects the underlying economics of noninterest income. For the asset management, wealth management, investment services, and mortgage and home equity servicing

⁵ The volume-based models for investment banking and mortgages and home equity use an industry-level fee, in place of a firm-specific fee, to address outliers observed in the data. Analysis indicates these outliers could stem from idiosyncratic measurement or reporting differences across firms, which could also contribute to excess volatility in projections. The industry approach mitigates the impact of these outliers and provides consistent treatment across firms.

business lines, firms collect fees based on the level of assets they manage for clients and their noninterest income is thus directly correlated with client-asset volume. For the investment banking, prime brokerage, mortgage and home equity production, and credit and debit card interchange fee business lines, firms collect fees on the size and number of deals or transactions they handle and their noninterest income is directly correlated with deal, or transaction, volume.

The dollar amount of noninterest income for the volume-based models consequently depends on two components. The first component is the volume of business customers generate—either through the volume of their transactions or the volume of serviced assets. This component is sensitive to economic conditions and is projected using scenario variables and historical data in the volume-based approach. The second component is the fee the firm charges customers per unit of volume. This second component is primarily a function of pricing and product mix and is held constant at a recently observed level rather than estimated throughout the projection horizon.

The Board proposes to use industry data to project business volume growth in order to reflect the response of customer transactions or assets to economic conditions without the influence of firm-specific events such as acquisitions, reorganizations, or changes in business strategy that are not driven by the macroeconomy and are not intended to be projected by the model.⁶ In what follows, the terms industry or industry-level aggregates refer exclusively to the current sample of firms that are subject to reporting the FR Y-14Q. Applying that growth

⁶ Incorporating firm-specific events such as acquisitions, reorganizations, or changes in business strategy into the volume-based models could significantly increase model complexity, be challenging due to data limitations, increase projection volatility, and conflict with the goals of the stress test. A volume-based approach based on projected industry growth is more consistent with the stress testing principles of simplicity, consistency, comparability, robustness, and stability.

relationship to a firm's own starting volume preserves a firm's actual scale and market position at the point the projection begins.

The Board proposes to use volume-based models to project seven noninterest income components for which there is a clear economic relationship between volume and income and for which there is sufficient data. The Board used relevant literature, business and economic intuition, discussions with the industry, and public comments to identify components for which a volume-based model was potentially viable. The Board then reviewed available data, primarily in FR Y-14Q, Schedule G.3, to identify appropriate measures of business volume. The Board also explored, and in some cases used, data from other schedules in the FR Y-14Q and the FR Y-9C. The macroeconomic variables used in the underlying regressions on business volume are selected based on their statistical significance and consistency with their expected economic relationship with the dependent variable being projected. Although the number of component models projecting noninterest income will increase under this proposal, they are simpler and easier to interpret. Additionally, increased granularity allows projections to more accurately reflect expected performance by individual firms.

The Board proposes using volume-based models as the basis for the following seven noninterest income components (for components that use multiple approaches, parentheses indicate subcomponents that use a volume-based approach):

- credit card fees (credit card interchange fees),
- mortgages and home equity (MHE production and MHE servicing fees),
- deposit fees (debit interchange fees),
- investment banking,
- asset management,

- wealth management, and
- investment services.

The credit card fees, mortgages and home equity, and deposit fees models also use regressions and flatlines for certain subcomponents as specified in Table A1.

A general description of the volume-based approach is provided below. Detailed model descriptions for each component are provided in subsequent subsections. Parameter estimates are provided in Appendix B.

i. General Volume-Based Model

As discussed above, the volume-based model is projected using two components, the volume of fee-generating business activity and the average fee earned on each unit of that activity. To project the volume of fee-generating activity, the proposed model first estimates the growth rate, rather than the dollar level, of industry business volume from one quarter to the next in order to reflect the overall response of business activity to economic conditions. Growth is measured as the change in natural logarithm of volume, referred to as the log difference.⁷

Growth is defined as follows:

Equation A1 – Growth Rate Definition

$$g_t \equiv \Delta \log V_t = \log V_t - \log V_{t-1}$$

where:

- g_t is the growth rate of the volume of business activity;
- V_t represents the volume of business activity;
- t is a quarterly time subscript; and
- $\log$ represents the natural logarithm.

⁷ Log differences are approximately equal to percentage changes and are symmetric around zero, which eases interpretation. The specification and use of models in log differences is a standardized and widely used technique in statistics when the objective of the model is to deal with relative changes.

Growth rates are used for two reasons. First, the dollar level of business volume generally has a trend over time and reflects the size of a firm in a given period. By contrast, growth rates are comparable across periods regardless of the firm's size.⁸ Second, expressing the relationship in growth terms allows the estimated sensitivity to economic conditions to be applied to any given starting volume of business observed at the time a projection is made. These features of growth rates align with the Board's simplicity and forward-looking modeling principles.

The industry growth rate is then related to macroeconomic conditions by estimating the following general equation, Equation A2:

Equation A2 – Industry Growth

$$g_t = \alpha + \sum_{k=1}^K \sum_{j=0}^J \beta_{k,j} X_{k,t-j} + \epsilon_t$$

where:

- g_t is the growth rate of the volume of business activity;
- α is a constant intercept;
- $\beta_{k,j}$ measures the sensitivity of business growth to variable k at lag j ;
- $X_{k,t-j}$ is a vector of variables which includes macroeconomic variables and may also include lags of the dependent variable, seasonal dummy variables, or period specific dummy variables; and
- ϵ_t is the unexplained residual.

⁸ Many macroeconomic time series (financial, nominal or real) feature unit roots in levels. For example, Hessler (2023) estimates trends and cycles in the real and financial sector. A unit root is a feature of time series data (data collected over time) that makes it less stable. If a data series has a unit root, it has a stochastic trend (a random drift). This means it does not return to a long-term average, and shocks or unexpected events change its direction permanently. Unit roots are problematic for forecasting and require some kind of statistical treatment. In general, the use of growth rates differences out (eliminates) unit roots from time series allowing for stable distributions and the use of linear models. See A. Hessler, *Unobserved components model estimates of credit cycles: Tests and predictions*, Journal of Financial Stability 66 (2023), 101120.

The general equation, Equation A2, is used to estimate coefficients reflecting the sensitivity of noninterest income to the independent variables in the vector $X_{k,t-j}$. This equation is estimated using ordinary least squares with FR Y-14Q data over the sample periods detailed for each model. The variables retained in the final specification, and the economic rationale for each such variable, are described in each model section. The form of the general equation for the volume-based approach in Equation A2 is identical to the general equation in the regression models, discussed in Section C.ii, with the exception that the dependent variable in this case is a growth rate of the relevant business volume, whereas in the regression models, the dependent variable is the growth rate of the noninterest income component itself.

The volume-based models generally use one or more macroeconomic variables included in the supervisory stress test scenarios as independent variables for each industry-growth regression.⁹ The use of macroeconomic variables enables model sensitivity to economic stress, consistent with the purposes of the supervisory stress test. The Board selected macroeconomic variables based on their statistical significance and consistency with the expected economic relationship with the dependent variable being projected. For example, if a certain income component is expected to be positively related to the short-term interest rate from an economic standpoint, the regression outcome should include a positive coefficient for the independent

⁹ These variables and their related historical data are reported in the Board's published supervisory stress test scenarios each year. *See, e.g.,* Board, 2026 Stress Test Scenarios (Feb. 2026), <https://www.federalreserve.gov/publications/files/2026-final-supervisory-stress-test-scenarios-20260204.pdf>, tables 2–4.

The Board did not consider third-party or alternative data sources for the macroeconomic variables used in the regressions below.

variable representing the short-term rate. The Board follows a process to choose macroeconomic variables with an economically intuitive relationship and the strongest correlation with the associated regression's dependent variable, and therefore the best indicative power. For example, if two macroeconomic variables are being tested in one of the volume-based models and just one of them demonstrates statistically significant correlation in a regression, then only that variable will be selected to be part of that model. Macroeconomic variables enter the regressions either at their original values or following mathematical transformations (e.g., first difference, percentage change, or change in the natural logarithm) that enhance model fit and result in an interpretable relationship. For example, variation in a quantity may have a stronger relationship with changes in a given macroeconomic variable than its level, in which case the regression would contain the quarter-over-quarter difference of that macroeconomic series.

The macroeconomic paths specified by the severely adverse scenario are used to project industry-level growth for a given business line in the following estimated equation:

Equation A3 – Industry Growth Projection

$$\hat{g}_{t0+h} = \hat{\alpha} + \sum_{k=1}^K \sum_{j=0}^J \hat{\beta}_{k,j} X_{k,t0+h-j}^s$$

where:

- $\hat{g}_{t0+h}$ denotes the projected growth rate at quarter $t0 + h$;
- $\hat{\alpha}$ and $\hat{\beta}_{k,j}$ are the coefficients estimated from the industry growth rate model for variable k at lag j ;
- $X_{k,t0+h-j}^s$ is a vector of variables which includes macroeconomic variables and may also include lags of the dependent variable, seasonal dummy variables, or period-specific dummy variables;
- s denotes the severely adverse scenario path of each macroeconomic variable;
- $t0$ denotes the jump-off quarter; and
- $h \in (1, 2, \dots, 13)$ denotes the projection quarter.

It should be noted that Equation A3 does not include a residual error term because the projection is deterministic based on the right-hand side variables. The result of the above equation is a projected growth rate for each quarter of the projection horizon. Because it depends only on the severely adverse scenario variable paths, and potentially its own lagged values or dummy variables, the projected growth rate is determined by the severely adverse scenario variable paths and starting conditions.

Projected growth rates describe how fast business activity changes, but do not on their own produce estimates of the dollar amount of that activity. To do so, a starting point, or anchor, is required. The anchor is the geometric mean of firm-specific business volume over the four quarters ending at jump-off (i.e., the starting quarter):

Equation A4 – Firm-specific Starting Volume

$$\bar{V}_{b,t0} = \left(\prod_{i=0}^3 V_{b,t0-i} \right)^{\frac{1}{4}}$$

where:

- $\bar{V}_{b,t0}$ denotes the firm-specific anchor value for business volume for firm b .

The Board proposes to use a four-quarter window to calculate the anchor rather than the single most recent quarter so that the projection does not inherit the effect of an unusually strong or weak final quarter of observed data. Additionally, the use of a four-quarter geometric mean ensures that normal seasonal variation within the year does not influence the starting level.¹⁰

¹⁰ The geometric mean is used in preference to the simple arithmetic average because it is the measure of central tendency that corresponds to the logarithmic form of the model. The model is estimated and projected in logarithms so anchoring on the geometric mean implies the projection begins from the average of recent history measured in the

Projected growth is applied to the firm-specific anchor and compounded forward so that each projected quarterly estimate grows from the value in the preceding quarter. An adjustment is applied to the first projected quarter to account for the application of a quarterly growth rate to a four-quarter geometric mean for the liftoff; the geometric mean requires adjustment prior to use as a quarterly measure because it would otherwise capture impacts from deterministic elements of the time series in the four quarters it averages, such as seasonality. In this way, the projection horizon begins from a level consistent with the seasonal factors and macroeconomic variables applicable in the liftoff. Details of the adjustment are provided in Appendix A.

The first difference of logarithms is a close approximation for percent change, and arithmetically converts into the form:

Equation A5 – Firm-specific Volume Growth Projection

$$\log \hat{V}_{b,t0+h} = \log \hat{V}_{b,t0+h-1} + \hat{g}_{t0+h}$$

where:

- $\hat{V}_{b,t0+h}$ denotes the projected firm-specific business volume for firm b at quarter $t0 + h$;

same units in which the model operates. It also has the practical effect of giving less weight to a single very large quarter than an arithmetic mean would.

The geometric mean is defined only when every observation in the window is strictly positive because the logarithm of zero or of a negative number does not exist. The model therefore applies the following control. If the value in any of the four quarters in the liftoff window is zero or negative, the anchor reverts to the arithmetic mean of the value in same four quarters:

$$\bar{V}_{b,t0} = \frac{1}{4} \sum_{i=0}^3 V_{b,t0-i}$$

where the subscripts and terms are as defined above. For any set of positive observations, the arithmetic mean is greater than or equal to the geometric mean, so where the exception is triggered the resulting anchor will be weakly higher than the geometric mean would have been had it been computable.

- $\hat{g}_{t0+h}$ denotes the projected growth rate of the business volume at quarter $t0 + h$;
- b denotes a specific firm;
- $t0$ denotes the jump-off quarter; and
- $h \in (1,2, \dots, 13)$ denotes the projection quarter.

The same relationship can be expressed in dollar terms as:

$$\hat{V}_{b,t0+h} = \hat{V}_{b,t0+h-1} * \exp(\hat{g}_{t0+h})$$

where:

- $\hat{V}_{b,t0+h}$ denotes the firm-specific business volume for firm b at quarter $t0 + h$;
- $\hat{g}_{t+h}$ denotes the projected growth rate of the business volume at quarter $t0 + h$;
- b denotes a specific firm;
- $t0$ denotes the jump-off quarter;
- $h \in (1,2, \dots, 13)$ denotes the projection quarter; and
- the recursion starts from the firm-specific anchor.

Applying the recursion repeatedly gives the firm-specific projected level of business activity in any quarter of the horizon based on the anchor and the cumulative sum of projected growth rates:

$$\hat{V}_{b,t0+h} = \bar{V}_{b,t0} * \exp\left(\sum_{j=1}^h \hat{g}_{t0+j}\right)$$

where:

- $\hat{V}_{b,t0+h}$ denotes the firm-specific business volume for firm b at quarter $t0 + h$;
- $\bar{V}_{b,t0}$ denotes the firm-specific anchor value for the business volume for firm b ; and
- $\hat{g}_{t0+j}$ denotes the projected growth rate at quarter $t0 + j$;
- b denotes a specific firm;
- $t0$ denotes the jump-off quarter; and
- $h \in (1,2, \dots, 13)$ denotes the projection quarter.

The result is a firm-specific projected dollar level of business activity for every quarter of the projection horizon.

As discussed above, the Board multiplies the projected volume of business activity by the average fee earned on each unit of that activity to project noninterest income. The fee rate is the firm-specific amount of noninterest income earned per unit of business activity conducted and is calculated using historical data on noninterest income and business line volume.¹¹ The fee rate is specified as:

Equation A6 – Firm-specific Fee Rate

$$F_{b,t} = \frac{N_{b,t}}{V_{b,t}}$$

where:

- $F_{b,t}$ denotes the fee rate for firm b at time t ;
- $N_{b,t}$ denotes the historical noninterest income of a particular business line for firm b at time t ; and
- $V_{b,t}$ denotes the historical volume of a particular business line for firm b at time t .

The fee rate used in the projection of noninterest income is the median of this ratio over the four quarters ending at the jump-off quarter:

Equation A7 – Firm-specific Starting Fee Rate

$$\bar{F}_{b,t0} = \text{median}(F_{b,t0-k})$$

where:

- $\bar{F}_{b,t0}$ is the median fee rate at $t0$ for firm b ;
- $t0$ denotes the jump-off quarter; and
- $k \in (0,1,2,3)$.

¹¹ The volume-based models for investment banking and mortgages and home equity use an industry-level fee rate in place of a firm-specific fee rate to address outliers observed in the data. Analysis indicates these outliers could stem from idiosyncratic measurement or reporting differences across firms, which could reduce precision and contribute to excess volatility in projections. The industry approach mitigates the impact of these outliers and provides consistent treatment across firms.

The median is used instead of the mean so that the projection is not distorted by a single quarter in which either the income line item or the historical volume of a business line was atypical. Using a recent four-quarter window produces a fee rate that is consistent with firms' current pricing and product mixes but that is not unduly skewed by irregularities.

After calculating the two components of noninterest income in the volume-based approach, the Board proposes to project noninterest income by multiplying the volume of business activity by the fee rate:

Equation A8 – Firm-specific Noninterest Income Projection – Volume-based Model

$$\hat{N}_{b,t0+h} = \hat{V}_{b,t0+h} \times \bar{F}_{b,t0}$$

where:

- $\hat{N}_{b,t0+h}$ denotes the projected noninterest income of a particular business line for firm b at time $t0 + h$;
- $\hat{V}_{b,t0+h}$ denotes the projected volume of a particular business line for firm b at time $t0 + h$; and
- $\bar{F}_{b,t0}$ is the constant firm-specific starting fee rate.

The volume-based approach assumes that fee rates are relatively stable and do not vary over the projection horizon, generally due to the economic and institutional characteristics of the modeled portfolios. The volume-based approach reflects the stress testing policy principles of robustness and stability by relying on inputs that demonstrate a statistically significant relationship with the dependent variable, and by anchoring on a smoothed average that captures recent firm performance while mitigating the impacts of seasonality and the volatility that can result from using a single-quarter starting value.

C. Proposed Regression Models

The Board proposes to use a one-step regression approach where the volume-based approach is not feasible due to data limitations, or where a relevant measure of volume is not available. A regression approach is appropriate in those cases because it aligns with the Board's stress testing principle of simplicity and captures the relationship between the quantity being projected and macroeconomic stress (as opposed to, e.g., a flatline projection model, which is applied to quantities expected to be insensitive to stress). The sections below describe the components of noninterest income that the Board proposes to model using this approach. Similar to the volume-based approach, the regression approach involves modeling activity at the industry level. However, in the regression approach, instead of modeling the volume of an underlying activity, the Board proposes to project industry growth rates in either firm revenue (for the Treasury services and insurance services components) or in the ratio of firm revenue to a relevant normalizing balance (for other retail lending). The macroeconomic variables used in the regression approach are selected based on their statistical significance and consistency with their expected economic relationship with the dependent variable being projected, as described in more detail below. These features of the regression approach align with the Board's supervisory stress testing principles, including the principles of simplicity and forward-looking models.¹² Projected industry revenue growth rates are applied to firm-specific starting values to generate revenue projections. The starting values are either the four-quarter mean ending at jump-off of the level of revenue or of the ratio of revenue to the relevant normalizing balance, as appropriate.

¹² 12 CFR Appendix B, section 1.

The Board proposes regression models for noninterest income for the following components:

- other retail lending,
- treasury services, and
- insurance services.

Detailed descriptions of each regression model are provided in the following subsections.

Parameter estimates are provided in Appendix B.

i. General Regression Model

The regression model generally relates macroeconomic variables to industry growth in order to project noninterest income for certain components of PPNR. The regression model is estimated using the growth rate, rather than the dollar level, of a noninterest income component from one quarter to the next. The regression model differs from the volume-based approach, which also uses a regression to estimate growth, in that the regression model directly projects growth in the dollar value of a noninterest income component, whereas the volume-based approach projects growth of the underlying business activity (and then multiplies the projected volume by the fee rate). Directly projecting the dollar-value growth rate allows for macro-sensitive projections of noninterest income components in cases where there is insufficient data or no available measure of underlying business activity to support the volume-based approach. For these components, the regression model produces robust estimates of income under stress in a manner aligned with the stress testing policy of simplicity.

Growth is measured as the change in natural logarithm of the dollar level of noninterest income, referred to as the log difference. Growth is defined as follows:

Equation A9 – Growth Rate Definition

$$g_t \equiv \Delta \log N_t = \log N_t - \log N_{t-1}$$

where:

- g_t is the growth rate of the noninterest income component;
- N_t represents the dollar value of the noninterest income component;
- t is a quarterly time subscript; and
- $\log$ represents the natural logarithm.

The use of growth rates enables comparability across time periods and allows the estimated sensitivity to economic conditions to be applied to any given starting dollar level, as discussed in the general description of the volume-based models in Section B.i.

The industry growth rate is then related to macroeconomic conditions by estimating the following Equation A10, which is generally applicable to the estimated regressions described below:

Equation A10 – Industry Growth

$$g_t = \alpha + \sum_{k=1}^K \sum_{j=0}^J \beta_{k,j} X_{k,t-j} + \epsilon_t$$

where:

- g_t is the growth rate of the noninterest income component;
- α is a constant intercept;
- β measures the sensitivity of noninterest income to variable k at lag j ;
- $X_{k,t-j}$ is a vector of variables which includes macroeconomic variables and may also include lags of the dependent variable, seasonal dummy variables, or period specific dummy variables; and
- ϵ_t is the unexplained residual.

The general equation, Equation A10, is used to estimate coefficients reflecting the sensitivity of noninterest income to macroeconomic variables. This equation is estimated using

ordinary least squares with FR Y-14Q data over the sample periods detailed for each model. The variables retained in the final specification, and the economic rationale for each such variable, are described in each model section.

The regression models generally use one or more macroeconomic variables included in the supervisory stress test scenarios as independent variables for each industry growth regression. As discussed in Section B.i above, the use of macroeconomic variables is consistent with the purposes of the supervisory stress test, and the Board follows a process to select macroeconomic variables with the best indicative power.

The macroeconomic paths specified by the severely adverse scenario are used to project industry-level growth for a given business line in the estimated equation:

Equation A11 – Industry Growth Projection

$$\hat{g}_{t0+h} = \hat{\alpha} + \sum_{k=1}^K \sum_{j=0}^J \hat{\beta}_{k,j} X_{k,t0+h-j}^s$$

where:

- $\hat{g}_{t0+h}$ denotes the projected growth rate at quarter $t0 + h$;
- $\hat{\alpha}$ and $\hat{\beta}_{k,j}$ are the coefficients estimated from the industry growth rate model for variable k at lag j ;
- $X_{k,t0+h-j}^s$ is a vector of variables which includes macroeconomic variables and may also include lags of the dependent variable, seasonal dummy variables, or period specific dummy variables;
- s denotes the severely adverse scenario path of each macroeconomic variable;
- $t0$ denotes the jump-off quarter; and
- $h \in (1,2, \dots, 13)$ denotes the projection quarter.

It should be noted that Equation A11 does not include a residual error term because the projection is deterministic based on the right-hand side variables. The result is a projected growth rate for each quarter of the horizon. Because it depends only on the severely adverse

scenario variable paths, and potentially its own lagged values or dummy variables, the projected growth rate is determined by the severely adverse scenario variable paths and starting conditions.

Projected growth rates describe how fast the noninterest income component changes, but do not on their own produce estimates of the dollar amount of that activity. To do so, a starting point, or anchor, is required. The anchor is the geometric mean of firm-specific noninterest income over the four quarters ending with the jump-off quarter:

Equation A12 – Firm-specific Starting Noninterest Income

$$\bar{N}_{b,t0} = \left(\prod_{i=0}^3 N_{b,t0-i} \right)^{\frac{1}{4}}$$

where:

- $\bar{N}_{b,t0}$ denotes the firm-specific anchor value for the noninterest income component for firm b .

The Board proposes to use a four-quarter window to calculate the anchor rather than the single most recent quarter so that the projection does not inherit the effect of an unusually strong or weak final quarter of observed data. Additionally, the use of a four-quarter geometric mean ensures that normal seasonal variation within the year does not influence the starting level.¹³

¹³ The geometric mean is used in preference to the simple arithmetic average because it is the measure of central tendency that corresponds to the logarithmic form of the model. The model is estimated and projected in logarithms so anchoring on the geometric mean implies the projection begins from the average of recent history measured in the same units in which the model operates. It also has the practical effect of giving less weight to a single very large quarter than an arithmetic mean would.

The geometric mean is defined only when every observation in the window is strictly positive because the logarithm of zero or of a negative number does not exist. The model therefore applies the following control. If any of the four quarters in the liftoff window is zero or negative, the anchor reverts to the arithmetic mean of the same four quarters

Projected growth is applied to the firm-specific anchor and compounded forward so that each projected quarterly estimate grows from the value in the preceding quarter. An adjustment is applied to the first projected quarter to account for the application of a quarterly growth rate to a four-quarter geometric mean for the liftoff; the geometric mean requires adjustment prior to use as a quarterly measure because it would otherwise capture impacts from deterministic elements of the time series in the four quarters it averages, such as seasonality. In this way, the projection horizon begins from a level consistent with the seasonal factors and macroeconomic variables applicable in the liftoff. Details of the adjustment are provided in Appendix A.

In logarithms, this is a simple addition of the form:

Equation A13 – Firm-specific Noninterest Income Growth Projection

$$\log \hat{N}_{b,t0+h} = \log \hat{N}_{b,t0+h-1} + \hat{g}_{t0+h}$$

where:

- $\hat{N}_{b,t0+h}$ denotes the firm-specific noninterest income for firm b at quarter $t0 + h$;
- $\hat{g}_{t0+h}$ denotes the projected growth rate of the noninterest income at quarter $t0 + h$;
- b denotes a specific firm;
- $t0$ denotes the jump-off quarter; and
- $h \in (1,2, \dots, 13)$ denotes the projection quarter.

The same relationship can be expressed in dollar terms as:

$$\bar{N}_{b,t0} = \frac{1}{4} \sum_{i=0}^3 N_{b,t0-i}$$

where the subscripts and terms are as defined above. For any set of positive observations, the arithmetic mean is greater than or equal to the geometric mean, so where the exception is triggered the resulting anchor will be weakly higher than the geometric mean would have been had it been computable.

$$\hat{N}_{b,t0+h} = \hat{N}_{b,t0+h-1} * \exp(\hat{g}_{t+h})$$

where:

- $\hat{N}_{b,t0+h}$ denotes the firm-specific noninterest income growth for firm b at quarter $t0 + h$;
- $\hat{g}_{t+h}$ denotes the projected growth rate at quarter $t + h$;
- b denotes a specific firm;
- $t0$ denotes the jump-off quarter;
- $h \in (1,2, \dots, 13)$ denotes the projection quarter; and
- the recursion starts from the firm-specific anchor.

Applying the recursion repeatedly gives the firm-specific projected level of noninterest income in any quarter of the horizon based on the anchor and the cumulative sum of projected growth rates:

Equation A14 – Firm-specific Noninterest Income Projection – Regression Model

$$\hat{N}_{b,t0+h} = \bar{N}_{b,t0} * \exp\left(\sum_{j=1}^h \hat{g}_{t0+j}\right)$$

where:

- $\hat{N}_{b,t0+h}$ denotes the firm-specific noninterest income growth for firm b at quarter $t0 + h$;
- $\bar{N}_{b,t0}$ denotes the firm-specific anchor value for the noninterest income component for firm b ; and
- $\hat{g}_{t0+j}$ denotes the projected growth rate at quarter $t0 + j$.

The result is a firm-specific projected dollar level of the noninterest income component for every quarter of the projection horizon. The regression approach reflects the stress testing policy principles of robustness and stability by relying on inputs that demonstrate a statistically significant relationship with the dependent variable, and by anchoring on a smoothed average that captures recent firm performance while mitigating the impacts of seasonality and the volatility that can result from using a single-quarter starting value.

D. Proposed Flatline Models

The Board proposes to use flatline projection models to estimate components of noninterest income that should not vary meaningfully as a result of macroeconomic stress. A flatline model involves fixing the projection at the same quantity for each quarter in the projection horizon. The fixed projection is typically an average over a designated lookback period, as opposed to, e.g., its value in the most recent quarter, to account for seasonality and limit the volatility that could result from capturing only the most recent performance. The Board proposes to use flatline models to avoid duplicating stress projections where a given income stream is modeled elsewhere in the stress test, when the underlying data does not exhibit any statistical relationship with macroeconomic variables, and/or when the component is expected to be stable during stress periods.

The Board proposes to use flatline projection models to estimate noninterest income from the following components:

- other credit card fees,
- other revenue from mortgage and home equity servicing,
- commercial lending,
- merchant banking/private equity, and
- miscellaneous.

A description for each proposed flatlined component of noninterest income is provided in the relevant subsections below.

i. General Flatline Model

The flatline model projects noninterest income by holding a single, firm-specific anchor value of noninterest income as constant throughout the projection horizon. The flatline model first determines an appropriate anchor value that is representative of recent firm performance but is robust to volatility and accounts for seasonality (where applicable). The anchor value is calculated by:

Equation A15 – Firm-specific Starting Noninterest Income

$$\bar{N}_{b,t0} = \text{average}(N_{b,t0-k})$$

where:

- $\bar{N}_{b,t0}$ is the four-quarter average, measured as either the geometric mean or the median, of the noninterest income component for firm b at quarter $t0$;
- $N_{b,t0-k}$ is the noninterest income component for firm b at quarter t ;
- $t0$ is the jump-off quarter; and
- $k \in \{0,1,2,3\}$.

The average is generally measured as the geometric mean in cases where there is apparent seasonality. When the variable does not exhibit seasonality (i.e., when the four quarters do not have systematically different characteristics), a median is used. When seasonality is present, it is appropriate to use the mean to summarize variation across all four quarters. By contrast, the calculation of a median necessarily entails dropping quarters, which, for variables that exhibit seasonality, would fail to capture shifting characteristics across quarters in an annual cycle. The Board proposes to use a median absent seasonality because it is robust to outliers that can otherwise distort an average.

In some applications of the flatline model, a normalizing balance is used to increase the stability of the projection and to tie the firm-specific anchor value more closely to the

characteristics of the firm's balance sheet at jump-off. In these cases, the anchor value is calculated as:

Equation A16 – Firm-specific Starting Noninterest Income Ratio

$$\overline{NRatio}_{b,t0} = \text{average}(N_{b,t0-k}/Balance_{b,t0-k})$$

where:

- $\overline{NRatio}_{b,t0}$ is the four-quarter average, measured as either the geometric mean or the median, of the noninterest income component normalized by a balance for firm b at quarter $t0$;
- $N_{b,t0-k}$ is noninterest income component for firm b at quarter t ;
- $Balance_{b,t}$ is the normalizing balance for firm b at quarter t ;
- $t0$ is the jump-off quarter; and
- $k \in \{0,1,2,3\}$.

Firm-specific noninterest income for a particular business line under the flatline model is set equal to the starting value for all projection quarters, as given by:

Equation A17 – Firm-specific Noninterest Income Projection – Flatline Model

$$\hat{N}_{b,t0+h} = \overline{N}_{b,t0}$$

where:

- $\hat{N}_{b,t0+h}$ is the dollar-level projection for the noninterest income of a component for firm b at projection horizon $t0 + h$, where $t0$ is the jump-off quarter and $h \in \{1,2, \dots, 13\}$.

In applications of the flatline model in which a normalizing balance is used, firm-specific noninterest income for a particular business line, for all projection quarters, is set equal to the product of the anchor value and the normalizing balance at jump-off, as given by:

Equation A18 – Firm-specific Noninterest Income Projection – Flatline Model for Normalized Fees

$$\hat{N}_{b,t0+h} = \overline{NRatio}_{b,t0} \times Balance_{b,t0}$$

where:

- $\hat{N}_{b,t0+h}$ is the dollar-level projection of the noninterest income component for firm b at projection horizon $t0 + h$, where $t0$ is the jump-off quarter and $h \in \{1,2, \dots, 13\}$;
- $\overline{NRatio}_{b,t0}$ is the four-quarter average, measured as either the geometric mean or the median, of the noninterest income component normalized by a balance for firm b at quarter $t0$; and
- $Balance_{b,t0}$ is the normalizing balance for firm b at the jump-off quarter.

The above equation multiplies two components, (i) firm b 's noninterest income fee ratio and (ii) firm b 's normalizing balance at the jump-off quarter, to estimate the dollar-value level of noninterest income for the projected component. The flatline approach reflects the stress testing policy principles of robustness and stability by projecting a smoothed average that captures recent firm performance while mitigating the impacts of seasonality and volatility that can result from using a single-quarter starting value.

E. Proposed Distribution-Based Haircut Models

The Board proposes to use distribution-based haircut models to project noninterest income when the component is reasonably expected to decline under stress and exploratory analysis supported this expectation, but an appropriate volume-based or regression model could not be identified. Challenges in identifying an appropriate model included a lack of suitable data and the model's sensitivity to variable selection and sample period. The distribution-based haircut model is similar to the flatline model but involves multiplying the constant anchor by a haircut factor that is less than one but greater than zero. That is, a firm's noninterest income from a particular component is lower during the stress test horizon than before it, to a degree determined by the haircut factor, and remains constant at this lower value during the projection

period. The distribution-based haircut model thus assumes that a historically observed severe decline in the noninterest income component of interest is realized during the stress horizon.

To calculate the haircut factor, the Board would first select a growth rate value from a given percentile in the tail of the unconditional distribution of firm-quarter growth rates of the noninterest income component of interest. The use of growth rates, as opposed to nominal values, allows for comparability across firms. The tail percentile represents a historically observed severe decline in the growth rate of the component because it corresponds to a quarterly growth rate lower than the vast majority of historical observations (for example, a 7th percentile growth rate would be lower than 93 percent of observations). The Board would then convert the percentile growth rate to a gross growth rate to enable its use in the proposed projection equation. This rate is subsequently multiplied by anchor value to produce an estimate of noninterest income, which would remain constant for each quarter of the projection horizon but reflect sensitivity to macroeconomic stress.

To ensure the consistency and comparability of results, the approach assumes that the projected relative change in the level of noninterest income of the component is uniform across firms. The Board proposes to account for firm-specific variation by applying the uniform projected relative change to a firm-specific anchor value. The firm-specific value is stressed in the first projection quarter and then held constant at that stressed level over the projection horizon.

The Board proposes to use distribution-based haircut projection models to estimate noninterest income from sales and trading.

i. General Distribution-Based Haircut Model

The distribution-based haircut model is similar to the flatline model discussed in the previous section. A flatline model projects noninterest income by holding a single, firm-specific, anchor value constant throughout the projection horizon. The key difference between the models is that the distribution-based haircut model involves the multiplication, during the projection step, of the starting anchor value of a firm's noninterest income from a given component by a haircut factor determined from an empirical distribution. The haircut factor decreases the projection quantity for a component that is reasonably expected to decline under stress.

The distribution-based haircut model involves computing an empirical distribution of the firm-quarter growth rates of the noninterest income component. The firm-quarter growth rate observations can be negative or positive. In order to construct a distribution with comparable firm-quarter growth rates across the sample of firms subject to the stress test, firm-quarter growth rates are treated using a regression to remove the firm-specific average growth rates and seasonality. An appropriate tail percentile is selected to represent a severely stressed growth rate. This growth rate is then converted to a haircut factor that represents the relative change that could occur under stress from a starting noninterest income level.

The proposed approach also determines an appropriate anchor value for the noninterest income component of interest. The anchor value is multiplied by the haircut factor and the result is used to project the noninterest income for the business line of interest, which is held constant for each quarter of the projection horizon.

To create the empirical distribution, the Board constructs a time series of firm-specific quarterly growth rates of the noninterest income component of interest. Growth is measured as

the change in natural logarithm of the dollar level of noninterest income or its ratio to relevant assets, referred to as the log difference. Growth is defined as follows:

Equation A19 – Growth Rate Definition

$$g_{b,t} \equiv \Delta \log N_{b,t} = \log N_{b,t} - \log N_{b,t-1}$$

where:

- $g_{b,t}$ is the firm-specific growth rate of the noninterest income component;
- $N_{b,t}$ represents the firm-specific dollar value of the noninterest income component or its ratio to relevant assets;
- t is a quarterly time subscript; and
- $\log$ represents the natural logarithm.

The Board proposes to remove seasonality and firm-specific performance¹⁴ from the time-series of firm-specific growth rate. To do so, the Board proposes to estimate a panel regression and regresses quarter-firm growth rates on quarterly dummy variables and firm-specific fixed effects. The regression specification is as follows.

Equation A20 – Seasonality and Firm-specific Means Extraction Regression

$$g_{b,t} = \alpha_b + QuarterlyDummies_t + \epsilon_{b,t}$$

where:

- $g_{b,t}$ is the firm-specific growth rate of the noninterest income component for firm b at time t ;
- α_b is a firm fixed effect for firm b ;
- $QuarterlyDummies_t$ are seasonal indicator variables for quarters; and
- $\epsilon_{b,t}$ is a residual for firm b in quarter t .

¹⁴ In this context, firm-specific performance refers to the average growth rate of each firm during the period of interest. This is calculated by the regression described in this paragraph.

The quarterly firm-level residuals from this regression ($\epsilon_{b,t}$) are growth rates without seasonality or firm-specific means.¹⁵ These residuals are referred to as treated firm-quarter growth rates. Removing seasonality from growth rate observations makes the distribution of growth rates applicable to any jump-off quarter and makes projections independent of the quarter when stress starts within a given year. Removing firm-specific means makes growth rate observations comparable across firms and suitable for pooling in one distribution.

Next, the Board proposes to calibrate the haircut to the p th percentile of the historical distribution of quarterly growth rates. The percentile is adjusted to account for differences in firm assets to mitigate the influence of extreme growth rates experienced due to low starting values. The haircut factor is given by:

Equation A21 – Haircut Factor Calculation

$$HaircutFactor = \exp(p - th\ prtl)$$

where:

- $p - th\ prtl$ is the p -percentile of the historical distribution of pooled firm growth rates adjusted by asset weights; and
- $\exp$ represents the exponential function.

Justification for the selection of a particular percentile is provided in the relevant model subsections. Generally, the Board would select a percentile in alignment with the stress testing principle of conservatism and would consider percentiles used elsewhere in the stress test for consistency. This haircut factor would be uniformly applied to the firms in the sample.

¹⁵ In this document, firm-specific means refer to the average growth rate of each firm in the data sample. This is calculated by regression as described in this paragraph.

Next, the Board proposes to compute an appropriate anchor value that is representative of recent firm performance but is robust to volatility and accounts for seasonality where applicable.

The anchor value is calculated by:

Equation A22 – Firm-specific Starting Noninterest Income

$$\bar{N}_{b,t0} = \text{average}(N_{b,t0-k})$$

where:

- $\bar{N}_{b,t0}$ is the average, measured as either the geometric mean, arithmetic mean, or the median, of the level of the noninterest income component or its ratio to relevant assets for firm b at quarter $t0$;
- $N_{b,t0-k}$ is the level of the noninterest income component or its ratio to relevant assets for firm b at quarter t ;
- $t0$ is the jump-off quarter; and
- $k \in \{0,1,2,3\}$.

The average is generally measured as the geometric mean in cases where there is apparent seasonality. When the variable does not exhibit seasonality (i.e., when the four quarters do not have systematically different characteristics), a median is used. When seasonality is present, it is appropriate to use the mean to summarize variation across all four quarters. By contrast, the calculation of a median necessarily entails dropping quarters, which, for variables that exhibit seasonality, would fail to capture shifting characteristics across quarters in an annual cycle. The Board proposes to use a median absent seasonality because it is robust to outliers that can otherwise distort an average.

In some applications of the model, a normalizing balance is used to increase the stability of the projection and to tie the firm-specific anchor value more closely to the characteristics of the firm's balance sheet at jump-off. In these cases, the anchor value is calculated as:

Equation A23 – Starting Noninterest Income Ratio

$$\overline{NRatio}_{b,t0} = \text{average}(N_{b,t0-k}/Balance_{b,t0-k})$$

where:

- $\overline{NRatio}_{b,t0}$ is the average, measured as either the geometric mean, arithmetic mean, or the median, of the noninterest income component normalized by a balance for firm b at quarter $t0$;
- $N_{b,t0-k}$ is the level of the noninterest income component for firm b at quarter t ;
- $Balance_{b,t}$ is the normalizing balance for firm b at quarter t ;
- $t0$ is the jump-off quarter; and
- $k \in \{0,1,2,3\}$.

Firm-specific noninterest for a particular business line is then calculated by multiplying the anchor value by the haircut factor. This level of noninterest income is projected to be constant across all projection quarters, and is given by:

Equation A24 – Firm-specific Noninterest Income Projection – Distribution-Based Haircut Model

$$\hat{N}_{b,t0+h} = \bar{N}_{b,t0} \times \text{HaircutFactor}$$

where:

- $\hat{N}_{b,t0+h}$ is the dollar-level projection for the noninterest income of a component for firm b at projection horizon $t0 + h$, where $t0$ is the jump-off quarter and $h \in \{1,2, \dots, 13\}$; and
- $\bar{N}_{b,t0}$ is the average, measured as either the geometric mean, arithmetic mean, or the median, of the level of the noninterest income component or its ratio to relevant assets for firm b at quarter $t0$.

In applications of the distribution-based haircut model where a normalizing balance is used to project a constant ratio rather than dollar-level noninterest income, firm-specific noninterest income for a particular business line is calculated, for all projection quarters, as:

Equation A25 – Firm-specific Noninterest Income Projection – Distribution-Based Haircut Model for Normalized Fees

$$\hat{N}_{b,t0+h} = \overline{NRatio}_{b,t0} \times Balance_{b,t0} \times HaircutFactor$$

where:

- $\hat{N}_{b,t0+h}$ is the dollar-level projection of the noninterest income component for firm b at projection quarter $t0 + h$, where $t0$ is the jump-off quarter and $h \in \{1, 2, \dots, 13\}$;
- $\overline{NRatio}_{b,t0}$ is the average, measured as either the geometric mean, arithmetic mean, or the median, of the noninterest income component normalized by a balance for firm b at quarter $t0$; and
- $Balance_{b,t0}$ is the normalizing balance for firm b at the jump-off quarter.

The above equation multiplies three components: (i) firm b 's noninterest income ratio, (ii) firm b 's normalizing balances at the starting period, and (iii) the haircut factor to produce a dollar-value estimate of noninterest income. This value is assumed to be constant for each quarter of the projection horizon. The distribution-based haircut approach reflects the stress testing policy principles of robustness and stability by calculating the haircut in a way that relies on inputs which demonstrate a statistically significant relationship with the dependent variable, and by anchoring on a smoothed average that captures recent firm performance while mitigating the impacts of seasonality and the volatility that can result from using a single-quarter starting value.

III. Noninterest Income Models By Business Line

A. Noninterest Income on Credit Card Fees

Noninterest income from credit card fees consists of credit card interchange fees and other credit card fees. The Board proposes to model these two components separately using different approaches. The Board proposes a volume-based approach for credit card interchange fees because they are directly driven by transaction volume. Transaction volume reflects the health of the economy and is thus modeled using macroeconomic drivers such as unemployment

and inflation. In contrast, other credit card fees encompass diverse fee types with heterogeneous reporting practices across firms that make the component unsuitable for macroeconomic-driven modeling that is consistent and comparable across firms. Consequently, the Board proposes to use a firm-specific four-quarter mean to flatline this component regardless of economic conditions. The following sections provide details on the models. Parameter estimates are provided in Appendix B.

i. Model Description

a. *Credit Card Interchange Fees*

Credit card interchange fees represent noninterest income a card-issuing firm earns each time a cardholder uses its credit card to complete a purchase transaction. These fees are paid by the merchant's acquiring firm to the cardholder's issuing firm as compensation for extending credit and assuming the associated fraud and credit risk. Noninterest income on credit card interchange fees scales directly with the volume of credit card purchase volume. The volume measure used to project the underlying business volume for credit card interchange fees is credit card purchase volume divided by the number of open credit card accounts. Normalizing the volume of credit card purchase volume by the number of open accounts isolates the average transactional intensity per active account. Modeling this ratio separates changes in interchange income caused by portfolio growth from changes caused by shifts in cardholder spending behavior. This separation is also important because the number open accounts is fixed during the projection horizon in accordance with the flat balance sheet assumption.

The proposed model begins by projecting industry-level average purchase volume per account using a regression. Credit card usage activity is generally influenced by overall

economic activity. Among the relevant variables measuring the broader economy, unemployment and inflation rates were selected as the macroeconomic drivers for the regression. Changes in the unemployment rate capture consumer spending capacity and economic health. When unemployment rises, consumers typically reduce discretionary spending, leading to lower credit card transaction values. Changes in the inflation rate capture the effect of changing price levels on nominal transaction volumes. The Board considered other measures of consumer activity, such as nominal and real GDP growth, but selected unemployment and CPI inflation because they provide a parsimonious and direct link to variables specified in the severely adverse scenario while yielding a relatively better statistical fit and model performance.

The industry-level volume-based credit card interchange fees model assumes that average purchase volume per account responds to changes in the unemployment rate, changes in CPI inflation, a COVID dummy, and quarterly dummies. The COVID dummy variable accounts for the disruption during the initial pandemic period that does not exhibit normal unemployment-spending relationships. Quarterly dummies capture the strong seasonality in credit card spending patterns.

The specification for the volume-based model for credit card interchange fees is thus given by:

Equation A26 – Credit Card Interchange Fees Volume-Based Model

$$\Delta \log CreditCardICVolumeRatio_t = \alpha + \beta_1 \Delta UR_t + \beta_2 \Delta CPI_t + COVID\ Dummy + QuarterlyDummies_t + \epsilon_t$$

where:

- $CreditCardICVolumeRatio_t$ is credit card purchase volume divided by the number of open credit card accounts at the industry level in quarter t ;
- α is a constant intercept;

- ΔUR_t is the quarterly change in the U.S. unemployment rate;
- ΔCPI_t is the quarterly change in the Consumer Price Index inflation rate;
- $COVIDDummy$ is an indicator variable for 2020:Q2;
- $QuarterlyDummies_t$ are seasonal indicator variables for quarters; and
- ϵ_t is a stochastic error term.

Credit card purchase volume is retrieved from FR Y-14Q, Schedule G.3, line item 2. The number of open credit card accounts is retrieved from FR Y-14Q, Schedule G.3, line item 1. The credit card interchange fees volume-based model is estimated on quarterly sample data from 2014:Q1 to 2024:Q4. Firms are excluded from the estimation sample if they did not report noninterest income in this business line or entered or exited the business line during the sample period. The sample starts in 2014:Q1 due to data availability, as most firms subject to the stress test had begun to report relevant data by that time. The Board will evaluate and consider the addition of new data every year and determine the appropriateness of re-estimation on an extended sample.

Industry-level growth rate projections are produced using the estimates of the credit card interchange fees volume-based model and the supervisory severely adverse scenario path for the unemployment rate and CPI inflation rate.

The projection of a firm's individual volume ratio begins from the anchor, the geometric mean¹⁶ of the firm's volume ratio over the four quarters ending at jump-off. Firm-specific volume ratios are calculated as:

Equation A27 – Credit Card Interchange Fees Firm-Specific Starting Volume Ratio

¹⁶ Details on the use of a geometric mean and related exception handling are provided in Appendix A.

$$\overline{CreditCardICVolumeRatio}_{b,t0} = \left(\prod_{i=0}^3 CreditCardICVolumeRatio_{b,t0-i} \right)^{\frac{1}{4}}$$

where:

- $\overline{CreditCardICVolumeRatio}_{b,t0}$ denotes the firm-specific anchor value for the ratio of credit card purchase to total number of open credit card accounts for firm b .

Projected industry-level growth is applied to the firm-specific anchor and compounded forward so that each projected quarterly estimate grows from the value in the preceding quarter. An adjustment is applied to the first projected quarter to account for the application of a quarterly growth rate to a four-quarter geometric mean for the liftoff; the geometric mean requires adjustment prior to use as a quarterly measure because it would otherwise capture impacts from deterministic elements of the time series in the four quarters it averages, such as seasonality. In this way, the projection horizon begins from a level consistent with the seasonal factors and macroeconomic variables applicable in the liftoff. Details of the adjustment are provided in Appendix A.

Applying the recursion repeatedly and multiplying by the total number of open credit card accounts at jump-off produces the firm-specific projected level in any quarter of the horizon directly in terms of the anchor and the cumulative sum of projected growth rates. Firm-specific projected credit card purchase volume is thus calculated as:

Equation A28 – Projected Credit Card Interchange Fees Volume

$$\begin{aligned}
& CreditCard\hat{IC}Volume_{b,t0+h} \\
&= Accounts_{b,t0} * \overline{CreditCardICVolumeRatio_{b,t0}} \\
&\quad * \exp\left(\sum_{j=1}^h \Delta \log CreditCard\hat{IC}VolumeRatio_{t0+j}\right)
\end{aligned}$$

where:

- $CreditCard\hat{IC}Volume_{b,t0+h}$ is the projected credit card purchase volume for firm b at projection period $t0 + h$;
- $Accounts_{b,t0}$ is the number of open credit card accounts at jump-off for firm b ; and
- $h \in (1,2, \dots, 13)$ is the projection horizon.

The result is firm-specific credit card purchase volume for every quarter of the projection horizon.

The fee rate is the firm-specific level of noninterest income earned per unit of business activity conducted, and is calculated by dividing the historical noninterest income on credit card interchange fees for a given firm by that firm's historical credit card volume:

Equation A29 – Credit Card Interchange Fees Fee

$$CreditCardICFeesFee_{b,t} = \frac{CreditCardICFees_{b,t}}{CreditCardICVolume_{b,t}}$$

where:

- $CreditCardICFeesFee_{b,t}$ denotes the firm-specific fee rate for firm b at time t ;
- $CreditCardICFees_{b,t}$ denotes the historical noninterest income on credit card interchange fees for firm b at time t ; and
- $CreditCardICVolume_{b,t}$ denotes the historical credit card purchase volume for firm b at time t .

Noninterest income on credit card interchange fees is retrieved from FR Y-14Q, Schedule G.1, line item 14C.

The fee rate used in the projection of noninterest income from credit card interchange fees is the median of the fee rate over the four quarters ending at jump-off, and is given by:

Equation A30 – Median Credit Card Interchange Fees Fee

$$\overline{CreditCardICFeesFee}_{b,t0} = \text{median}(CreditCardICFeesFee_{b,t0-k})$$

where:

- $\overline{CreditCardICFeesFee}_{b,t0}$ is the median firm-specific fee rate for firm b , at $t0$;
- $t0$ denotes the jump-off quarter; and
- $k \in (0,1,2,3)$.

The four-quarter median fee rate is used instead of the average so that the projection is not distorted by a single quarter in which either the income line item or the volume measure was atypical. Using a recent four-quarter window produces a fee rate that is consistent with firms' current pricing and product mixes.

Finally, projected noninterest income from credit card interchange fees is estimated by multiplying the projected volume of business activity by the median fee rate, as given by:

Equation A31 – Noninterest Income on Credit Card Interchange Fees Projection

$$Credit\widehat{CardICFees}_{b,t0+h} = Credit\widehat{CardICVolume}_{b,t0+h} \times \overline{CreditCardICFeesFee}_{b,t0}$$

where:

- $Credit\widehat{CardICFees}_{b,t0+h}$ denotes the projected noninterest income on credit card interchange fees for firm b at time $t0 + h$;
- $Credit\widehat{CardICVolume}_{b,t0+h}$ denotes the projected volume of credit card purchases for firm b at time $t0 + h$; and
- $\overline{CreditCardICFeesFee}_{b,t0}$ is the constant firm-specific starting fee rate.

b. *Other Credit Card Fees*

Noninterest income on other credit card fees includes residual fee income from the credit card business line that does not fall into the credit card interchange fee category. These fees typically include items such as annual or account membership fees, late payment fees, over-limit fees, and cash advance fees, among other miscellaneous charges.

The Board proposes to model this category using a flatline projection rather than the volume-based approach, given the particular characteristics of the other credit card fees revenue streams. First, some firms may report contra revenues from their rewards programs in this category while others may not. Contra revenues are recorded as a reduction to gross credit card income, rather than as a separate expense, and reflect firms' spending on their rewards programs. The reporting of contra revenues from rewards programs in other fees means that this line item will be countercyclical for some firms as rewards, and associated expenses incurred, increase when economic conditions are good. Additionally, during periods of economic stress, while late fees may increase, it is uncertain whether they would be recoverable. Consequently, a flatline model constitutes a conservative approach given the Board's empirical observations and expectations about firm income behavior under an extremely severe scenario, which is aligned with the stress testing policy of conservatism.

Additionally, because late fees are excluded from the credit card model within the stress testing Retail Model, their estimation in the other credit card fees model does not duplicate consideration of these exposures.

The Board proposes to estimate noninterest income from other credit card fees as a flatline model in the manner described above in the overview. The other credit card fees liftoff is calculated as:

Equation A32 – Other Credit Card Fees Starting Ratio

$$\overline{OtherCCFeeRatio}_{b,t0} = \text{mean}(OtherCCFees_{b,t0-k} / CreditCardBalances_{b,t0-k})$$

where:

- $\overline{OtherCCFeeRatio}_{b,t0}$ is four-quarter geometric mean of other credit fees ratio normalized by credit card balances for firm b at quarter $t0$;
- $OtherCCFees_{b,t0-k}$ is other credit card fees for firm b at quarter t ;
- $CreditCardBalances_{b,t}$ is average credit card balances for firm b at quarter t ;
- $t0$ is the jump-off quarter; and
- $k \in \{0,1,2,3\}$.

Other credit card fees are scaled by outstanding credit card balances because many of these fees (such as late fees, over-limit fees, and cash advance fees) are directly or indirectly related to balance levels. Normalizing by balances creates a stable ratio that captures both firm-specific fee structures and the scale of each firm's credit card portfolio. Other credit card fees are flatlined at their four-quarter mean, instead of median, to incorporate observed seasonality.

Firm-specific noninterest income from other credit card fees is calculated, for all projection quarters, as the product of this ratio and credit card balance at jump-off given by:

Equation A33 – Other Credit Card Fees Projection

$$Other\hat{CCFees}_{b,t0+h} = \overline{OtherCCFeesRatio}_{b,t0} \times CreditCardBalances_{b,t0}$$

where:

- $Other\hat{CCFees}_{b,t0+h}$ is the dollar-level projection for firm b 's other credit card fees at projection horizon $t0 + h$, where $t0$ is the jump-off quarter and $h \in \{1,2, \dots, 13\}$;
- $\overline{OtherCCFeeRatio}_{b,t0}$ is four-quarter geometric mean of other credit fees ratio normalized by credit card balances for firm b at quarter $t0$; and
- $CreditCardBalances_{b,t}$ is average credit card balances for firm b at quarter t .

The above equation multiplies two components: (i) firm *b*'s other credit card fee ratio and (ii) firm *b*'s outstanding credit card balance level at jump-off. Data on other credit card fees is retrieved from FR Y-14Q, Schedule G.1, line item 14D. Average credit card balances are retrieved from FR Y-14Q, Schedule G.2, line item 5.¹⁷

ii. Assumptions and Limitations

The volume-based approach for credit card interchange fees relies on several key modeling choices. The model uses the ratio of credit card purchase volume to the number of open credit card accounts as the measure of business activity underlying interchange fees. An alternative specification could model credit card purchase volume as the dependent variable in a separate regression, which would imply that both the number of accounts and spending per account respond separately to macroeconomic conditions. In contrast, the proposed specification isolates the macroeconomic impact on spending per account while treating the number of accounts as firm-specific and relatively stable in the projection horizon. The proposed specification was preferred since the number of accounts are not expected to fluctuate drastically during the relatively short term of stress test projections.

As previously discussed, an assumption underpinning the volume-based approach is that fee ratios are relatively stable and do not vary over the projection horizon. In the volume-based

¹⁷ For firms that report domestic bank card revenue and loss sharing agreement payments in noninterest income, these amounts are not projected by the Noninterest Income Model but are projected separately using a consistent treatment for all firms. The Supervisory Stress Test Model Documentation – Credit Risk Models provides a detailed methodology.

To prevent measuring duplicative revenue and loss sharing amounts in noninterest income projections, the Board isolates these amounts in a new FR Y-14Q, Schedule G.1, line item 14D.1 when firms report them in noninterest income. This field is excluded from the input data of the other noninterest income for credit and charge cards. Until these newly added fields are available for four quarters, the period used to calculate the other credit card fee ratio, the Board will use special data collections to obtain necessary inputs.

model for noninterest income from credit card interchange fees, this assumption is consistent with the fact that credit card interchange fees are generally standardized by interchange networks and change infrequently, as well as with the stress testing principles of simplicity, robustness, and stability.

The volume-based approach also assumes that industry-level credit card interchange activity is representative for all firms under stress. Credit card spending is driven by consumer demand that reflects the state of the real economy, which affects all card issuers similarly.¹⁸ Although this assumption may not fully capture firm-specific differences in customer base or product mix that could lead to heterogeneous responses to economic stress, an industry-level model reduces firm-specific noise and better captures macroeconomic sensitivity by focusing on the aggregate industry response to economic conditions. In addition, an industry-level model is in line with the stress testing principle of consistency and comparability since all firms receive the same treatment and short-term, temporary fluctuations in firm attributes do not interfere with stress test projections.

The Board proposes to use a flatline model for other credit card fees due to the particular characteristics of the other credit card fees revenue streams, as described above. A limitation of the flatline model for other credit card fees is that it does not allow projections to reflect changes in economic conditions. However, absent more granular data on other credit card fees and consistent accounting practices across firms, the flatline projection approach is appropriate and conservative given current data availability and reporting practices.

¹⁸ Credit card spending can be used to measure household consumption, as in, for example, S. Agarwal, C. Liu, and N. Souleles, *The reaction of consumer spending and debt to tax rebates: Evidence from consumer credit data*, *Journal of Political Economy* 115(6) (2007), 986–1019.

iii. Alternatives for Noninterest Income on Credit Card Interchange Fees

The Board considered the availability of alternative approaches to calculate noninterest income on credit card interchange fees in the supervisory stress test. In particular, the Board could estimate noninterest income on credit card interchange fees using an approach that is similar to others described in this 2027 Proposed PPNR Model Documentation, including the regression, flatline, and distribution-based haircut approaches.

In a direct regression approach, the Board could model noninterest income on credit card interchange fees as a function of macroeconomic variables such as unemployment, real or nominal GDP, and inflation, rather than separately projecting credit card purchase volume and applying a fee rate. Under this approach, the estimated model would combine changes in credit card purchase volume and fee rates, making it more difficult to identify the channel through which stress affects this revenue stream. Because credit card purchase volume is directly observable and fee rates are assumed to be relatively stable, the proposed volume-based approach more directly captures the expected effect of stress through changes in credit card purchase volume. Separating the volume and fee-rate components also makes the source of projected changes in noninterest income on credit card interchange fees easier to interpret and explain, which is more consistent with the Board's modeling principles favoring simpler, more transparent approaches where appropriate.

In a flatline approach, the Board could model noninterest income on credit card interchange fees by setting projected noninterest income on credit card interchange fees to the firm-specific four-quarter geometric mean, or the median, of noninterest income on credit card interchange fees, as described above. Under this approach, the model would assume that

noninterest income on credit card interchange fees would not vary with the broader macroeconomy under a severely adverse scenario.

In a distribution based-haircut approach, the Board could model noninterest income on credit card interchange fees by setting projected noninterest income on credit card interchange fees to a firm-specific four-quarter arithmetic mean of noninterest income multiplied by a haircut. The Board would analyze the distribution of growth rates of noninterest income on credit card interchange fees across stress-tested firms, then select a growth rate from an appropriate haircut percentile. An appropriate percentile could be the 7th percentile as described in the distribution-based model for noninterest income on sales and trading or a different conservative percentile. As discussed below (see, e.g., Section III.B.iii.a) for other sources of noninterest income, under this approach the model would assume that fees would not vary with the broader macroeconomy under a severely adverse scenario, but in contrast to a pure flatline this distribution based-haircut approach would assume a level of decline under stress.

Additionally, within the proposed volume-based approach, the Board could adopt a standardized data adjustment to account for the COVID period, which could entail excluding specified pandemic-period observations rather than including a 2020:Q2 dummy. If adopted, this approach would simplify the treatment of COVID-period observations across relevant components, but would further reduce the relatively short estimation sample. The proposed dummy instead retains the 2020:Q2 observation while limiting the effect of the pandemic-specific disruption on the estimated relationship between macroeconomic conditions and credit transaction activity.

Further, as detailed in Appendix A, the Board proposes to apply an adjustment to the first projected quarter to compensate for the use of a four-quarter geometric mean for the liftoff. This

adjustment supports the principle of robustness as it allows for more precise projections.

However, its impact is small. To further the principle of simplicity, the Board is considering an alternative where this adjustment is omitted from the model.

The Board considered the availability of these alternative approaches and determined that the proposed volume-based approach for noninterest income on credit card interchange fees was reasonably designed to achieve the goals of the stress test. The Board is interested in feedback on these alternative approaches, and whether they should be adopted in any final PPNR model for the 2027 supervisory stress test.

(i) Alternatives for Noninterest Income from Other Credit Card Fees

The Board considered the availability of alternative approaches and determined that the proposed flatline approach for noninterest income on other credit card fees was reasonably designed to achieve the goals of the stress test. The choice of a flatline projection over other alternative approaches (volume-based, regression, or distribution based) is appropriate given the institutional features of other credit card fees revenue streams. As described above, the heterogeneous reporting of rewards contra revenues creates countercyclical behavior for some firms that make it difficult to develop a consistent modeling approach. A flatline model constitutes a conservative approach given the Board's empirical observations and expectations about firm income behavior under an extremely severe scenario, which is aligned with the stress testing policy of conservatism.

iv. Questions

The Board is requesting public input on this proposed model for noninterest income on credit card fees, including, but not limited to, input on the following questions:

Question 4: The Board seeks input on the proposed approach to model noninterest income on credit card fees. What are the advantages and disadvantages of the proposed approach? Are there alternative specifications, in terms of right-hand side variables, differences, lags, transformations, or the sample period of estimation, that the Board should consider, and why? Should the Board consider an alternative measure of activity volume, or a different scaling method for the dependent variable, in this model?

Question 5: Should the Board adjust the first projection quarter to account for seasonality and the liftoff from a four-quarter geometric mean? Is the adjustment described in Appendix A appropriate? Alternatively, should the Board decline to adjust the first projection quarter? If so, what would be the advantages and disadvantages of doing so?

Question 6: The Board seeks input on the use of the mean four-quarter lookback and the associated weighted average adjustment for log differenced models. Are there alternative approaches or lookback periods that the Board should consider to mitigate volatility and seasonality from the liftoff values for the noninterest income on credit card fees model? Does the use of a four-quarter lookback period appropriately balance reflecting recent trends while mitigating volatility and the effects of seasonality and atypical observations? What are the advantages and disadvantages of any such alternative?

B. Noninterest Income on Mortgages and Home Equity

Firms subject to the stress test generate noninterest income from mortgages and home equity (MHE) from both production (i.e., originating mortgages for sale in the secondary market) and servicing, as reflected on FR Y-14Q, Schedule G.1. Noninterest income from production reflects gains from selling mortgages on the secondary market along with origination and related

fees. Noninterest income from servicing reflects the servicing fee revenue earned on holdings of mortgage servicing rights (MSRs) for mortgages not held on balance sheet. MSRs grant the holder rights to the contractual fees on an underlying mortgage, including loan administration fees, such as fees incurred for payment processing and managing escrow accounts, and ancillary fees like late fees. A firm's MSR holdings are considered intangible assets that gain and lose value due to the amortization of existing MSRs, changes in the principal balance of existing MSRs, changes in MSR valuation modeling assumptions, and new MSR holdings via production or acquisition. Changes to the value of MSR holdings are considered noninterest income and are modeled together as MSR value changes. Finally, other noninterest income on mortgages and home equity servicing includes miscellaneous fees that do not fit cleanly into the other servicing fee subcomponents. The next section provides details on the models. Parameter estimates are provided in Appendix B.

i. Model Description

The Board proposes four models to project noninterest income on MHE loans and lines of credit.¹⁹ The four models consist of volume-based models for MHE production and MHE servicing fees, a regression model for MSR value changes, and a flatline model for other MHE noninterest income (MHE other).

The data for these four subcomponents of MHE are sourced from FR Y-14Q, Schedule G.1, line items 14F, 14J, 14L, and 14M. Additionally, data on MSR carry values for use in the

¹⁹ For ease of exposition, these line items are referred to as the following (full name in parenthesis): MHE production (MHE Production), MHE servicing fees (MHE Servicing: Servicing and Fees), MSR value changes (MHE Servicing: MSR Value Changes due to Changes in Assumptions/Model Inputs/Other Net of Hedge Performance), and MHE other (MHE Servicing: Other).

MSR value changes model is sourced from FR Y-9C, Schedule HC-M, line item 12.a.(1). All modeled components except for MHE other use an estimation sample from 2014:Q1 to 2024:Q4 with no firm exclusions. Finally, MHE other is flatlined at a firm-specific four-quarter median in order to reflect recent income levels in the absence of seasonality.

a. Noninterest Income from MHE Production

Noninterest income from MHE production consists primarily of gains and losses from the sale of MHE loans and lines of credit originated through all production channels with the intent to sell. Origination fees are recognized when MHE loans and lines of credit originated with the intent to sell are marked at fair value on the balance sheet. When MHE originations are sold off the balance sheet, the final fair value mark includes any deferred fees or costs. Sales of MHE loans and lines of credit primarily reflect the volume of sales originated in the production pipeline.

The industry-level MHE production model assumes MHE sales responds to the mortgage rate because MHE origination is determined in part by the cost of financing new mortgages or home equity.²⁰ To project noninterest income from MHE production, the Board would begin by estimating the change in MHE sales volume at the industry level using changes to the fixed-rate mortgage interest rate. The specification for the volume-based model for MHE production is thus given by:

Equation A34 – MHE Production Volume-Based Model

$$\Delta \log Sales_t = \alpha + \beta_1 \Delta MortgageRate_t + \epsilon_t$$

²⁰ For example, DeFusco and Paciorek (2017) demonstrate the inverse relationship between mortgage rates and mortgage demand. See A. DeFusco and A. Paciorek, *The interest rate elasticity of mortgage demand: Evidence from bunching at the conforming loan limit*, American Economic Journal: Economic Policy 9(1) (2017), 210–40.

where:

- $Sales_t$ is MHE sold aggregated at the industry level at time t ;
- α is a constant intercept;
- $\Delta MortgageRate_t$ is the quarterly change in the 30-year fixed-rate mortgage interest rate at time t , representing the changing interest rates in the mortgage market; and
- ϵ_t is a stochastic error term.

Sales volume is retrieved from FR Y-14Q, Schedule G.3, line item 6. The MHE production volume-based model is estimated on a quarterly sample from 2014:Q1 to 2024:Q4. The sample starts in 2014:Q1 due to data availability, as most firms subject to the stress test had begun to report relevant data by that time. The Board will evaluate and consider the addition of new data every year and determine the appropriateness of re-estimation on an extended sample.

Industry-level MHE production growth rate projections are produced using the estimates of the MHE production volume-based model and the supervisory severely adverse scenario path for the mortgage rate.

The projection of firm-specific MHE production volume begins from an anchor, the geometric mean²¹ of the firm's volume over the four quarters ending at jump-off. Firm-specific MHE production volume is calculated as:

Equation A35 – MHE Production Firm-Specific Starting Volume

$$\overline{Sales}_{b,t0} = \left(\prod_{i=0}^3 Sales_{b,t0-i} \right)^{\frac{1}{4}}$$

where:

- $\overline{Sales}_{b,t0}$ denotes the firm-specific anchor value for mortgages and home equity sold for firm b .

²¹ Details on the use of a geometric mean and related exception handling are provided in Appendix A.

Projected industry-level MHE production growth is then applied to the firm-specific anchor and compounded forward so that each projected quarterly growth rate is calculated using the growth rate in the preceding quarter. An adjustment is applied to the first projected quarter to account for the application of a quarterly growth rate to a four-quarter geometric mean for the liftoff; the geometric mean requires adjustment prior to use as a quarterly measure because it would otherwise capture impacts from deterministic elements of the time series in the four quarters it averages, such as seasonality. In this way, the projection horizon begins from a level consistent with the seasonal factors and macroeconomic variables applicable in the liftoff. Details of the adjustment are provided in Appendix A.

Applying the recursion repeatedly gives the firm-specific projected level in any quarter of the horizon directly in terms of the anchor and the cumulative sum of projected growth rates.

Firm-specific projected MHE sales volume is thus calculated as:

Equation A36 – Projected MHE Production Volume

$$\hat{Sales}_{b,t0+h} = \overline{Sales}_{b,t0} * \exp \left(\sum_{j=1}^h \Delta \log \hat{Sales}_{t+j} \right)$$

where:

- $\hat{Sales}_{b,t0+h}$ is the projected dollar value of MHE sales volume for firm b at period $t0 + h$; and
- $h \in (1,13)$ is the projection horizon.

The result is a firm-specific projected dollar level of MHE sales activity for every quarter of the horizon.

The fee rate is the industry level of noninterest income earned per unit of business activity conducted, and is calculated by:

Equation A37 – MHE Production Fee

$$MHEProductionFee_t = \frac{\sum_b (MHEProduction_{b,t})}{\sum_b (Sales_{b,t})}$$

where:

- $MHEProductionFee_t$ denotes the industry-level fee rate at time t ;
- $MHEProduction_{b,t}$ denotes the historical noninterest income of MHE production for firm b at time t ; and
- $Sales_{b,t}$ denotes the historical volume of MHE sales for firm b at time t .

Noninterest income on MHE production is retrieved from FR Y-14Q, Schedule G.1, line item 14F. An industry-level MHE fee is estimated instead of a firm-specific fee to address outliers observed in the data. Analysis indicates these outliers could stem from idiosyncratic measurement or reporting differences across firms, which could produce overly volatile projections in a firm-specific fee model. The industry-level approach mitigates the impact of these outliers and provides consistent treatment across firms.

The fee rate used in the projection of noninterest income from MHE production is the median of the production fee rate over the four quarters ending at jump-off, and is given by:

Equation A38 – Median MHE Production Fee

$$\overline{MHEProductionFee}_{t_0} = \text{median}(MHEProductionFee_{t_0-k})$$

where:

- $\overline{MHEProductionFee}_{t_0}$ is the median industry-level fee rate at t_0 ;
- t_0 denotes the jump-off quarter; and
- $k \in (0,1,2,3)$.

The four-quarter median fee rate is used instead of the average so that the projection is not distorted by a single quarter in which either the income line item or the volume measure was

atypical. Using a recent four-quarter window produces a fee rate that is consistent with firms' current pricing and product mixes.

Finally, projected noninterest income from MHE production is estimated by multiplying the projected volume of MHE production activity by the median fee rate, as given by:

Equation A39 – Noninterest Income on MHE Production Projection

$$\widehat{MHEProduction}_{b,t0+h} = \widehat{Sales}_{b,t0+h} \times \overline{MHEProductionFee}_{t0}$$

where:

- $\widehat{MHEProduction}_{b,t0+h}$ denotes the projected noninterest income MHE production for firm b at time $t0 + h$;
- $\widehat{Sales}_{b,t0+h}$ denotes the projected volume of a particular business line for firm b at time $t0 + h$; and
- $\overline{MHEProductionFee}_{t0}$ is the constant starting industry-level fee rate.

b. Noninterest Income from MHE Servicing Fees

MHE servicing fees are the recurring revenue a firm earns for collecting payments, managing escrow, and handling administrative tasks on MHE loans and lines of credit a firm services on behalf of investors. The rights to collect this recurring revenue are referred to as mortgage servicing rights (MSRs). As stated above, MSRs are intangible assets and are reported as mortgage servicing assets on the FR Y-9C. The MHE servicing fees model assumes that the MHE servicing fees are proportional to the average volume of third-party residential mortgages serviced (serviced balance) by a firm.²² The serviced balance represents the principle that the firm has a right to servicing fees as a part of the firm's MSR holdings. Generally, serviced

²² As discussed in Chiang, Yang, and Tsai (2016), for example. See S. Chiang, T. Yang, and M. Tsai, *Assessing mortgage servicing rights using a reduced-form model: Considering the effects of interest rate risks, prepayment and default risks, and random state variables*, Journal of Housing Economics 32 (2016), 29–46.

balances respond to interest rates, which affect prepayment rates because refinancing property and paying down the prior loan becomes more (less) attractive to borrowers as rates decrease (increase). Among available and relevant variables, the change in the 30-year fixed mortgage rate was selected as the sole macroeconomic variable for the regression because it has explanatory power and produces reasonable projections. The Board also considered the 10-year Treasury yield and real variables like real GDP growth but chose not to include them in the model specification because they did not exhibit as strong of a statistical fit. In addition, the aggregate time series for serviced balances featured a high degree of persistence, meaning observations in the series are influenced by prior values, which may be due to the fact that serviced balances tend to be associated with 15- or 30-year fixed mortgages that remain in the dataset for long periods.²³ To account for this persistence, the Board included a lag of serviced balances. The Board thus proposes to model this component using the change in the 30-year fixed mortgage rate and a lag of serviced balances.

To project noninterest income from MHE servicing fees, the Board would begin by estimating industry-level serviced balance using the lagged industry-level serviced balance and the change in the 30-year fixed mortgage rate, as specified by:

Equation A40 – MHE Servicing Fees Volume-Based Model

$$\Delta \log \text{ServicedBalance}_t = \alpha + \beta_1 \Delta \text{MortgageRate}_t + \beta_2 \Delta \log \text{ServicedBalance}_{t-1} + \epsilon_t$$

where:

- ServicedBalance_t is the average serviced balance of third-party residential mortgages aggregated at the industry level at time t ;
- α is a constant intercept;

²³ This mechanism is also discussed in Chiang, Yang, and Tsai (2016). *Id.*

- $\Delta MortgageRate_t$ is the quarterly change in the 30-year fixed-rate mortgage rate at time t , representing the changing interest rates in the mortgage market; and
- ϵ_t is a stochastic error term.

Serviced balance is retrieved from FR Y-14Q, Schedule G.3, line item 4. The MHE servicing fees model is estimated on a quarterly sample from 2014:Q1 to 2024:Q4. The sample starts in 2014:Q1 due to data availability, as most firms subject to the stress test had begun to report relevant data by that time. The Board will evaluate and consider the addition of new data every year and determine the appropriateness of re-estimation on an extended sample.

Industry-level growth rate projections are produced using the estimates of the MHE servicing fees volume-based model and the supervisory severely adverse scenario path for the mortgage rate.

The projection of firm-specific MHE serviced balance volume begins from an anchor, the geometric mean²⁴ of the firm's serviced balance volume over the four quarters ending at jump-off. Firm-specific serviced balance volume is calculated by:

Equation A41 – MHE Servicing Fees Firm-Specific Starting Volume

$$\overline{ServicedBalance}_{b,t0} = \left(\prod_{i=0}^3 ServicedBalance_{b,t0-i} \right)^{\frac{1}{4}}$$

where:

- $\overline{ServicedBalance}_{b,t0}$ denotes the firm-specific starting value for mortgages and home equity serviced for firm b .

Projected growth is applied to the firm-specific anchor and compounded forward so that each projected quarterly estimate grows from the value in the preceding quarter. An adjustment is

²⁴ Details on the use of a geometric mean and related exception handling are provided in Appendix A.

applied to the first projected quarter to account for the application of a quarterly growth rate to a four-quarter geometric mean for the liftoff; the geometric mean requires adjustment prior to use as a quarterly measure because it would otherwise capture impacts from deterministic elements of the time series in the four quarters it averages, such as seasonality. In this way, the projection horizon begins from a level consistent with the seasonal factors and macroeconomic variables applicable in the liftoff. Details of the adjustment are provided in Appendix A.

Applying the recursion repeatedly produces the firm-specific projected level of MHE serviced balance in any quarter of the horizon in terms of the anchor and the cumulative sum of projected growth rates. Firm-specific projected MHE serviced balance volume is thus calculated as:

Equation A42 – Projected MHE Servicing Fees Volume

$$Serviced\hat{Balance}_{b,t0+h} = \overline{ServicedBalance}_{b,t0} * \exp\left(\sum_{j=1}^h \Delta \log Serviced\hat{Balance}_{t+j}\right)$$

where:

- $Serviced\hat{Balance}_{b,t0+h}$ is the projected dollar value of serviced balance volume for firm b at period $t0 + h$; and
- $h \in (1,2, \dots, 13)$ is the projection horizon.

The result is a firm-specific projected dollar level of MHE serviced balance for every quarter of the horizon.

To estimate noninterest income from MHE serviced balance, the Board would calculate a fee rate for MHE servicing to apply to MHE servicing activity. The fee rate is the industry-level of noninterest income earned per unit of MHE serviced balance, and is given by:

Equation A43 – MHE Servicing Fees Fee

$$MHEServicingFeesFee_t = \frac{\sum_b (MHEServicingFees_{b,t})}{\sum_b (ServicedBalance_{b,t})}$$

where:

- $MHEServicingFeesFee_t$ denotes the industry-level fee rate at time t ;
- $MHEServicingFees_{b,t}$ denotes the historical noninterest income of MHE Production for firm b at time t ; and
- $ServicedBalance_{b,t}$ denotes the historical volume of MHE sales for firm b at time t .

Noninterest income on MHE servicing fees is retrieved from FR Y-14Q, Schedule G.1, line item 14J. All firms are assigned an industry-level fee. An industry-level MHE servicing fee is estimated instead of a firm-specific fee to address outliers observed in the data. Analysis indicates these outliers could stem from idiosyncratic measurement or reporting differences across firms, which could produce overly volatile projections in a firm-specific fee model. The industry approach mitigates the impact of these outliers and provides consistent treatment across firms.

The fee rate used in the projection is the median of the MHE servicing fee rate over the four quarters ending at jump-off, and is given by:

Equation A44 – Median MHE Servicing Fees Fee

$$\overline{MHEServicingFeesFee}_{t_0} = \text{median}(MHEServicingFeesFee_{t_0-k})$$

where:

- $\overline{MHEServicingFeesFee}_{t_0}$ is the median industry-level fee rate at t_0 ;
- t_0 denotes the jump-off quarter; and
- $k \in (0,1,2,3)$.

The four-quarter median MHE fee rate is used instead of the average so that the projection is not distorted by a single quarter in which either the income line item or the volume

measure was atypical. Using a recent four-quarter window produces a fee rate that is consistent with firms' current pricing and product mixes.

Finally, projected noninterest income from MHE servicing is estimated by multiplying the projected serviced balance volume by the median fee rate, as given by:

Equation A45 – MHE Servicing Fees Projection

$$\widehat{MHEServicingFees}_{b,t0+h} = \widehat{ServicedBalance}_{b,t0+h} \times \overline{MHEServicingFeesFee}_{t0}$$

where:

- $\widehat{MHEServicingFees}_{b,t0+h}$ denotes the projected noninterest income MHE servicing fees for firm b at time $t0 + h$;
- $\widehat{ServicedBalance}_{b,t0+h}$ denotes the projected serviced balance for firm b at time $t0 + h$; and
- $\overline{MHEServicingFeesFee}_{t0}$ is the constant starting industry-level fee rate.

c. Noninterest Income from MSR Value Changes

As stated above, mortgage servicing rights (MSRs) grant firms the right to service mortgages and collect the associated fee revenue on behalf of an investor. A firm's MSR holdings are considered an intangible asset that gains and loses value in part due to the amortization of existing MSRs, changes in the principal balance of existing MSRs, changes in MSR valuation modeling assumptions, and additions to MSR holdings via production or acquisition. These adjustments to the value of MSRs represent noninterest income and are modeled together as MSR value changes.

The Board proposes to use a regression model to project noninterest income from MSR value changes. The carry value of MSRs is generally driven by changes in interest rates which affect the prepayment behavior of the underlying borrowers as discussed above. Among available and relevant variables, the change in the 30-year fixed mortgage rate was selected as

the sole macroeconomic variable for the regression because it has explanatory power and produces reasonable projections. The Board also considered the 10-year Treasury yield and real variables like real GDP growth but chose not to include them in the model specification because they did not exhibit as strong of a statistical fit. The regression model for MSR carry value is thus given by:

Equation A46 – MSR Carry Value

$$\Delta \log MSR Carry Value_t = \alpha + \beta_1 \Delta Mortgage Rate_t + \epsilon_t$$

where:

- $MSR Carry Value_t$ is the aggregate MSR Carry Value retrieved from the FR Y-9C, at time t ;
- α is a constant intercept;
- $\Delta Mortgage Rate_t$ is the quarterly change in the 30-year fixed-rate mortgage interest rate at time t , representing changing interest rates in the mortgage market; and
- ϵ_t is a stochastic error term.

The proposed specification models aggregate MSR carry value from FR Y-9C, Schedule HC-M, line item 12.a.(1). The MSR carry value retrieved from the FR Y-9C is aggregated across all bank holding companies subject to the 2026 stress test. The MSR carry value growth rate path is projected at the aggregate level and then applied to firm-specific MSR carry value liftoffs to generate firm-specific MSR carry value projections. These projections are then first differenced to produce MSR value changes.

The projection of a firm's individual MSR carry value begins from an anchor, the geometric mean²⁵ of the firm's MSR carry value over the four quarters ending at jump-off. Firm-specific MSR carry value is calculated as:

²⁵ Details on the use of a geometric mean and related exception handling are provided in Appendix A.

Equation A47 – Firm-Specific Starting MSR Carry Value

$$\overline{MSRCarryValue}_{b,t0} = \left(\prod_{i=0}^3 MSRCarryValue_{b,t0-i} \right)^{\frac{1}{4}}$$

where:

- $\overline{MSRCarryValue}_{b,t0}$ denotes the firm-specific starting value for MSR carry value for firm b .

Projected growth is applied to the firm-specific anchor and compounded forward so that each projected MSR carry value grows from the value in the preceding quarter. An adjustment is applied to the first projected quarter to account for the application of a quarterly growth rate to a four-quarter geometric mean for the liftoff; the geometric mean requires adjustment prior to use as a quarterly measure because it would otherwise capture impacts from deterministic elements of the time series in the four quarters it averages, such as seasonality. In this way, the projection horizon begins from a level consistent with the seasonal factors and macroeconomic variables applicable in the liftoff. Details of the adjustment are provided in Appendix A.

Applying the recursion repeatedly produces the firm-specific projected level of MSR carry value in any quarter of the horizon directly in terms of the anchor and the cumulative sum of projected growth rates. Firm-specific MSR carry value is thus calculated as:

Equation A48 – Projected Level of MSR Carry Value

$$MSRCarryValue_{b,t0+h} = \overline{MSRCarryValue}_{b,t0} * \exp \left(\sum_{j=1}^h \Delta \log MSRCarryValue_{t0+j} \right)$$

where:

- $MSRCarryValue_{b,t0+h}$ is the projected level of MSR carry value for firm b at projection period $t0 + h$;

- $\overline{MSRCarryValue}_{b,t0}$ denotes the firm-specific starting value for MSR carry value for firm b ; and
- $h \in \{1,2, \dots, 13\}$ is the projection horizon.

The result is a firm-specific projected level of MSR carry value for every quarter of the projection horizon. To obtain a value of noninterest income from MSR carry value changes, the projected level of MSR carry value is first-differenced.

d. *Noninterest Income from MHE Other*

Noninterest income from MHE other includes all other revenue from servicing activities not captured in the above-described MHE servicing categories. MHE other is projected using a flatline approach because it does not feature any apparent macroeconomic variation and tends to be immaterial, as not all firms report in the relevant line-item in the FR Y-14 reports, reported amounts are small relative to the rest of this category, and reported amounts do not exhibit any discernible pattern. Noninterest income from MHE other is consequently flatlined at the firm-specific four-quarter median of MHE other, consistent with the stress testing principle of simplicity.

The anchor value for MHE other is calculated as:

Equation A49 – Starting Noninterest Income

$$\overline{MHEOther}_{b,t0} = \text{median}(MHEOther_{b,t0-k})$$

where:

- $\overline{MHEOther}_{b,t0}$ is the median of the noninterest income on MHE other for firm b at quarter $t0$;
- $MHEOther_{b,t0-k}$ is the noninterest income on MHE other for firm b at quarter t ;
- $t0$ is the jump-off quarter; and
- $k \in \{0,1,2,3\}$.

Firm-specific noninterest income on MHE other under the flatline model is set equal to the starting value for all projection quarters, as given by:

Equation A50 – Flatline Projection

$$MHE\hat{O}ther_{b,t0+h} = \overline{MHEO}ther_{b,t0}$$

where:

- $MHE\hat{O}ther_{b,t0+h}$ is the dollar-level projection for the noninterest income on MHE other for firm b at projection horizon $t0 + h$, where $t0$ is the jump-off quarter and $h \in \{1, 2, \dots, 13\}$; and
- $\overline{MHEO}ther_{b,t0}$ is the median of the noninterest income on MHE other for firm b at quarter $t0$.

Data on MHE other is retrieved from FR Y-14Q, Schedule G, line item 14M.

ii. Assumptions and Limitations

The Board proposes to use a volume-based approach to project MHE production and MHE servicing fees. An assumption of these models is that MHE production and MHE servicing fees are proportional to the volume of MHE sold at the industry level and the average volume of third-party mortgages serviced, respectively, as discussed above. This assumption implies that fluctuations in noninterest income projections for a particular business line under stress are driven only by variations in the associated business volume. The volume-based model also implicitly assumes the industry levels of the respective business activities are representative for all firms under stress. An industry-level model for the volume of MHE production and MHE servicing is aligned with the stress testing principles of consistency and comparability. In contrast, individual firm-level models would create distinct regressions and coefficients, each responding with differing macroeconomic sensitivity to the same underlying scenario. The

proposed industry-level approach ensures that projected noninterest income on MHE production and servicing differs only due to a firm's scale and business volume.

As previously discussed, an assumption underpinning the volume-based approach is that fee ratios are relatively stable and do not vary over the projection horizon. The proposed MHE production and servicing models also assume that fees on mortgages originated for sale and serviced balances do not vary across firms. These assumptions are consistent with industry practice, in which these fees are standardized.²⁶

The Board proposes to use a regression to project MSR value changes. A limitation of the proposed MSR value changes model is that it does not distinguish between valuation changes due to changes in interest rates from those due to increases in delinquency rates. It also does not reflect the differing characteristics of firms' servicing portfolios. The Board considered an industry-level structural model to link the value of MHE servicing fees to the carry value of MSRs as reported in the FR Y-9C, in which the value of MSRs to a firm is dependent on the firm's valuation of the anticipated future cash flow earned on servicing the underlying mortgages. This alternative model could address some of these limitations; however, such a model cannot be developed without collecting additional data on the features of MSRs, such as servicing fees and costs, which would likely increase burden on reporting firms.

The Board also proposes to use an industry-level model for MSR value changes. The model does not include covariates reflecting characteristics of the underlying mortgages

²⁶ Fee standardization for MSRs is discussed in Aldrich, Greenberg and Payner (2001). See S. Aldrich, W. R. Greenberg, and B. Payner, *A capital markets view of mortgage servicing rights*, *Journal of Fixed Income* 11(1) (2001), 37–53.

serviced, or their interactions, as limits to the available data would make it difficult to reliably estimate more complex models.

Additionally, the proposed MSR value changes model uses data on MSR values from the FR Y-9C, rather than MSR value changes as reported in the FR Y-14Q. The Board chose not to use the FR Y-14Q line item for MSR value changes because it is reported net of hedging impact; since hedging strategies vary significantly across firms and cannot be observed in the current data collection, this line item is not directly suitable for modeling.

Relatedly, the proposed MSR value changes model does not account for the impact of hedges due to a lack of sufficient data on MSR hedges. The Board will explore options to incorporate the impact of MSR hedges, including alternatives involving the collection or use additional data.

iii. Alternatives

a. Alternatives for Noninterest Income on MHE Production

The Board considered the availability of alternative approaches to calculate noninterest income on MHE production in the supervisory stress test. In particular, the Board could estimate noninterest income on MHE production using an approach that is similar to others described in this 2027 Proposed PPNR Model Documentation, including the regression, flatline, and distribution-based haircut approaches.

In a regression approach, the Board could model noninterest income on MHE production by estimating a regression on the industry-level of noninterest income on MHE production. The regression could feature macroeconomic scenario variables, including, but not limited to, the change in the mortgage rate or the growth rate of nominal GDP.

In a flatline approach, the Board could model noninterest income on MHE production by setting projected noninterest income on MHE production to the firm-specific four-quarter geometric mean, or the median, of noninterest income on MHE servicing fees, as described above. Under this approach, the model would assume that noninterest income on MHE production would not vary with the broader macroeconomy under a severely adverse scenario.

In a distribution based-haircut approach, the Board could model noninterest income on MHE production by setting projected noninterest income on MHE production to a firm-specific four-quarter geometric mean, or the median, of noninterest income multiplied by a haircut. The Board would analyze the distribution of growth rates in noninterest income on MHE production across stress-tested firms, then select a growth rate from an appropriate haircut percentile. An appropriate percentile could be the 7th percentile as described in the distribution-based model for noninterest income on sales and trading or a different conservative percentile. Under this approach, the model would assume that noninterest income on MHE production would not vary with the broader macroeconomy under a severely adverse scenario. In contrast to a pure flatline described above, this distribution based-haircut approach would assume a level of decline under stress.

The Board could alternatively model noninterest income on MHE production using the general volume-based approach described above but with different macroeconomic scenario variables. The Board could also consider the use of a firm-specific fee in the MHE production volume-based model.

Additionally, as detailed in Appendix A, the Board proposes to apply an adjustment to the first projected quarter to compensate for the use of a four-quarter geometric mean for the liftoff. This adjustment supports the principle of robustness as it allows for more precise projections.

However, its impact is small. To further the principle of simplicity, the Board is considering an alternative where this adjustment is omitted from the model.

The Board considered the availability of these alternative approaches and determined that the proposed volume-based approach for noninterest income on MHE production was reasonably designed to achieve the goals of the stress test. The Board is interested in feedback on these alternative approaches, and whether they should be adopted in any final PPNR model for the 2027 supervisory stress test.

b. Alternatives for Noninterest Income on MHE Servicing Fees

The Board considered the availability of alternative approaches to calculate noninterest income on MHE servicing fees in the supervisory stress test. In particular, the Board could estimate noninterest income on MHE servicing fees using an approach that is similar to others described in this 2027 Proposed PPNR Model Documentation, including the regression, flatline, and distribution-based haircut approaches.

In a regression approach, the Board could model noninterest income on MHE servicing fees by estimating a regression on the industry level of noninterest income on MHE servicing fees, rather than separately projecting MHE servicing volume and applying a fee rate. The regression could feature macroeconomic scenario variables including, but not limited to, the change in the mortgage rate or the growth rate of nominal GDP.

In a flatline approach, the Board could model noninterest income on MHE servicing fees by setting projected noninterest income on MHE servicing fees to the firm-specific four-quarter geometric mean, or the median, of noninterest income on MHE servicing fees, as described

above. Under this approach, the model would assume that noninterest income on MHE value changes would not vary with the broader macroeconomy under a severely adverse scenario.

In a distribution based-haircut approach, the Board could model noninterest income on MHE servicing fees by setting projected noninterest income on MHE servicing fees to a firm-specific four-quarter geometric mean, or the median, of noninterest income multiplied by a haircut. The Board would analyze the distribution of growth rates in noninterest income on MHE servicing fees across stress-tested firms, then select a growth rate from an appropriate haircut percentile. An appropriate percentile could be the 7th percentile as described in the distribution-based model for noninterest income on sales and trading or a different conservative percentile. Under this approach, the model would assume that noninterest income on MHE servicing fees would not vary with the broader macroeconomy under a severely adverse scenario. In contrast to a pure flatline described above, this distribution based-haircut approach would assume a level of decline under stress.

The Board could alternatively model noninterest income on MHE servicing fees by using the general volume-based approach described above but with different macroeconomic scenario variables. The Board could also consider the use of a firm-specific fee in the MHE servicing fees volume-based model.

Additionally, as detailed in Appendix A, the Board would apply an adjustment to the first projected quarter to compensate for the use of a four-quarter geometric mean for the liftoff. This adjustment supports the principle of robustness as it allows for more precise projections. However, its impact is small. To further the principle of simplicity, the Board is considering an alternative where this adjustment is omitted from the model.

The Board considered the availability of these alternative approaches and determined that the proposed volume-based approach for noninterest income on MHE servicing fees was reasonably designed to achieve the goals of the stress test. The Board is interested in feedback on these alternative approaches, and whether they should be adopted in any final PPNR model for the 2027 supervisory stress test.

c. Alternatives for Noninterest Income on MSR Value Changes

The Board considered the availability of alternative approaches to project noninterest income on MSR value changes in the supervisory stress test. In particular, the Board could project noninterest income on MSR value changes using an approach that is similar to others described in this 2027 Proposed PPNR Model Documentation, including the flatline and distribution-based haircut approaches.

In a flatline approach, the Board could model noninterest income on MSR value changes by setting projected noninterest income on MSR value changes to the firm-specific four-quarter geometric mean, or the median, of noninterest income on MHE value changes, as described above. Under this approach, the model would assume that noninterest income on MSR value changes would not vary with the broader macroeconomy under a severely adverse scenario.

In a distribution based-haircut approach, the Board could model noninterest income on MSR value changes by setting projected noninterest income on MSR value changes to a firm-specific four-quarter geometric mean, or the median, of noninterest income multiplied by a haircut. The Board would analyze the distribution of growth rates in the MSR value changes across stress-tested firms, then select a growth rate from an appropriate haircut percentile. An appropriate percentile could be the 7th percentile as described in the distribution-based model for

noninterest income on sales and trading or a different conservative percentile. Under this approach, the model would assume that noninterest income on MSR value changes would not vary with the broader macroeconomy under a severely adverse scenario. In contrast to a pure flatline described above, this distribution based-haircut approach would assume a level of decline under stress.

The Board could also consider two alternative modeling approaches for MSR valuation changes. The first approach would involve modifying the proposed regression model. The Board could consider introducing an interaction term between the mortgage rate and the direction of the interest rate changes to account for the nonlinearities in the impact of rates on MSR values. In addition, the Board could consider interacting the mortgage rate changes with covariates reflecting the characteristics of a firm's servicing portfolio, such as average loan-to-value, coupon rate, and whether the MSRs are from FNMA/FHLMC or GNMA securities. The Board could consider adding other macroeconomic variables, such as the change in the house price index (potentially with interactions), which would capture the decline in value resulting from increased delinquencies. One challenge with such an approach is that the regression framework and the available estimation data (which is aggregated to the firm level) may not be able to accurately capture these economic relationships.

The second alternative modeling approach would be more structural and would build on Elul, Pence, Ranish, and Suher (2026).²⁷ In this approach, the first lien mortgage model would be used—together with information on firms' servicing portfolios reported in the Y14-M—to project default and prepayment rates under stress for firms' MSR portfolios. This would capture

²⁷ See R. Elul, K. Pence, B. Ranish, and M. Suher, *Mortgage Servicing Right Valuations Under Stress*, FEDS Notes (June 4, 2026).

the unique characteristics of each firm's servicing portfolio. The resulting projections would then be applied to data reflecting the sensitivity of MSR values to shocks in default and prepayment rates as collected in FR Y-14Q, Schedule I to arrive at a change in MSR value for each firm's portfolio. This change in value would then be allocated to the relevant quarters of the projection horizon. The Board has determined that the sensitivities collected in Schedule I through 2019 yield reasonable projected value changes under stress for firms' current MSR portfolios, but the Board could collect additional data to determine if and when the model should be re-estimated.

Additionally, within the proposed regression approach, the Board proposes to apply an adjustment to the first projected quarter to compensate for the use of a four-quarter geometric mean for the liftoff, as detailed in Appendix A. This adjustment supports the principle of robustness as it allows for more precise projections. However, its impact is small. To further the principle of simplicity, the Board is considering an alternative where this adjustment is omitted from the model.

The Board considered the availability of these alternative approaches and determined that the proposed regression approach for noninterest income on MSR value changes was reasonably designed to achieve the goals of the stress test. The Board is interested in feedback on these alternative approaches, and whether they should be adopted in any final PPNR model for the 2027 supervisory stress test.

d. Alternatives for Noninterest Income on MHE Other

The Board considered the availability of alternative approaches to calculate noninterest income on MHE other in the supervisory stress test. In particular, the Board could estimate

noninterest income on MHE other using an approach that is similar to others described in this 2027 Proposed PPNR Model Documentation, including the volume-based, regression, and distribution-based haircut approaches.

In a volume-based approach, the Board could model noninterest income on MHE other by modeling the growth of the volume of serviced balances as described in the MHE servicing fees volume-based model. The projected growth rate of the volume of serviced balances would then be multiplied by a fee ratio calculated as the ratio of noninterest income on MHE other to the volume of balances serviced. This fee ratio could be calculated at the firm-specific or industry level. The fee ratio would then be multiplied by the starting value for serviced balances to retrieve a dollar-level estimate for noninterest income on MHE other. Under this approach, the model would assume that, similar to MHE servicing fees, noninterest income on MHE other is proportional to serviced balances. However, this assumption may not reflect this business line accurately. If adopted, this approach would attribute macroeconomic sensitivity to a line item that is not well understood. If the Board pursued a volume-based approach for noninterest income on MHE other, the Board might seek to identify and consider alternatives to serviced balances as a measure of the relevant volume.

In a regression approach, the Board could model noninterest income on MHE other by estimating a regression on the industry level of noninterest income on MHE other. The regression could feature macroeconomic scenario variables, including, but not limited to, the change in the mortgage rate or the growth rate of nominal GDP. Under this approach, the model would assume that noninterest income on MHE other commoves with the broader economy. If adopted, this approach would also attribute macroeconomic sensitivity to a line item that is not well understood.

In a distribution based-haircut approach, the Board could model noninterest income on MHE other by setting projected noninterest income on MHE other to a firm-specific four-quarter geometric mean of noninterest income multiplied by a haircut. The Board would analyze the distribution of growth rates in noninterest income on MHE other across stress-tested firms, then select a growth rate from an appropriate haircut percentile. An appropriate percentile could be the 7th percentile as described in the distribution-based model for noninterest income on sales and trading or a different conservative percentile. As discussed above (see, e.g., Section III.B.iii.a) for other sources of noninterest income, under this approach the model would assume that noninterest income would not vary with the broader macroeconomy under a severely adverse scenario.

The Board considered the availability of these alternative approaches and determined that the proposed flatline approach for noninterest income on MHE other was reasonably designed to achieve the goals of the stress test. The Board is interested in feedback on these alternative approaches, and whether they should be adopted in any final PPNR model for the 2027 supervisory stress test.

iv. Questions

The Board is requesting public input on the proposed models for noninterest income on mortgages and home equity, including, but not limited to, input on the following questions:

Question 7: The Board seeks input on the proposed approach to model noninterest income on MHE. What are the advantages and disadvantages of the proposed models? Are there alternative specifications, in terms of right-hand side variables, differences, lags, transformations, or the sample period of estimation, that the Board should consider, and why?

Should the Board consider alternative measures of activity volume, or different scaling methods for the dependent variables, in these models?

Question 8: Should the Board address any nonlinearities in the MHE production, MHE servicing fees, or MSR value changes models? For example, could MSR value changes respond differently to increases versus decreases in rates? How could the Board address nonlinearities in the models? What are the advantages and disadvantages of approaches to address nonlinearities?

Question 9: The Board seeks input on the use of the four-quarter mean and the associated weighted average adjustment for log differenced models. Are there alternative approaches or lookback periods that the Board should consider to mitigate volatility and seasonality from the liftoff values for the noninterest income on mortgage and home equity model? Does the use of a four-quarter lookback period appropriately balance reflecting recent trends while mitigating volatility? What are the advantages and disadvantages of any such alternative?

Question 10: Should the Board adjust the first projection quarter to account for seasonality and the liftoff from a four-quarter geometric mean? Is the adjustment described in Appendix A appropriate? Alternatively, should the Board decline to adjust the first projection quarter? If so, what would be the advantages and disadvantages of doing so?

Question 11: Should production or servicing fees vary across firms—for instance, with the characteristics of the serviced portfolios? Which characteristics would be most important in determining firm-level fees? What would be the pros and cons of allowing such variation?

Question 12: Should the Board consider projecting default and prepayment rates on the underlying serviced mortgages under the supervisory stress test scenario and using information on the sensitivities of MSR values to changes in these default and prepayment rates? Such an

approach would account more completely for the characteristics of each firm's portfolio.

However, this approach would require additional data on these sensitivities, potentially from the 2027 Models and Reporting Proposal.²⁸ Alternatively, should the Board collect granular data on fees, costs, and foreclosure timelines for different types of serviced mortgages so that it could consider developing a structural discounted cash flow model for MSR valuation in conjunction with projected default and prepayment rates? This approach could also enable the modeling of recapture in the event of prepayments. What are the advantages and disadvantages of these approaches? Are there alternative modeling approaches and data sources the Board should consider to model MSR?

Question 13: The expansion of the hedge data collection for the Y-14Q, Schedule B.2 will capture derivative securities used for hedging interest rate risk. Would this additional data allow the Board to capture the impact of hedges on MSR values? If not, are there additional data sources or approaches that the Board should consider?

C. Noninterest Income on Deposit Fees

i. Model Description

The Board proposes an industry-level volume-based model and two regression models to estimate noninterest income on deposit fees. Noninterest income on deposit fees is modeled at the subcomponent level, which includes debit interchange fees, non-sufficient funds (NSF) fees, and other deposit fees. A volume-based approach is used to model debit interchange fees, as debit interchange fees are driven by transaction volume and are assumed to respond to

²⁸ See Elul et al. (2026) for an implementation of this approach. *Id.*

unemployment and inflation, as described below. The remaining subcomponents, NSF fees and other deposit fees, are modeled directly using regressions in the absence of appropriate data to capture the underlying business volume. The next section provides details on the models.

Parameter estimates are provided in Appendix B.

a. Noninterest Income from Debit Interchange Fees

Noninterest income on debit interchange fees represents the fee revenue a firm earns each time a customer uses a debit card linked to a checking or money market account to complete a purchase transaction. These fees are paid by the merchant's acquiring firm to the cardholder's issuing firm as compensation for processing the transaction. This revenue is transactional in nature and scales with the number and characteristics of debit purchase transactions rather than with deposit account balances.

The Board proposes a volume-based approach because debit interchange income is generated by debit card transactions. Separately projecting transaction volume and applying a firm-specific fee rate allows the model to capture the effect of economic stress on customer transaction activity while preserving firm-specific differences in interchange revenue per transaction. The industry-level volume-based model for debit interchange fees models the ratio of debit card purchase transaction to the total number of checking and money market accounts. The Board has selected this ratio as the relevant measure of volume for debit interchange fees because debit interchange fees are assessed primarily on a per-transaction basis. The Board proposes to use the number of debit purchase transactions, rather than transaction dollar value, because transaction counts directly measure the activity that generates interchange fees without assuming that fee income increases proportionately with transaction size. Normalizing that

transaction count by the number of open checking and money market accounts isolates the average transactional activity per active deposit. Modeling this ratio separates changes in interchange income caused by growth in the deposit account base from changes caused by shifts in cardholder usage patterns. This separation is also important because the Board assumes that the size of the deposit account base is fixed over the projection horizon in accordance with the flat balance sheet assumption.

The proposed volume-based model relates interchange fees to macroeconomic variables. The model assumes the transaction count per deposit responds to the change in the unemployment rate, the change in the CPI inflation rate, a COVID dummy, and quarterly dummies. Changes in the unemployment rate reflect consumer spending capacity and economic health. When unemployment rises, consumers typically reduce discretionary spending, leading to a lower volume of debit card transactions. Changes in the inflation rate capture the effect of changing price levels on nominal transaction volumes and changes in the price environment that may affect the frequency and composition of purchases. The COVID dummy variable accounts for the disruption during the initial pandemic period that is inconsistent with normal unemployment-spending relationships. Quarterly dummies capture the strong seasonality in debit card spending patterns. The Board considered other measures of consumer activity but selected unemployment and CPI inflation because they provide a parsimonious and direct link to variables specified in the severely adverse scenario while yielding a relatively better statistical fit and model performance.

The Board proposes to estimate the volume relationship at the industry level because the relevant FR Y-14Q data are available for a relatively short period. Pooling observations provides a more robust basis for estimating sensitivity to macroeconomic conditions than separate firm-

level regressions, while firm-specific volume anchors, account counts, and fee rates preserve relevant differences across firms.

The specification for the volume-based model for debit interchange fees is thus given by:

Equation A51 – Noninterest Income on Debit Interchange Fees

$$\begin{aligned} \Delta \log DebitICVolumeRatio_t \\ = \alpha + \beta_1 \Delta UR_t + \beta_2 \Delta CPI_t + COVID\ Dummy + QuarterlyDummies_t \\ + \epsilon_t \end{aligned}$$

where:

- $DebitICVolumeRatio_t$ is the ratio of debit card purchase transactions to total number of open checking and money market accounts;
- α is a constant intercept;
- ΔUR_t is the quarterly change in the U.S. unemployment rate;
- ΔCPI_t is the quarterly change in the Consumer Price Index inflation rate;
- $COVIDDummy$ is a dummy indicator for 2020:Q2;
- $QuarterlyDummies_t$ are dummy variables for quarters 2, 3, and 4, which are equal to 1 only if the period t is in quarters 2, 3, or 4, respectively; and
- ϵ_t is a stochastic error term.

Debit card purchase transactions are retrieved from FR Y-14Q, Schedule G.3, line item 9 and the number of open checking and money market accounts is retrieved from Schedule G.3, line item 8. The volume-based debit interchange fees model is estimated on a quarterly sample from 2015:Q1 to 2024:Q4. The sample starts in 2015:Q1 due to data availability, as most firms subject to the stress test had begun to report relevant data by that time. The Board will evaluate and consider the addition of new data every year and determine the appropriateness of re-estimation on an extended sample.

Industry-growth rate projections are produced using the estimates of the debit interchange fees volume-based model and the supervisory severely adverse scenario path for the unemployment rate and CPI inflation rate.

The projection of a firm's own volume ratio begins from an anchor, the geometric mean²⁹ of the firm's volume ratio over the four quarters ending at jump-off. Firm-specific volume ratios are calculated as:

Equation A52 – Debit Interchange Fees Firm-Specific Starting Volume Ratio

$$\overline{DebitICVolumeRatio}_{b,t0} = \left(\prod_{i=0}^3 DebitICVolumeRatio_{b,t0-i} \right)^{\frac{1}{4}}$$

where:

- $\overline{DebitICVolumeRatio}_{b,t0}$ denotes the firm-specific anchor value for the ratio of debit card transactions to total number of open checking and money market accounts for firm b .

Projected growth is applied to the firm-specific anchor and compounded forward so that each projected quarterly estimate grows from the value in the preceding quarter. An adjustment is applied to the first projected quarter to account for the application of a quarterly growth rate to a four-quarter geometric mean for the liftoff; the geometric mean requires adjustment prior to use as a quarterly measure because it would otherwise capture impacts from deterministic elements of the time series in the four quarters it averages, such as seasonality. In this way, the projection horizon begins from a level consistent with the seasonal factors and macroeconomic variables applicable in the liftoff. Details of the adjustment are provided in Appendix A.

²⁹ Details on the use of a geometric mean and related exception handling are provided in Appendix A.

Applying the recursion repeatedly and multiplying by the total number of open checking and money market accounts at jump-off produces the firm-specific projected interchange fee ratio in any quarter of the horizon directly in terms of the anchor and the cumulative sum of projected growth rates. Firm-specific projected debit interchange fee volume is thus given by:

Equation A53 – Projected Debit Interchange Fees Volume

$$\begin{aligned} DebitICVolume_{b,t0+h} \\ &= Accounts_{b,t0} * \overline{DebitICVolumeRatio}_{b,t0} \\ &\quad * \exp \left(\sum_{j=1}^h \Delta \log DebitICVolumeRatio_{t0+j} \right) \end{aligned}$$

where:

- $DebitICVolume_{b,t0+h}$ is the projected volume of debit card transactions for firm b at projection period $t0 + h$;
- $Accounts_{b,t0}$ is the number of open checking and money market accounts at jump-off for firm b ;
- $\overline{DebitICVolumeRatio}_{b,t0}$ denotes the firm-specific starting value for the ratio of debit card transactions to total number of open checking and money market accounts for firm b ; and
- $h \in (1,13)$ is the projection horizon.

The result is firm-specific debit card transaction volume for every quarter of the horizon.

The fee rate is the firm-specific level of noninterest income earned per unit of business activity conducted, and is calculated by dividing historical noninterest income on debit interchange fees for a given firm by that firm's historical debit card transaction volume:

Equation A54 – Debit Interchange Fees Fee

$$DebitICFeesFee_{b,t} = \frac{DebitICFees_{b,t}}{DebitICVolume_{b,t}}$$

where:

- $DebitICFeesFee_{b,t}$ denotes the firm-specific fee rate for firm b at time t ;
- $DebitICFees_{b,t}$ denotes the historical noninterest income on debit interchange fees for firm b at time t ; and
- $DebitICVolume_{b,t}$ denotes the historical volume of debit card transaction for firm b at time t .

Data on noninterest income on debit interchange fees is retrieved from FR Y-14Q,

Schedule G.1, line item 14Q.

The fee rate used in the projection of noninterest income from debit card interchange fees is the median of this ratio over the four quarters ending at jump-off, and is given by:

Equation A55 – Median Debit Interchange Fees Fee

$$\overline{DebitICFeesFee}_{b,t0} = \text{median}(DebitICFeesFee_{b,t0-k})$$

where:

- $\overline{DebitICFeesFee}_{b,t0}$ is the median firm-specific fee rate for firm b , at $t0$,
- $t0$ denotes the jump-off quarter; and
- $k \in (0,1,2,3)$.

The four-quarter median fee rate is used instead of the average so that the projection is not distorted by a single quarter in which either the income line item or the volume measure was atypical. Using a recent four-quarter window produces a fee rate that is consistent with firms' current pricing and product mixes.

Finally, projected noninterest income from debit interchange fees is estimated by multiplying the projected volume of business activity by the median fee rate, as given by:

Equation A56 – Noninterest Income on Debit Interchange Fees Projection

$$\widehat{DebitICFees}_{b,t0+h} = \widehat{DebitICVolume}_{b,t0+h} \times \overline{DebitICFeesFee}_{b,t0}$$

where:

- $\widehat{DebitICFees}_{b,t0+h}$ denotes the projected noninterest income on debit interchange fees for firm b at time $t0 + h$;
- $\widehat{DebitICVolume}_{b,t0+h}$ denotes the projected volume of debit card transactions for firm b at time $t0 + h$; and
- $\overline{DebitICFeesFee}_{b,t0}$ is the constant firm-specific starting fee rate.

Considering the economic mechanism generating interchange income, the available data, and the objectives of robustness, comparability, transparency, and sensitivity to economic stress, the Board assessed the proposed specification as reasonably designed to achieve the goals of the supervisory stress test.

b. Noninterest Income on Non-Sufficient Funds (NSF) Fees

Noninterest income on non-sufficient funds (NSF) fees represents fee revenue a firm earns when a customer attempts a debit card transaction or other account withdrawal that exceeds the available balance in a checking or money market account and the transaction is either declined or paid by the institution on the customer's behalf. This income is distinct from interchange fees as it arises from account balance mismanagement or liquidity shortfalls, rather than solely according to underlying transaction volume.

The Board proposes to model noninterest income on NSF fees using a regression model. A regression model is appropriate for modeling NSF fees under stress because NSF fees are generally driven by customer payment failures during economic downturns rather than by underlying transaction volume, and a regression framework can directly capture how adverse conditions increase the likelihood of insufficient funds events.

Noninterest income from NSF fees is estimated based on two primary components: (1) the projection of the non-sufficient funds fee-to-deposit ratio under stress; and (2) the firm-specific deposit balances at liftoff. The Board first projects the growth rate of the fee ratio under

stress using an industry-level regression as a function of macroeconomic variables, applies this growth rate to a fixed firm-specific anchor ratio to obtain projected ratios, and then multiplies the projected ratios by the firm's deposit balances at liftoff to generate the path of noninterest income over the projection horizon. The following paragraphs detail the Board's proposed methodology. Parameter estimates are provided in Appendix B.

The industry-level regression for noninterest income on NSF fees is modeled as the ratio of NSF fee income to deposit balances. This normalization allows for the consistent comparability of the ratio over time. The Board proposes to normalize NSF fee income by domestic deposit balances because the opportunity for NSF events depends in part on the size of the deposit business from which those fees are generated. Normalization separates changes in NSF fee income associated with firm size from changes in the incidence of NSF fees relative to the deposit base and provides a comparable measure across firms and over time.

The regression model for NSF fees assumes the ratio of NSF fees to deposit balances responds to the change in the unemployment rate, a COVID dummy, and quarterly dummies. Changes in the unemployment rate capture consumer spending capacity and economic health. When unemployment rises, a larger share of depositors experiences reduced income, which increases the likelihood that depositors will draw down their accounts and attempt to complete transactions or withdrawals despite insufficient funds. Using the change in unemployment also aligns with the model's specification of changes in the log NSF fee-to-deposit ratio and directly links the projection to a variable specified in the supervisory scenario. The COVID dummy variable accounts for the disruption during the initial pandemic period that does not exhibit normal unemployment-spending relationships, and thus supports the stress testing principle of

producing forward-looking projections. Quarterly dummies capture the strong seasonality pattern in noninterest income on NSF fees.

The Board proposes to estimate the relationship at the industry level because the relevant FR Y-14Q data provide a relatively short quarterly sample. Pooling observations provides a more robust basis for estimating the relationship between unemployment and NSF fee income than separate firm-level regressions, while the firm-specific anchor and deposit balance preserve relevant differences across firms.

The specification for the regression model to project the ratio of NSF fees to average deposit balances is:

Equation A57 – Noninterest Income on NSF Fees

$$\Delta \log NSFDep_t = \alpha + \beta_1 \Delta UR_t + COVID\ Dummy + QuarterlyDummies_t + \epsilon_t$$

where:

- $NSFDep_t$ is NSF fees divided by average liability balances on domestic deposits;
- α is a constant intercept;
- ΔUR_t is the quarterly change in the U.S. unemployment rate;
- $COVIDDummy$ is a dummy indicator for 2020:Q2;
- $QuarterlyDummies_t$ are dummy variables for quarters 2, 3, and 4, which are equal to 1 only if the period t is in quarter 2, 3, or 4, respectively; and
- ϵ_t is a stochastic error term.

Noninterest income on non-sufficient funds fees is retrieved from FR Y-14Q, Schedule G.1, line item 14P. Average liability balances on domestic deposits are retrieved from FR Y-14Q, Schedule G.2, line item 34. The noninterest income on NSF fees regression model is estimated on quarterly sample data from 2014:Q1 to 2024:Q4. The sample starts in 2014:Q1 due to data availability, as most firms subject to the stress test had begun to report relevant data by that

time. The Board will evaluate and consider the addition of new data every year and determine the appropriateness of re-estimation on an extended sample.

Industry-growth rate projections are produced using the estimates of the NSF fees regression model and the supervisory severely adverse scenario path for the unemployment rate.

The projection of a firm's individual noninterest income on NSF fees begins from an anchor, the geometric mean³⁰ of the firm's ratio of NSF fees to deposits over the four quarters ending at jump-off:

Equation A58 – Firm-Specific Starting NSF Fees

$$\overline{NSFDep}_{b,t0} = \left(\prod_{i=0}^3 NSFDep_{b,t0-i} \right)^{\frac{1}{4}}$$

where:

- $\overline{NSFDep}_{b,t0}$ denotes the firm-specific starting value for the ratio of NSF fees to average liability balances on domestic deposits for firm b .

Projected growth is applied to the firm-specific anchor and compounded forward so that each projected quarterly estimate grows from the value in the preceding quarter. An adjustment is applied to the first projected quarter to account for the application of a quarterly growth rate to a four-quarter geometric mean for the liftoff; the geometric mean requires adjustment prior to use as a quarterly measure because it would otherwise capture impacts from deterministic elements of the time series in the four quarters it averages, such as seasonality. In this way, the projection horizon begins from a level consistent with the seasonal factors and macroeconomic variables applicable in the liftoff. Details of the adjustment are provided in Appendix A.

³⁰ Details on the use of a geometric mean and related exception handling are provided in Appendix A.

Applying the recursion repeatedly, and multiplying by deposit balances at liftoff, produces the firm-specific projected level in any quarter of the horizon directly in terms of the anchor and the cumulative sum of projected growth rates. Firm-specific noninterest income from NSF fees is thus calculated as:

Equation A59 – Projected Noninterest Income on Non-sufficient Funds Fees

$$NSF\hat{Fees}_{b,t0+h} = Dep_{b,t0} * \overline{NSFDep}_{b,t0} * \exp\left(\sum_{j=1}^h \Delta \log NSFDep_{t0+j}\right)$$

where:

- $NSF\hat{Fees}_{b,t0+h}$ is projected noninterest income on NSF fees for firm b at projection period $t0 + h$;
- $Dep_{b,t0}$ is the level of domestic balances at jump-off for firm b ;
- $\overline{NSFDep}_{b,t0}$ denotes the firm-specific starting value for the ratio of NSF fees to average liability balances on domestic deposits for firm b ;
- $NSFDep_t$ is NSF fees divided by average liability balances on domestic deposits;
- $h \in \{1,2, \dots, 13\}$ is the projection horizon.

The result is a firm-specific projected level of noninterest income on NSF fees for every quarter of the projection horizon.

c. Noninterest Income on Other Deposit Fees

Noninterest income on other deposit fees represents a residual category of deposit fees that do not fall into the interchange or NSF fees categories. The other deposit fees category includes items such as account maintenance fees, foreign transaction fees, card replacement fees, and other miscellaneous service charges tied to deposit accounts.

The Board proposes to use a regression model to estimate noninterest income on other deposit fees because other deposit fees arise largely from the servicing and maintenance of

deposit accounts rather than from business volume-level activity. Additionally, because other deposit fees comprise several types of fees associated with servicing deposit accounts and do not have a single observable measure of underlying business volume, a regression allows the proposed model to estimate how aggregate other deposit fee income changes with economic and interest-rate conditions without requiring separate volume measures for each underlying fee category.

The industry-level regression for noninterest income on other deposit fees is modeled as the ratio of other deposit fees to deposit balances. This normalization allows for the consistent comparability of the ratio over time. The Board proposes to normalize other deposit fee income by domestic deposit balances because these fees arise from services associated with the deposit business, and deposit balances provide a consistently available measure of the scale of that business. Normalization separates changes associated with firm size from changes in fee income relative to the deposit base and facilitates comparison across firms and over time.

The regression model for other deposit fees assumes the ratio of other deposit fees to deposit balances responds to the change in the unemployment rate and the change in the three-month Treasury rate. The Board proposes to use the change in unemployment to capture changes in household economic conditions and spending capacity that may affect customers' use of deposit-account services and the likelihood of incurring miscellaneous fees. Changes in the unemployment rate capture consumer spending capacity and economic health, which affect the likelihood of incurring miscellaneous charges. Using the change in unemployment also aligns with the model's specification of changes in the log fee-to-deposit ratio and directly links the projection to a variable specified in the supervisory scenario. Additionally, the Board proposes to use the change in the three-month Treasury rate to capture changes in the short-term interest-

rate environment that may affect deposit-account behavior and associated fee income. The change in the three-month Treasury rate is assumed to reflect the broader rate environment; the influence of the broader rate environment on other deposit fees is supported by the data. The three-month Treasury rate provides a common market-based measure of short-term rates and is directly specified in the supervisory scenario, allowing the projected fee ratio to respond to the scenario's interest-rate path.

The Board proposes to estimate the relationship at the industry level because the relevant FR Y-14Q data provides a relatively short quarterly sample. Pooling observations provides a more robust basis for estimating macroeconomic sensitivity than separate firm-level regressions, while the firm-specific anchor and deposit balance preserve relevant differences across firms.

The specification for the regression model to project the ratio of other deposit fees to average deposit balances is:

Equation A60 – Noninterest Income on Other Deposit Fees

$$\Delta \log OthDepFeesRatio_t = \alpha + \beta_1 \Delta UR_t + \beta_2 \Delta T3M_t + \epsilon_t$$

where:

- $OthDepFeesRatio_t$ is noninterest income on other deposit fees divided by average liability balances on domestic deposits;
- α is a constant intercept;
- ΔUR_t is the quarterly change in the U.S. unemployment rate, representing changes in aggregate economic conditions;
- $\Delta T3M_t$ is the quarterly change in the 3-month Treasury rate, representing changes in the level of interest rates; and
- ϵ_t is a stochastic error term.

Noninterest income on other deposit fees is retrieved from FR Y-14Q, Schedule G.1, line item 14R. Average liability balances on domestic deposits are retrieved from the FR Y-14Q,

Schedule G.2, line item 34. The noninterest income other deposit fees regression model is estimated on quarterly sample data from 2014:Q1 to 2024:Q4. The sample starts in 2014:Q1 due to data availability, as most firms subject to the stress test had begun to report relevant data by that time. The Board will evaluate and consider the addition of new data every year and determine the appropriateness of re-estimation on an extended sample.

Industry-level growth rate projections are produced using the estimates of the other deposit fees regression model and the supervisory severely adverse scenario path for the unemployment rate and the three-month Treasury rate.

The projection of a firm's individual noninterest income on other deposit fees begins from an anchor, the geometric mean³¹ of the firm's ratio of other deposit fees to deposits over the four quarters ending at jump-off:

Equation A61 – Firm-Specific Starting Other Deposit Fees

$$\overline{OthDepFeesRatio}_{b,t0} = \left(\prod_{i=0}^3 OthDepFeesRatio_{b,t0-i} \right)^{\frac{1}{4}}$$

where:

- $\overline{OthDepFeesRatio}_{b,t0}$ denotes the firm-specific starting value for the ratio of other deposit fees to average liability balances on domestic deposits for firm b .

Projected growth is applied to the firm-specific anchor and compounded forward so that each projected quarterly estimate grows from the value in the preceding quarter. An adjustment is applied to the first projected quarter to account for the application of a quarterly growth rate to a four-quarter geometric mean for the liftoff; the geometric mean requires adjustment prior to use

³¹ Details on the use of a geometric mean and related exception handling are provided in Appendix A.

as a quarterly measure because it would otherwise capture impacts from deterministic elements of the time series in the four quarters it averages, such as seasonality. In this way, the projection horizon begins from a level consistent with the seasonal factors and macroeconomic variables applicable in the liftoff. Details of the adjustment are provided in Appendix A.

Applying the recursion repeatedly, and multiplying by deposit balances at liftoff, produces the firm-specific projected level in any quarter of the horizon directly in terms of the anchor and the cumulative sum of projected growth rates. Firm-specific noninterest income from other deposit fees is thus calculated as:

Equation A62 – Projected Noninterest Income on Other Deposit Fees

$$\begin{aligned} Oth\hat{Dep}Fees_{b,t0+h} \\ = Dep_{b,t0} * \overline{OthDepFeesRatio}_{b,t0} * \exp\left(\sum_{j=1}^h \Delta \log Oth\hat{Dep}FeesRatio_{t0+j}\right) \end{aligned}$$

where:

- $Oth\hat{Dep}Fees_{b,t0+h}$ is projected noninterest income on other deposit fees for firm b at projection period $t0 + h$;
- $Dep_{b,t0}$ is the level of domestic deposits balances at jump-off for firm b ; and
- $h \in \{1,2, \dots, 13\}$ is the projection horizon.

The result is a firm-specific projected level of noninterest income on other deposit fees for every quarter of the projection horizon. The proposed specification was assessed as reasonably likely to capture the relationship between economic and interest-rate conditions and other deposit fee income while maintaining a parsimonious, robust, and transparent model.

ii. Assumptions and Limitations

The Board proposes a volume-based model to project noninterest income from debit interchange fees and two regression models to project noninterest income from insufficient funds and other deposit fees. The volume-based model for noninterest income from debit interchange fees assumes that the ratio of debit card purchase transactions to the number of open checking and money market accounts is an appropriate measure of the business activity driving debit interchange fees. This is an appropriate assumption for the measure of business activity driving debit interchange fees because interchange revenue is generated on a per-transaction basis, and this ratio captures the average transaction activity level per account, which directly determines fee generation. The Board chose the number of open checking and money market accounts as a normalizing variable based on the observation that the ratio was stable over time and allowed for comparability between firms, consistent with the Board's modeling principles.

Additionally, as previously discussed, an assumption underpinning the volume-based approach is that fee ratios are relatively stable and do not vary over the projection horizon. Notably, the Durbin Amendment placed a cap on interchange fee rates, resulting in their stability.³²

The Board considered an alternative specification using the dollar volume of activity as a normalizing value but did not select this alternative due to worse model fit. Additionally, the debit interchange fees model uses a COVID dummy variable for the second quarter of 2020. The Board observed that the relationship between deposit fees and macroeconomic factors was atypical during the pandemic, and the use of a dummy variable improved model fit.

³² See V. Mukharlyamov and N. Sarin, *Price regulation in two-sided markets: Empirical evidence from debit cards*, *Journal of Financial Economics* 172 (2025), 104094.

Further, the volume-based model also implicitly assumes the industry level of noninterest income on debit interchange fees is representative for all firms under stress. The Board proposes to use an industry-level model in alignment with the stress testing principles of consistency and comparability. Individual firm-level models would create distinct regressions and coefficients, each responding with differing macroeconomic sensitivity to the same underlying scenario. In contrast, an industry-level approach ensures that projected noninterest income on other deposit fees differs only due to a firm's scale and business volume.

Finally, the regression models for noninterest income from NSF fees and other deposit fees assume that existing volume measures for deposits, such as debit card purchase transactions, do not scale with the respective revenue streams.

iii. Alternatives for Noninterest Income on Deposit Fees

a. Alternatives for Noninterest Income from Debit Interchange Fees

The Board considered the availability of alternative approaches to calculate noninterest income on debit interchange fees in the supervisory stress test. In particular, the Board could estimate noninterest income on debit interchange fees using an approach that is similar to others described in this 2027 Proposed PPNR Model Documentation, including alternative regression, flatline, and distribution-based haircut approaches.

In a regression approach, the Board could model debit interchange fee income as a function of macroeconomic variables, such as the U.S. unemployment rate, CPI inflation, disposable personal income, or real GDP growth, rather than separately projecting transaction volume and applying a fee rate. A regression would simplify the model's structure but would also collapse underlying transaction activity and pricing into a single reduced-form relationship.

By contrast, the proposed volume-based approach reflects the economic mechanism responsible for fee generation—which is based on transaction volumes—and cleanly separates the volume component from the fee rate. That decomposition makes projections more transparent and easier to explain, consistent with the Board’s modeling principles favoring simpler, more transparent approaches where appropriate.

In a flatline approach, the Board could model noninterest income on debit interchange fees by holding projected income constant at a recent firm-specific historical level, such as the value at jump-off or a recent average or median. Under this approach, the model would not project debit transaction volume or its response to the severely adverse scenario. If adopted, this approach would be simple and transparent but would not allow debit interchange income to respond to the severely adverse scenario and therefore would be less forward-looking and less able to capture the effects of economic stress.

In a distribution-based haircut approach, the Board could model noninterest income on debit interchange fees by setting projected noninterest income on debit interchange fees to a firm-specific starting value of noninterest income multiplied by a haircut. The Board would analyze the distribution of growth rates in the ratio of noninterest income on debit interchange fees across stress-tested firms, then select a growth rate from an appropriate haircut percentile. An appropriate percentile could be the 7th percentile as described in the distribution-based model for noninterest income on sales and trading or a different higher or lower percentile. If adopted, this approach would provide a simple way to incorporate historically adverse outcomes, but projected income would not be directly linked to the paths in the severely adverse scenario and therefore could be less sensitive to the economic conditions specified in the stress test. As discussed above (see, e.g., Section III.B.iii.a) for other sources of noninterest income, in contrast

to a pure flatline this distribution based-haircut approach would assume a level of decline under stress.

Within the volume-based approach, the Board could alternatively model the debit transaction volume ratio using other measures of consumer activity, such as disposable personal income or real GDP growth, or could use alternative lags or transformations of unemployment and inflation. Measures of income or broader economic activity could capture additional aspects of household spending, while alternative lags could capture delayed responses of debit card usage to economic conditions. The proposed macroeconomic drivers were selected based on economic intuition, statistical fit, and model performance while maintaining model parsimony. Given the relatively short FR Y-14Q sample, including additional variables or lags could increase estimation uncertainty and model complexity, while also reducing the direct link between the model and variables specified in the supervisory scenario.

Additionally, the Board could adopt a standardized data adjustment to account for the COVID period, which could entail excluding specified pandemic-period observations rather than including a 2020:Q2 dummy. If adopted, this approach would simplify the treatment of COVID-period observations across relevant components, but would further reduce the relatively short estimation sample. The proposed dummy instead retains the 2020:Q2 observation while limiting the effect of the pandemic-specific disruption on the estimated relationship between macroeconomic conditions and debit transaction activity.

Further, as detailed in Appendix A, the Board proposes to apply an adjustment to the first projected quarter to compensate for the use of a four-quarter geometric mean for the liftoff. This adjustment supports the principle of robustness as it allows for more precise projections.

However, its impact is small. To further the principle of simplicity, the Board is considering an alternative where this adjustment is omitted from the model.

The Board considered the availability of these alternative approaches and determined that the proposed volume-based approach for noninterest income on debit interchange fees was reasonably designed to achieve the goals of the stress test. The Board is interested in feedback on these alternative approaches, and whether they should be adopted in any final PPNR model for the 2027 supervisory stress test.

b. Alternatives for Noninterest Income on Non-Sufficient Funds (NSF) Fees

The Board considered the availability of alternative approaches to calculate noninterest income on NSF fees in the supervisory stress test. In particular, the Board could estimate noninterest income on NSF fees using an approach that is similar to others described in this 2027 Proposed PPNR Model Documentation, including the volume-based, flatline, and distribution-based haircut approaches.

In a volume-based approach, the Board could model noninterest income on NSF fees using a measure of the underlying activity that generates NSF events, such as the number of attempted transactions against accounts with insufficient balances, and apply a firm-specific fee rate. Under this approach, the model would separately project the volume of NSF events and the income earned per event. If adopted, a volume-based approach could more directly capture the activity generating NSF fee income, but would require the identification and analysis of appropriate data on the underlying business activity.

In a flatline approach, the Board could model noninterest income on NSF fees by holding projected income constant at a recent firm-specific historical level, such as the value at jump-off

or a recent average or median. Under this approach, the model would not estimate how NSF fee income responds to changes in economic conditions. If adopted, this approach would be simple and transparent, but would not allow NSF fee income to respond to the severely adverse scenario and therefore would be less forward-looking and less able to capture the effects of economic stress.

In a distribution-based haircut approach, the Board could model noninterest income on NSF fees by setting projected noninterest income on NSF fees to a firm-specific starting value of noninterest income multiplied by a haircut. The Board would analyze the distribution of growth rates in noninterest income on NSF fees across stress-tested firms, then select a growth rate from an appropriate haircut percentile. Under this approach, the Board would need to select the historical period and percentile or other statistic used to determine the haircut. If adopted, this approach would provide a simple way to incorporate historically adverse outcomes, but projected income would not be directly linked to economic conditions specified in the stress test. As discussed above (see, e.g., Section III.B.iii.a) for other sources of noninterest income, in contrast to a pure flatline this distribution based-haircut approach would assume a level of decline under stress.

Within the proposed regression approach, the Board could alternatively model the NSF fee-to-deposit ratio using other measures of household financial conditions, such as disposable personal income, or use alternative lags or transformations of unemployment. Under this approach, measures of household income could capture additional factors affecting customers' ability to maintain sufficient account balances, while alternative lags could capture delayed responses of NSF activity to economic conditions. The proposed macroeconomic driver was selected based on economic intuition, statistical fit, and model performance while maintaining

model parsimony. Given the relatively short FR Y-14Q sample, including additional variables or lags could increase estimation uncertainty and model complexity.

As detailed in Appendix A, the Board proposes to apply an adjustment to the first projected quarter to compensate for the use of a four-quarter geometric mean for the liftoff. This adjustment supports the principle of robustness as it allows for more precise projections. However, its impact is small. To further the principle of simplicity, the Board is considering an alternative where this adjustment is omitted from the model.

Additionally, the Board could adopt a standardized data adjustment to account for the COVID period, which could entail excluding specified pandemic-period observations rather than including a 2020:Q2 dummy. If adopted, this approach would simplify the treatment of COVID-period observations across relevant components, but would reduce the available estimation sample. The proposed dummy instead retains the 2020:Q2 observation while limiting the effect of the pandemic-specific disruption on the estimated relationship between unemployment and NSF fee income.

The Board considered the availability of these alternative approaches and determined that the proposed regression approach for noninterest income on NSF fees was reasonably designed to achieve the goals of the stress test. The Board is interested in feedback on these alternative approaches, and whether they should be adopted in any final PPNR model for the 2027 supervisory stress test.

c. Alternatives for Noninterest Income on Other Deposit Fees

The Board considered the availability of alternative approaches to calculate noninterest income on other deposit fees in the supervisory stress test. In particular, the Board could

estimate noninterest income on other deposit fees using an approach that is similar to others described in this 2027 Proposed PPNR Model Documentation, including the volume-based, flatline, and distribution-based haircut approaches.

In a volume-based approach, the Board could model other deposit fees using measures of the underlying activities that generate these fees, such as the number of deposit accounts or the volume of specific fee-generating services, and apply corresponding firm-specific fee rates. Under this approach, the model would separately project the relevant business volumes and fees earned per unit of activity. If adopted, a volume-based approach could more directly capture the activities generating individual fees but would require identification and analysis of appropriate data on the underlying business activity.

In a flatline approach, the Board could model noninterest income on other deposit fees by holding projected income constant at a recent firm-specific historical level, such as the value at jump-off or a recent average or median. Under this approach, the model would not estimate how other deposit fee income responds to changes in economic or interest-rate conditions. If adopted, this approach would be simple and transparent but would not allow other deposit fee income to respond to the severely adverse scenario and therefore would be less forward-looking and less able to capture the effects of economic stress.

In a distribution-based haircut approach, the Board could model noninterest income on other deposit fees by setting projected noninterest income on other deposit fees to a firm-specific starting value of noninterest income multiplied by a haircut. The Board would analyze the distribution of growth rates in noninterest income on other deposit fees across stress-tested firms, then select a growth rate from an appropriate haircut percentile. An appropriate percentile could be the 7th percentile as described in the distribution-based model for noninterest income on sales

and trading or a different conservative percentile. If adopted, this approach would provide a simple way to incorporate historically adverse outcomes, but projected income would not be directly linked to the supervisory scenario. As discussed above (see, e.g., Section III.B.iii.a) for other sources of noninterest income, in contrast to a pure flatline this distribution based-haircut approach would assume a level of decline under stress.

Within the proposed regression approach, the Board could alternatively model the other deposit fee-to-deposit ratio using other measures of household economic or interest-rate conditions, such as disposable personal income or alternative interest rates, or use alternative lags or transformations of unemployment and the three-month Treasury rate. Alternative variables could capture additional factors affecting deposit-related fee activity, while alternative lags could capture delayed responses to economic or interest-rate conditions. The proposed macroeconomic drivers were selected based on economic intuition, statistical fit, and model performance while maintaining model parsimony.

Additionally, as detailed in Appendix A, the Board proposes to apply an adjustment to the first projected quarter to compensate for the use of a four-quarter geometric mean for the liftoff. This adjustment supports the principle of robustness as it allows for more precise projections. However, its impact is small. To further the principle of simplicity, the Board is considering an alternative where this adjustment is omitted from the model.

The Board considered the availability of these alternative approaches and determined that the proposed regression approach for noninterest income on other deposit fees was reasonably designed to achieve the goals of the stress test. The Board is interested in feedback on these alternative approaches, and whether they should be adopted in any final PPNR model for the 2027 supervisory stress test.

iv. Questions

The Board is requesting public input on the proposed model for noninterest income on deposit fees, including, but not limited to, input on the following questions.

Question 14: The Board seeks input on the proposed approach to model noninterest income on deposit fees. Are there alternative approaches the Board should consider? What are the advantages and disadvantages of the Board's proposal and any alternatives? Are there alternative specifications, in terms of right-hand side variables, differences, lags, transformations, or the sample period of estimation, that the Board should consider, and why? Should the Board consider an alternative measure of activity volume, or a different scaling method for the dependent variable in the noninterest income on deposit fees models?

Question 15: The Board seeks input on the use of the four-quarter mean and the associated weighted average adjustment for log differenced models. Are there alternative approaches or lookback periods that the Board should consider to mitigate volatility and seasonality from the liftoff values for the noninterest income on deposit fees models? Does the use of a four-quarter lookback period appropriately balance reflecting recent trends while mitigating volatility? What are the advantages and disadvantages of any such alternative?

Question 16: Should the Board adjust the first projection quarter to account for seasonality and the liftoff from a four-quarter geometric mean? Is the adjustment described in Appendix A appropriate? Alternatively, should the Board decline to adjust the first projection quarter? If so, what would be the advantages and disadvantages of doing so?

D. Noninterest Income on Investment Banking

i. Model Description

The Board proposes industry-level volume-based models to project noninterest income on investment banking. Noninterest income on investment banking is modeled through the advisory, equity capital markets (ECM), debt capital markets (DCM), and syndicated/corporate lending (SCL) subcomponents. These four subcomponents are modeled separately using the volume-based approach. The firm-level projection for noninterest income on investment banking is the sum of each of the firm's subcomponent projections across each projection horizon. The following sections provide details on the models. Parameter estimates are provided in Appendix B.

a. Noninterest Income on Investment Banking: Advisory

Firms engaged in investment banking activities provide strategic advice on M&A transactions and other corporate deals (e.g., restructuring, spin-offs, etc.), collecting advisory fees as a percentage of transaction volume. The Board proposes to use a volume-based approach that projects noninterest income on advisory fees as the product of two components: (i) advisory deal volume and (ii) the advisory fee ratio. The Board would first project advisory deal volume under stress and then multiply projected volumes by a fixed advisory fees-to-volume ratio to generate firm-specific noninterest income from advisory fees.

The Board proposes a volume-based approach because advisory fees are generated from completed corporate transactions and generally vary with the amount of advisory deal activity. Separately projecting deal volume and applying a fee rate allows the model to capture the effect of stress on advisory activity while maintaining a transparent relationship between business

volume and resulting income. The Board proposes to use the dollar value of advisory deals as the measure of business volume because advisory fees are generally related to transaction size. Dollar volume therefore captures differences in both the number and size of completed transactions and provides a direct measure of the activity underlying advisory fee income. The following paragraphs detail the methodology for advisory deal volume and the advisory fee ratio.

Advisory deal volume responds to both equity market performance and recent trends in deal levels.³³ Given this dependence on overall equity market performance, this component is modeled using a Dow Jones Total Stock Market Index return variable lagged by two quarters, reflecting how equity market conditions affect corporate valuations, financing conditions, and firms' willingness to pursue transactions, which in turn affect advisory deal activity. The Board proposes to use the equity market return lagged by two quarters because changes in market conditions generally affect completed advisory transactions with a delay. Advisory transactions require time to originate, negotiate, and complete, so contemporaneous market movements may not be reflected immediately in reported completed deal volume. The Board also proposes to include lagged advisory deal volume to capture the fact that, because advisory transactions often develop over multiple quarters, recent deal activity contains information about transactions likely to reach completion in subsequent quarters. Finally, the Board proposes to model advisory deal volume using a fourth-quarter dummy variable to account for seasonal patterns in deal timing and completion.

³³ For example, Rhodes-Kropf and Viswanathan (2004) demonstrate that merger waves are driven by equity market valuations, with high stock prices leading to increased M&A activity, while Carow, Heron, and Saxton (2004) show that acquisition activity exhibits temporal clustering and herding behavior, with firms following others in making acquisitions. See M. Rhodes-Kropf and S. Viswanathan, *Market valuation and merger waves*, *Journal of Finance* 59(6) (2004), 2685–718; K. Carow, R. Heron, and T. Saxton, *Do early birds get the returns? An empirical investigation of early-mover advantages in acquisitions*, *Strategic Management Journal* 25(6) (2004), 563–85.

The Board proposes to estimate deal-volume growth at the industry level because the relevant FR Y-14Q data provide a relatively short quarterly sample and firm-level advisory volumes can be volatile. Pooling the available information provides a more robust estimate of the relationship between market conditions and deal activity, while firm-specific volume anchors preserve differences in firms' starting levels of advisory business.

The specification for the volume-based model for advisory deals is thus given by:

Equation A63 – Investment Banking: Advisory Deal Volume-Based Model

$$\Delta \log \text{Advisory } DV_t = \alpha + \beta_1 \Delta \log DJI_{t-2} + \beta_2 \Delta \log \text{Advisory } DV_{t-1} + \beta_3 Q4 \text{ Dummy}_t + \epsilon_t$$

where:

- α is a constant intercept; $\text{Advisory } DV_t$ is advisory deal volume aggregated at the industry level at time t ;
- α is a constant intercept;
- $\Delta \log DJI_{t-2}$ is the quarterly change in the natural logarithm of the Dow Jones Total Stock Market Index (DJI) lagged by two quarters, representing changes in equity market conditions;
- $Q4 \text{ Dummy}_t$ is a dummy variable equal to 1 when t is in the fourth quarter and 0 otherwise; and
- ϵ_t is a stochastic error term.

Advisory deal volume is retrieved from FR Y-14Q, Schedule G.3, line item 14. The advisory investment banking volume-based model is estimated on quarterly sample data from 2014:Q1 to 2024:Q4. The sample starts in 2014:Q1 due to data availability, as most firms subject to the stress test had begun to report relevant data by that time. The Board will evaluate and consider the addition of new data every year and determine the appropriateness of re-estimation on an extended sample.

Industry-level advisory deal volume growth rate projections are produced using the estimates of the advisory investment banking volume-based model, Equation A63, and the supervisory severely adverse scenario path for the lagged Dow Jones Total Stock Market Index.

The projection of a firm's individual advisory deal volume begins from an anchor, the geometric mean³⁴ of the firm's volume over the four quarters ending at jump-off. Firm-specific starting advisory deal volume is calculated as

Equation A64 – Advisory Investment Banking Starting Deal Volume

$$\overline{Advisory\ DV}_{b,t0} = \left(\prod_{i=0}^3 \overline{Advisory\ DV}_{b,t0-i} \right)^{\frac{1}{4}}$$

where:

- $\overline{Advisory\ DV}_{b,t0}$ denotes the firm-specific starting value for advisory deal volume for firm b .

Projected industry-level advisory deal volume growth is then applied to the firm-specific anchor and compounded forward so that each quarterly advisory deal volume growth rate increases or decreases from the growth rate in the preceding quarter. An adjustment is applied to the first projected quarter to account for the use of a quarterly growth rate applied to a four-quarter geometric mean for the liftoff; the geometric mean requires adjustment to be used as a quarterly measure because it would otherwise capture impacts from deterministic elements of the time series in the four quarters it averages, such as seasonality. In this way, the projection

³⁴ Details on the use of a geometric mean and related exception handling are provided in Appendix A.

horizon begins from a level consistent with the seasonal factors and macroeconomic variables applicable in the liftoff. Details of the adjustment are provided in Appendix A.

Applying the recursion repeatedly gives the firm-specific projected level in any quarter of the horizon directly in terms of the anchor and the cumulative sum of projected growth rates.

Firm-specific projected advisory deal volume is thus calculated as:

Equation A65 – Projected Advisory Investment Banking Deal Volume

$$\widehat{Advisory\ DV}_{b,t0+h} = \overline{Advisory\ DV}_{b,t0} * \exp \left(\sum_{j=1}^h \Delta \log \widehat{Advisory\ DV}_{t+j} \right)$$

where:

- $h \in \{1,2, \dots, 13\}$ is the projection horizon; and
- $\widehat{Advisory\ DV}_{b,t0+h}$ is the projected dollar value of advisory deal volume for firm b at period $t0 + h$; and
- $h \in \{1,2, \dots, 13\}$ is the projection horizon.

The result is a firm-specific projected dollar level of advisory deal activity for every quarter of the projection horizon.

To estimate noninterest income from advisory deal volume, the Board would calculate a fee rate for advisory deals to apply to deal volume. The Board proposes to use an industry-level rather than firm-specific fee rate because firm-level ratios contain outliers that may reflect idiosyncratic measurement or reporting differences. Aggregating fee income and deal volume across firms reduces the influence of these observations and promotes more stable and comparable projections across firms. The fee rate is the industry-level of noninterest income earned per unit of business activity conducted, and is given by:

Equation A66 – Investment Banking: Advisory Fee Rate

$$AdvisoryFeeRate_t = \frac{\sum_b AdvisoryFees_{b,t}}{\sum_b Advisory DV_{b,t}}$$

where:

- $AdvisoryFeeRate_t$ denotes the industry-level fee rate at time t ;
- $AdvisoryFees_{b,t}$ denotes the historical noninterest income from advisory investment banking activities for firm b at time t ; and
- $Advisory DV_{b,t}$ denotes the historical deal volume of advisory investment banking activities for firm b at time t .

Noninterest income on advisory investment banking is retrieved from FR Y-14Q, Schedule G.1, line item 16A. The Board proposes to hold the industry-level fee rate constant over the projection horizon because advisory fee rates are relatively stable and the Board has not identified a sufficiently supported relationship between supervisory scenario variables and changes in fee rates. This treatment allows stress to affect advisory income through projected deal activity without introducing an additional fee-rate relationship that may not be reliably estimated.

The fee rate used in the projection of noninterest income from advisory deal volume is the median of the advisory fee rate over the four quarters ending at jump-off, and is given by:

Equation A67 – Median Advisory Investment Banking Fee

$$\overline{AdvisoryFeeRate}_{t_0} = \text{median}(AdvisoryFeeRate_{t_0-k})$$

where:

- $\overline{AdvisoryFeeRate}_{t_0}$ is the median industry-level fee rate at t_0 ;
- t_0 denotes the jump-off quarter; and
- $k \in \{0,1,2,3\}$.
- $\overline{AdvisoryFeeRate}_{t_0}$ is the median industry-level fee rate at t_0 .

The four-quarter median fee rate is used instead of the average so that the projection is not distorted by a single quarter in which either the income line item or the volume measure was atypical. Using a recent four-quarter window produces a fee rate that is consistent with firms' current pricing and product mixes.

Finally, projected advisory noninterest income is estimated by multiplying the projected volume of advisory deals by the median fee rate, as given by:

Equation A68 – Noninterest Income on Advisory Investment Banking Projection

$$\widehat{Advisory\ Investment\ Banking}_{b,t0+h} = \widehat{Advisory\ DV}_{b,t0+h} \times \overline{AdvisoryFeeRate}_{t0}$$

where:

- $\widehat{Advisory\ Investment\ Banking}_{b,t0+h}$ denotes the projected noninterest income on advisory investment banking for firm b at time $t0 + h$;
- $\widehat{Advisory\ DV}_{b,t0+h}$ denotes the projected deal volume for firm b at time $t0 + h$;
- and
- $\overline{AdvisoryFeeRate}_{t0}$ is the constant starting industry-level fee rate.

b. Noninterest Income on Investment Banking: Equity Capital Markets

Investment banks earn equity capital market (ECM) fees by underwriting equity issuances, collecting fees as a percentage of the capital raised. Noninterest income on ECM fees is expressed as the product of two components: (i) ECM volume; and (ii) the ECM fee ratio. The Board would first project ECM deal volume under stress and then multiply projected volumes by a fixed ECM fees-to-volume ratio. The following paragraphs detail the methodology for ECM volume and the ECM fee ratio.

Equity issuance activity is closely linked to overall equity capital market performance. For instance, literature suggests that favorable stock market conditions generally encourage firms to raise capital through initial public offerings, follow-on offerings, and other equity issuance

activities.³⁵ To capture the impact of equity market performance on issuance activity, the Board selected the Dow Jones Total Stock Market Index to model ECM deal volume. The Board's choice of this control variable over other macroeconomic indicators was supported by both economic rationale and because the Dow Jones Total Stock Market Index showed superior statistical significance and in-sample fit over other alternatives. To project noninterest income from ECM, the Board would begin by estimating industry-level ECM deal volume using a regression model given by:

Equation A69 – Investment Banking: ECM Deal Volume-Based Model

$$\Delta \log ECM DV_t = \alpha + \beta_1 \Delta \log DJI_t + \epsilon_t$$

where:

- α is a constant intercept;
- $ECM DV_t$ is ECM deal volume aggregated at the industry level at time t ;
- α is a constant intercept;
- $\Delta \log DJI_t$ is the quarterly change in the natural logarithm of the Dow Jones Total Stock Market Index at time t , representing changes in equity market conditions; and
- ϵ_t is a stochastic error term.

ECM deal volume is retrieved from FR Y-14Q, Schedule G.3, line item 18. The ECM deal volume model is estimated on quarterly sample data from 2014:Q1 to 2024:Q4. The sample starts in 2014:Q1 due to data availability, as most firms subject to the stress test had begun to report relevant data by that time. The Board will evaluate and consider the addition of new data every year and determine the appropriateness of re-estimation on an extended sample.

³⁵ For example, Baker and Wurgler (2000) show that firms are more likely to issue equity when their market valuations are high, consistent with firms timing equity issuance to favorable market conditions. See M. Baker and J. Wurgler, *The equity share in new issues and aggregate stock returns*, *Journal of Finance* 55(5) (2000), 2219–57.

Industry-level ECM growth rate projections are produced using the estimates of the ECM volume regression model and the supervisory severely adverse scenario path for the Dow Jones Total Stock Market Index.

The projection of a firm's individual ECM deal volume begins from an anchor, the geometric mean³⁶ of the firm's volume over the four quarters ending at jump-off. Firm-specific starting ECM deal volume is calculated by:

Equation A70 – ECM Firm-Specific Starting Deal Volume

$$\overline{ECM DV}_{b,t0} = \left(\prod_{i=0}^3 ECM DV_{b,t0-i} \right)^{\frac{1}{4}}$$

where:

- $\overline{ECM DV}_{b,t0}$ denotes the firm-specific starting dollar value for ECM deals completed for firm b .

Projected industry-level ECM deal volume growth is applied to the firm-specific anchor and compounded forward so that each projected quarterly estimate grows from the value in the preceding quarter. An adjustment is applied to the first projected quarter to account for the use of a quarterly growth rate applied to a four-quarter geometric mean for the liftoff; the geometric mean requires adjustment to be used as a quarterly measure because it would otherwise capture impacts from deterministic elements of the time series in the four quarters it averages, such as seasonality. In this way, the projection horizon begins from a level consistent with the seasonal factors and macroeconomic variables applicable in the liftoff. Details of the adjustment are provided in Appendix A.

³⁶ Details on the use of a geometric mean and related exception handling are provided in Appendix A.

Applying the recursion repeatedly gives the firm-specific projected dollar-value level of ECM deal volume in any quarter of the projection horizon in terms of the anchor and the cumulative sum of projected growth rates. Firm-specific projected ECM deal volume is thus calculated as:

Equation A71 – Projected ECM Deal Volume

$$ECM \widehat{DV}_{b,t0+h} = \overline{ECM DV}_{b,t0} * \exp \left(\sum_{j=1}^h \Delta \log \widehat{ECM DV}_{t+j} \right)$$

where:

- $ECM \widehat{DV}_{b,t0+h}$ is the projected dollar value of ECM deal volume for firm b at period $t0 + h$; and
- $h \in \{1,2, \dots, 13\}$ is the projection horizon.

The result is a firm-specific projected dollar level of ECM deal activity for every quarter of the projection horizon.

To estimate noninterest income from ECM, the Board would calculate a fee rate for ECM deals to apply to ECM deal volume. The fee rate is the industry level of noninterest income earned per unit of business activity conducted, and is given by:

Equation A72 – Investment Banking: Equity Capital Markets Fee Rate

$$ECM FeeRate_t = \frac{\sum_b ECM Fees_{b,t}}{\sum_i ECM DV_{b,t}}$$

where:

- $ECM FeeRate_t$ denotes the industry-level fee rate at time t ;
- $ECM Fees_{b,t}$ denotes the historical noninterest income of ECM for firm b at time t ; and
- $ECM DV_{b,t}$ denotes the historical volume of ECM deals for firm b at time t .

Noninterest income on ECM investment banking is retrieved from FR Y-14Q, Schedule G.1, line item 16B. An industry-level ECM fee is estimated instead of a firm-specific fee to address outliers observed in the data. Analysis indicates these outliers could stem from idiosyncratic measurement or reporting differences across firms, which could produce overly volatile projections in a firm-specific fee model. The industry approach mitigates the impact of these outliers and provides consistent treatment across firms, consistent with the Board's modeling principles.

The fee rate used in the projection of noninterest income from ECM is the median of the ECM fee rate over the four quarters ending at jump-off, and is given by:

Equation A73 – Median ECM Investment Banking Fee

$$\overline{ECMFeeRate}_{t_0} = \text{median}(ECMFeeRate_{t_0-k})$$

where:

- $\overline{ECMFeeRate}_{t_0}$ is the median industry-level fee rate at t_0 ;
- t_0 denotes the jump-off quarter; and
- $k \in \{0,1,2,3\}$.

The four-quarter median fee rate is used instead of the average so that the projection is not distorted by a single quarter in which either the income line item or the volume measure was atypical. Using a recent four-quarter window produces a fee rate that is consistent with firms' current pricing and product mixes.

Finally, projected ECM noninterest income is estimated by multiplying the projected volume of ECM deal activity by this median fee rate, as given by:

Equation A74 – Noninterest Income on ECM Investment Banking Projection

$$ECM \widehat{Fees}_{b,t_0+h} = \widehat{ECM DV}_{b,t_0+h} \times \overline{ECMFeeRate}_{t_0}$$

where:

- $\widehat{ECM Fees}_{b,t0+h}$ denotes the projected noninterest income on ECM investment banking for firm b at time $t0 + h$;
- $\widehat{ECM DV}_{b,t0+h}$ denotes the projected deal volume for firm b at time $t0 + h$; and
- $\overline{ECM FeeRate}_{t0}$ is the constant starting industry-level fee rate.

This robust and parsimonious modeling approach is expected to produce stable and economically meaningful projections, in line with stress testing principles of stability and simplicity.

c. Noninterest Income on Investment Banking: Debt Capital Markets

Investment banks earn debt capital market (DCM) fees by underwriting debt issuances, collecting fees as a percentage of the capital raised. Noninterest income on DCM would be expressed as the product of two components: (i) DCM deal volume; and (ii) the DCM fee ratio. The Board would first project DCM deal volume under stress and then multiply projected volume by a fixed DCM fees-to-volume ratio. The following paragraphs detail the methodology to derive DCM deal volume and the DCM fee ratio.

The proposed volume-based model begins by projecting industry-level DCM deal volume using a regression. Debt issuance activity is generally influenced by financing costs, as debt issuance tends to become more attractive when interest payments on debt are lower. To capture the impact of financing costs on debt issuance, the Board would model DCM deal volume using changes in corporate credit spreads and Treasury yield movements. Specifically, the term spread proxies the cost of financing long-term investment projects, while the BBB spread serves as a proxy for the risk premium that issuing firms face over the term spread. This intuition is corroborated by literature showing that firms issue more debt when interest rates are low and

when credit market risk premia are favorable.³⁷ The Board's choice of these variables over other macroeconomic indicators was supported by both economic rationale and the variables' superior statistical significance and in-sample fit over other alternatives. Although growth expectations may theoretically influence debt issuance decisions, macroeconomic variables proxying for growth did not demonstrate statistical significance in explaining historical DCM deal volume patterns. Additionally, a COVID dummy variable is included to control for the atypical surge in debt capital market activity during the pandemic.

The specification for the volume-based model for DCM deals is thus given by:

Equation A75 – Investment Banking: DCM Deal Volume Regression

$$\Delta \log DCM DV_t = \alpha + \beta_1 \Delta BBBSpread_t + \beta_2 \Delta TermSpread_t \\ + QuarterlyDummies_t + COVID Dummy + \epsilon_t$$

where:

- α is a constant intercept;
- $DCM DV_t$ is DCM deal volume aggregated at the industry level at time t ;
- $\Delta BBBSpread_t$ is the quarterly change in the spread of the BBB corporate bond yield to the 10-year Treasury yield at time t , representing revaluation adjustments due to changes in the risk premium;
- $\Delta TermSpread_t$ is the quarterly change in the spread of the 10-year Treasury yield to the 3-month Treasury yield at time t , representing the term premium;
- $QuarterlyDummies_t$ are dummy variables for quarters 2, 3, and 4 which are equal to 1 only if the period t is in quarter 2, 3, or 4, respectively, and zero otherwise;
- $COVIDDummy$ is a dummy variable, which takes a value of 1 during the first and second quarter of 2020 and 0 elsewhere; and
- ϵ_t is a stochastic error term.

³⁷ For example, Barry et al. (2008) demonstrate that firms issue more debt when interest rates are low compared to historical levels. See C. B. Barry, S. C. Mann, V. T. Mihov, and M. Rodríguez, *Corporate debt issuance and the historical level of interest rates*, Financial Management 37(3) (2008), 413–30. Greenwood and Hanson (2013) show that firm debt issuance responds to variation in credit-market risk premia, with riskier firms issuing disproportionately more debt when required returns are low. See R. Greenwood and S. G. Hanson, *Issuer quality and corporate bonds*, The Review of Financial Studies 26(6) (2013), 1483–1525.

DCM deal volume is retrieved from FR Y-14Q, Schedule G.3, line item 21. The DCM investment banking volume-based model is estimated on quarterly sample data from 2014:Q1 to 2024:Q4. The sample starts in 2014:Q1 due to data availability, as most firms subject to the stress test had begun to report relevant data by that time. The Board will evaluate and consider the addition of new data every year and determine the appropriateness of re-estimation on an extended sample.

Industry-level DCM volume growth rate projections are produced using the estimates of the DCM deal volume and the supervisory severely adverse scenario paths for the BBB and Treasury spreads.

The projection of a firm's individual DCM deal volume begins from an anchor, the geometric mean³⁸ of the firm's volume over the four quarters ending at jump-off. Firm-specific starting DCM deal volume is calculated as:

Equation A76 – DCM Firm-Specific Starting Deal Volume

$$\overline{DCM DV}_{b,t0} = \left(\prod_{i=0}^3 DCM DV_{b,t0-i} \right)^{\frac{1}{4}}$$

where:

- $\overline{DCM DV}_{b,t0}$ denotes the firm-specific starting dollar value for DCM deals completed for firm b .

Projected industry-level DCM deal volume growth is applied to the firm-specific anchor and compounded forward so that each quarterly deal volume growth rate changes according to the growth rate from the preceding quarter. An adjustment is applied to the first projected

³⁸ Details on the use of a geometric mean and related exception handling are provided in Appendix A.

quarter to account for the use of a quarterly growth rate applied to a four-quarter geometric mean for the liftoff; the geometric mean requires adjustment to be used as a quarterly measure because it would otherwise capture impacts from deterministic elements of the time series in the four quarters it averages, such as seasonality. In this way, the projection horizon begins from a level consistent with the seasonal factors and macroeconomic variables applicable in the liftoff.

Details of the adjustment are provided in Appendix A.

Applying the recursion repeatedly gives the firm-specific projected level in any quarter of the horizon directly in terms of the anchor and the cumulative sum of projected growth rates.

Firm-specific projected DCM deal volume is thus calculated as:

Equation A77 – Projected DCM Deal Volume

$$DCM \widehat{DV}_{b,t0+h} = \overline{DCM DV}_{b,t0} * \exp \left(\sum_{j=1}^h \Delta \log \widehat{DCM DV}_{t+j} \right)$$

where:

- $DCM \widehat{DV}_{b,t0+h}$ is the projected dollar value of DCM deal volume for firm b at period $t0 + h$; and
- $h \in \{1,2, \dots, 13\}$ is the projection horizon.

To estimate noninterest income from DCM deals, the Board would calculate a DCM fee rate to apply to DCM deal activity. The fee rate is the industry level of noninterest income earned per unit of business activity conducted, and is given by:

Equation A78 – Investment Banking: Debt Capital Markets Fee Rate

$$DCM FeeRate_t = \frac{\sum_b DCM Fees_{b,t}}{\sum_b DCM DV_{b,t}}$$

where:

- $DCMFeeRate_t$ denotes the industry-level fee rate at time t ;
- $DCMFees_{b,t}$ denotes the historical noninterest income of DCM for firm b at time t ; and
- $DCM DV_{b,t}$ denotes the historical volume of DCM deals for firm b at time t .

Noninterest income on DCM investment banking is retrieved from FR Y-14Q, Schedule G.1, line item 16C. An industry fee rate is used in place of a firm-specific fee to address outliers observed in the data. Analysis indicates these outliers could stem from idiosyncratic measurement or reporting differences across firms, which could produce overly volatile projections in a firm-specific fee model. The industry approach mitigates the impact of these outliers and provides consistent treatment across firms, consistent with the Board's modeling principles.

The fee rate used in the projection of noninterest income from DCM deal activity is the median of the DCM fee rate over the four quarters ending at jump-off, and is given by:

Equation A79 – Median DCM Investment Banking Fee

$$\overline{DCMFeeRate}_{t_0} = \text{median}(DCMFeeRate_{t_0-k})$$

where:

- $\overline{DCMFeeRate}_{t_0}$ is the median industry-level fee rate at t_0 ;
- t_0 denotes the jump-off quarter; and
- $k \in \{0,1,2,3\}$.

The four-quarter median fee rate is used instead of the average so that the projection is not distorted by a single quarter in which either the income line item or the volume measure was atypical. Using a recent four-quarter window produces a fee rate that is consistent with firms' current pricing and product mixes.

Projected DCM noninterest income is estimated by multiplying the projected volume of DCM deal activity by this median fee rate, as given by:

Equation A80 – Noninterest Income on DCM Investment Banking Projection

$$DCM \widehat{Fees}_{b,t0+h} = DCM \widehat{DV}_{b,t0+h} \times \overline{DCM FeeRate}_{t0}$$

where:

- $DCM \widehat{Fees}_{b,t0+h}$ denotes the projected noninterest income on DCM investment banking for firm b at time $t0 + h$;
- $DCM \widehat{DV}_{b,t0+h}$ denotes the projected deal volume for firm b at time $t0 + h$; and
- $\overline{DCM FeeRate}_{t0}$ is the constant starting industry-level fee rate.

An assumption underpinning the volume-based approach is that fee ratios are relatively stable and do not vary over the projection horizon. Similar to the above two modelling approaches, this is consistent with a related assumption, that investment banking fees are determined by long-term client relationships that go beyond individual deals, which is likely to help reduce variation in fee ratios.

This robust and parsimonious modeling approach is likely to produce stable and economically meaningful projections, in line with stress test principles of stability and simplicity.

d. Noninterest Income on Investment Banking: Syndicated/Corporate Lending

Investment banks earn syndicated and corporate lending (SCL) fees by arranging and underwriting syndicated loans, collecting fees as a percentage of loan volume. Noninterest income on SCL fees is expressed as the product of two components: (i) SCL deal volume; and (ii) the SCL fee ratio. In the proposed model, the Board would first project SCL deal volume under stress and then multiply projected volumes by a fixed SCL fees-to-volume ratio.

The proposed model begins by estimating SCL deal volume. SCL loan origination volume is generally influenced by funding costs and economic growth expectations. To capture these dynamics, the Board proposes to use changes in the 10-year U.S. Treasury yield, which proxy for growth expectations, to model SCL deal volume.³⁹ When investors expect higher future growth and investment opportunities, they can be expected to shift away from bonds to pursue investment in real projects that offer relatively higher expected returns, driving demand for 10-year U.S. Treasuries down and increasing their yield. Higher growth expectations are likely to increase demand for large loan amounts, thereby increasing syndicated lending deal volume. In the Board's assessment, changes in the 10-year U.S. Treasury yield demonstrated the strongest statistical significance and in-sample fit among the macroeconomic variables considered. Although financing cost variables such as credit spreads and growth-related variables such as GDP or stock market indexes may theoretically influence loan origination decisions, these macroeconomic variables did not demonstrate statistical significance in explaining SCL deal volume patterns. The in-sample analysis indicated the presence of recurring year-end seasonality in syndicated lending activity, and a fourth-quarter dummy variable is included to capture this pattern.⁴⁰ The Board's choice of these variables was supported by both economic rationale and their superior statistical performance over other alternatives considered.

The specification for the volume-based model for SCL deals is thus given by:

Equation A81 – Investment Banking: SCL Deal Volume Regression

³⁹ See Fama and Bliss (1987), who suggest that expected term premiums are related to the business cycle, being mostly positive during economically successful periods but mostly negative during recessions. E. F. Fama and R. R. Bliss, *The Information in Long-Maturity Forward Rates*, American Economic Review 77(4) (1987), 680–92.

⁴⁰ See, e.g., Bertrand et al. (2021), who find that banks grant significantly larger loan amounts at quarter-end and year-end months. J. Bertrand, A. Burietz, and L. Weill, *The month-of-the-year effect in corporate lending*. *Finance Research Letters* 43 (2021), 102014.

$$\Delta \log SCL DV_t = \alpha + \beta_1 \Delta T10Y_t + \beta_2 Q4 Dummy_t + \epsilon_t$$

where:

- α is a constant intercept;
- $SCL DV_t$ is SCL deal volume aggregated at the industry level at time t ;
- α is a constant intercept;
- $\Delta T10Y_t$ is the quarterly change in the 10-year Treasury yield at time t , representing changes in interest rate levels;
- $Q4 Dummy_t$ is a dummy variable equal to 1 when t is in the fourth quarter and 0 otherwise; and
- ϵ_t is a stochastic error term.

SCL deal volume is retrieved from FR Y-14Q, Schedule G.3, line item 24. The SCL volume regression is estimated on quarterly sample data from 2014:Q1 to 2024:Q4. The sample starts in 2014:Q1 due to data availability, as most firms subject to the stress test had begun to report relevant data by that time. The Board will evaluate and consider the addition of new data every year and determine the appropriateness of re-estimation on an extended sample.

Industry-level SCL deal volume growth rate projections are produced using the estimates of the SCL deal volume and the supervisory severely adverse scenario path for the 10-year Treasury rate.

The projection of a firm's individual SCL deal volume begins from an anchor, the geometric mean⁴¹ of the firm's volume over the four quarters ending at jump-off. Firm-specific starting SCL deal volume is calculated as:

Equation A82 – SCL Investment Banking Firm-Specific Starting Volume

$$\overline{SCL DV}_{b,t0} = \left(\prod_{i=0}^3 SCL DV_{b,t0-i} \right)^{\frac{1}{4}}$$

⁴¹ Details on the use of a geometric mean and related exception handling are provided in Appendix A.

where:

- $\overline{SCL\ DV}_{b,t0}$ denotes the firm-specific starting dollar value of completed SCL deal volume for firm b .

Projected industry-level SCL deal growth is applied to the firm-specific anchor and compounded forward so that each quarterly deal growth rate increases or decreases based on the growth rate from the preceding quarter. An adjustment is applied to the first projected quarter to account for the application of a quarterly growth rate to a four-quarter geometric mean for the liftoff; the geometric mean requires adjustment prior to use as a quarterly measure because it would otherwise capture impacts from deterministic elements of the time series in the four quarters it averages, such as seasonality. In this way, the projection horizon begins from a level consistent with the seasonal factors and macroeconomic variables applicable in the liftoff.

Details of the adjustment are provided in Appendix A.

Applying the recursion repeatedly gives the firm-specific projected level in any quarter of the horizon directly in terms of the anchor and the cumulative sum of projected growth rates.

Firm-specific projected advisory deal volume is thus calculated as:

Equation A83 – Projected SCL Deal Volume

$$SCL\widehat{DV}_{b,t0+h} = \overline{SCL\ DV}_{b,t0} * \exp\left(\sum_{j=1}^h \Delta \log \widehat{SCL\ DV}_{t+j}\right)$$

where:

- $SCL\widehat{DV}_{b,t0+h}$ is the projected dollar value of SCL deal volume for firm b at period $t0 + h$; and
- $h \in \{1,2, \dots, 13\}$ is the projection horizon.

The result is a firm-specific projected dollar level of SCL deal volume for every quarter of the projection horizon.

To estimate noninterest income from SCL, the Board would calculate a fee rate for SCL deals to apply to SCL deal volume. The fee rate is the industry-level of noninterest income earned per unit of dollar-value SCL deal activity conducted, and is given by:

Equation A84 – SCL Fee Rate

$$SCLFeeRate_t = \frac{SCL\ Industry\ Fees_t}{SCL\ Industry\ DV_t}, \text{ where}$$

$$SCL\ Industry\ Fees_t = \text{Median}(SCL\ Industry\ Fees_{b,t}) \text{ across } b \text{ at period } t$$

$$SCL\ Industry\ DV_t = \text{Median}(SCL\ Industry\ DV_{b,t}) \text{ across } b \text{ at period } t$$

where:

- $SCL\ Industry\ Fees_{b,t}$ is firm b reported fees earned by all relevant industry participants in the SCL area in period t ;
- $SCL\ Industry\ DV_{b,t}$ is firm b 's reported dollar volume of completed deals for all relevant industry participants in the SCL area in period t ;
- $SCL\ Industry\ Fees_t$ is the cross-sectional median of $SCL\ Industry\ Fees_{b,t}$ at period t ; and
- $SCL\ Industry\ DV_t$ is the cross-sectional median of $SCL\ Industry\ DV_{b,t}$ at period t .

$SCL\ Industry\ Fees_{b,t}$ and $SCL\ Industry\ DV_{b,t}$ are retrieved from FR Y-14Q, Schedule G.3, line items 25 and 26, respectively. Like the fee rates calculated for the other investment banking models (advisory, ECM and DCM), the SCL fee rate is calibrated using an industry measure. However, the Board chose an SCL fee rate aggregation method that differs from that of the other investment banking models to avoid a duplicate measurement of fair value adjustments. The other investment banking models in this Section II.D.i use a fee rate aggregation method that sums reported firm-level noninterest income and volumes directly across firms. However,

historical firm-level SCL noninterest income includes fair value adjustments on corporate loans that do not represent actual fees earned on completed deals, and these fair value adjustments are included in the Fair Value Option (FVO) model. The Board instead proposes to use industry-aggregate measures derived from reported SCL fee and deal volume in FR Y-14Q, Schedule G.3, which excludes fair value adjustments to avoid duplicative measurement.

Specifically, each firm b reports its estimate of total industry fees ($SCL\ IndustryFees_{b,t}$) and total industry deal volume ($SCL\ Industry\ DV_{b,t}$) in quarter t . Since these estimates vary across firms, the Board would take the cross-sectional median across all firms' reports to approximate true industry aggregates, smoothing out firm-specific reporting variation. $SCL\ Industry\ Fees_t$ thus represents the median of reported industry fees, while $SCL\ Industry\ DV_t$ represents the median of reported industry volumes. The Board proposes to calculate the fee rate in each quarter as the ratio of these two median values. The fee rate is necessarily expressed at the industry level because available firm-level data includes fair value adjustments that would result in a duplicative measurement across models.

The fee rate used in the projection of noninterest income from SCL deals is the median of the SCL fee rate over the four quarters ending at jump-off, and is given by:

Equation A85 – Median SCL Investment Banking Fee

$$\overline{SCLFeeRate_{t0}} = \text{median}(SCLFeeRate_{t0-k})$$

where:

- $\overline{SCLFeeRate_{t0}}$ is the median industry-level fee rate at $t0$;
- $t0$ denotes the jump-off quarter; and
- $k \in \{0,1,2,3\}$.

The four-quarter median fee rate is used instead of the average so that the projection is not distorted by a single quarter in which either the income line item or the volume measure was atypical. Using a recent four-quarter window produces a fee rate that is consistent with firms' current pricing and product mixes.

The projected SCL noninterest income is estimated by multiplying the projected volume of SCL deal activity by this median fee rate, as given by:

Equation A86 – Noninterest Income on SCL Investment Banking Projection

$$SCL \widehat{Fees}_{b,t0+h} = \widehat{SCL DV}_{b,t0+h} \times \overline{SCL FeeRate}_{t0}$$

where:

- $SCL \widehat{Fees}_{b,t0+h}$ denotes the projected noninterest income on SCL investment banking for firm b at time $t0 + h$;
- $\widehat{SCL DV}_{b,t0+h}$ denotes the projected deal volume for firm b at time $t0 + h$; and
- $\overline{SCL FeeRate}_{t0}$ is the constant starting industry-level fee rate.

An assumption underpinning the volume-based approach is that fee ratios are relatively stable and do not vary over the projection horizon. This is related to the assumption that investment banking fees are determined by long-term client relationships that extend beyond individual deals, which is likely to help reduce volatility in fee ratios.

This robust and parsimonious modeling approach is likely to produce stable and economically meaningful projections, in line with stress test principles of stability and simplicity.

ii. Assumptions and Limitations

The volume-based approach assumes that noninterest income on investment banking for each firm fluctuates proportionally to changes in industry volume for all subcomponents of investment banking. The Board proposes to use an industry-level model in alignment with the

stress testing principles of consistency and comparability. Individual firm-level models would require distinct regressions and coefficients, each responding with differing macroeconomic sensitivity to the same underlying scenario. In contrast, an industry-level approach ensures that projected noninterest income on investment banking fees differs only due to a firm's scale and business volume.

The volume-based approach assumes that fee rates do not vary over the projection horizon. This assumption is consistent with the observation that investment banking fees are determined by long-term client relationships that extend beyond individual deals, which is likely to help reduce volatility in fee rates.⁴² Beyond adding simplicity to the model, keeping the fee rate fixed allows the model to parsimoniously capture the dynamics of noninterest income through volume changes, in accordance with the volume-based assumption that deal volume is a driver of noninterest income. These model properties align with the stress testing principles of simplicity and stability.

The volume-based model for noninterest income from DCM deals uses a COVID dummy for the first and second quarters of 2020. The use of a dummy variable improved model fit and was considered appropriate. However, the COVID dummy variable for the DCM model differs from the dummy variables used elsewhere in noninterest income models because it includes both the first and second quarters of 2020. The Board chose this specification following an analysis of the data on noninterest income from debt capital markets that indicated that debt capital

⁴² Fang (2005) finds that reputable banks maintain more stable fees over time than smaller competitors and that past relationship scope significantly affects underwriter selection, consistent with long-term relationships reducing fee variation. See L. H. Fang, *Investment Bank Reputation and the Price and Quality of Underwriting Services*, *Journal of Finance* 60(6) (2005), 2729–61.

markets responded atypically quickly to economic stress compared to other areas of noninterest income during the COVID pandemic.

The volume-based model for noninterest income from SCL assumes the median of the firm-reported values for industry market size fees and volume is the industry fee rate for SCL. This assumption mitigates potential duplicative measurements between the PPNR and Fair Value Option (FVO) models, as discussed above in Section D.i.d.⁴³

One limitation of the noninterest income models for investment banking is their use of an aggregate median fee ratio. The aggregate median fee rate was used in part to address firm-specific outlier fee ratios. However, the use of an aggregate median implies that the fee ratio may not accurately reflect an individual firm's performance in a given business line and means that the fee ratio applied to each firm depends on the sample of firms. The Board proposes to use an aggregate median because it promotes comparability and avoids complexity.

iii. Alternatives for Investment Banking Component Models

The Board considered the availability of alternative approaches to calculate noninterest income on advisory, ECM, DCM, and SCL in the supervisory stress test. In particular, the Board could estimate noninterest income on advisory, ECM, DCM, or SCL noninterest fees using alternative approaches including regression, flatline, and distribution-based haircut approaches.

In a regression approach, the Board could model noninterest income on advisory, ECM, DCM, or SCL fees directly as a function of macroeconomic variables, rather than separately modeling volume and applying a fixed fee rate. Under this approach, the Board would directly

⁴³ Valuation adjustments are reported in the G.1 line item for SCL. Reported industry market size does not include valuation adjustments, and thus it is the preferred source for this specific component.

model the industry growth rate of noninterest income from advisory, ECM, DCM, or SCL fees as the dependent variable and relevant macroeconomic variables (e.g., lagged and contemporaneous quarterly changes of the Dow Jones Total Stock Market Index for advisory and ECM, respectively; changes to the BBB and term spreads for DCM; and the quarterly changes in the 10-year Treasury yield for SCL) as explanatory variables to capture the joint dynamic of volume and fees embedded in noninterest income. The model would then project noninterest income growth under the severely adverse scenario by applying the estimated coefficients to the scenario paths of the macroeconomic variables. Finally, the projected growth rates would be applied to a starting anchor value of noninterest income to recover the path of noninterest income over the projection horizon.

A regression approach may be appropriate for components of noninterest income from investment banking. Noninterest income on advisory, ECM, DCM, or SCL fees depends on both deal volume and fee rates. Therefore, directly modeling noninterest income through a regression would capture the combined effects of both volume and fee rates simultaneously. A regression approach would constitute a more direct modeling framework that would not require separate assumptions regarding fee rates. This modeling approach would also be in line with the stress test principle of simplicity. The Board opted to propose a volume-based approach based on the economic rationale that noninterest income should increase with deal volumes, which is further supported by the historical comovement between volume and noninterest income. Such a historical correlation yields stable projections of noninterest income, which is consistent with the stress testing principle of stability. The Board is seeking public comment on the advantages and disadvantages of modeling noninterest income directly through a regression, including which

financial variables and their transformations could better capture the dynamics of noninterest income.

In a flatline approach, the Board could model noninterest income on advisory, ECM, DCM, or SCL fees by setting projected noninterest income to the firm-specific four-quarter geometric mean, or median, of noninterest income on advisory, ECM, DCM, or SCL fees. Under this approach, the model would assume that noninterest income on advisory, ECM, DCM, or SCL fees would not vary with the broader macroeconomy under a severely adverse scenario. The flatline approach is appropriate for income components that are not expected to clearly respond to macroeconomic conditions. However, this expectation does not apply to noninterest income on advisory, ECM, DCM, or SCL fees because they are highly dependent on corresponding deal volume, which in turn strongly reacts to market conditions and would be expected to decline materially under a severely adverse scenario. Specifically, both advisory and ECM deal volume are dependent on equity market activity, which historically contracts during periods of market stress.⁴⁴ By failing to reflect an expected decline in deal volume, a flatline approach would understate the stress on firms and would not be forward-looking.

In a distribution-based haircut approach, the Board could model noninterest income on advisory, ECM, DCM, or SCL fees by setting projected noninterest income equal to a firm-specific starting value of noninterest income multiplied by a haircut. The Board would analyze the distribution of growth rates in noninterest income across stress-tested firms, then select a growth rate from an appropriate haircut percentile. An appropriate percentile could be the 7th

⁴⁴ DCM and SCL deal volumes tend to decline with higher funding costs due to increased interest rates and credit spreads. Because both interest rates and credit spreads generally increase during adverse scenarios, DCM and SCL deals are expected to decline in the face of higher funding costs over a stressful scenario.

percentile as described in the distribution-based model for noninterest income on sales and trading or a different conservative percentile. This distribution-based haircut approach would aim to project outcomes in stressed economic environments consistent with the Board's modeling principles. As discussed above (see, e.g., Section III.B.iii.a) for other sources of noninterest income, this approach would provide a simple way to incorporate historically adverse outcomes, but projected income would not be directly linked to economic conditions specified in the stress test, although in contrast to a pure flatline this distribution based-haircut approach would assume a level of decline under stress.

Within the proposed volume-based approach, the Board could alternatively model noninterest income on advisory, ECM, DCM and SCL fees using different macroeconomic scenario variables. The Board could also consider the use of a firm-specific fee in any of these investment banking volume-based models.

The Board could also adopt a standardized data adjustment to account for the COVID period, which could entail excluding specified pandemic-period observations rather than including a 2020:Q1–2020:Q2 dummy for the DCM volume-based model. If adopted, this approach would simplify the treatment of COVID-period observations across relevant components, but would further reduce the relatively short estimation sample. The proposed dummy instead retains the 2020:Q1 and 2020:Q2 observations while limiting the effect of the pandemic-specific disruption on the estimated relationship between macroeconomic conditions and DCM deal activities.

Additionally, as detailed in Appendix A, the Board proposes to apply an adjustment to the first projected quarter to compensate for the use of a four-quarter geometric mean for the liftoff. This adjustment supports the principle of robustness as it allows for more precise projections.

However, its impact is small. To further the principle of simplicity, the Board is considering an alternative where this adjustment is omitted from the model.

The Board considered the availability of these alternative approaches and determined that the proposed volume-based approaches for noninterest income on advisory, ECM, DCM, and SCL fees were reasonably designed to achieve the goals of the stress test. The Board is interested in feedback on these alternative approaches, and whether they should be adopted in any final PPNR model for the 2027 supervisory stress test.

iv. Questions

The Board is requesting public input on this proposed model for noninterest income on investment banking including, but not limited to, input on the following questions.

Question 17: The Board seeks input on the proposed approach to model noninterest income on investment banking. Should the Board consider an alternative approach to modeling noninterest income on investment banking or its subcomponents? What are the advantages and disadvantages of the Board's approach and any potential alternatives? Are there alternative specifications, in terms of right-hand side variables, differences, lags, transformations, or the sample period of estimation, that the Board should consider, and why? Should the Board consider an alternative measure of activity volume, or a different scaling method for the dependent variable, in this model?

Question 18: The Board seeks input on using the four-quarter mean and the associated weighted average adjustment for log differenced models. Are there alternative approaches or lookback periods that the Board should consider to mitigate volatility and seasonality from the liftoff values for the noninterest income on investment banking model? Does the use of a four-

quarter lookback period appropriately balance reflecting recent trends while mitigating volatility? What are the advantages and disadvantages of any such alternative?

Question 19: Should the Board adjust the first projection quarter to account for seasonality and the liftoff from a four-quarter geometric mean? Is the adjustment described in Appendix A appropriate? Alternatively, should the Board decline to adjust the first projection quarter? If so, what would be the advantages and disadvantages of doing so?

Question 20: The Board seeks input on approaches to compute firm-specific investment banking fee rates at the subcomponent level. What are the advantages and disadvantages of potential firm-specific approaches? Should the Board collect additional data to compute firm-specific fee rates? If so, what additional data would be needed?

E. Noninterest Income on Asset Management

i. Model Description

Financial institutions involved in asset management generate revenue from managing client assets in mutual funds and institutional accounts, collecting fees as a percentage of assets under management (AUM). The Board proposes to model noninterest income from asset management using a volume-based approach. Under the proposed model, noninterest income from asset management is expressed as the product of two components: (i) total AUM under stress; and (ii) the asset management fee ratio. Total AUM under stress comprises two subcomponents: (1) the existing stock of clients' AUM and (2) net incoming flows. The Board would project the growth rate of (1) existing AUM and (2) the flow rate of net incoming funds under stress and apply these rates to each firm's AUM at liftoff, summing the two projections to project total AUM under stress. The Board would then multiply total projected AUM by a firm-

specific asset management fees-to-AUM ratio to project noninterest income on AUM. The following paragraphs detail the methodology to derive each component. Parameter estimates are provided in Appendix B.

The proposed model begins by estimating the growth rate of existing AUM. The growth rate of existing AUM, net of flows, reflects the market valuation of current holdings and responds to equity and credit market conditions. To capture these valuation effects, the Board selected three macroeconomic variables based on economic intuition and empirical performance. The Dow Jones Total Stock Market Index is used to capture the valuation of equity positions held under management.⁴⁵ Changes in the 10-year Treasury yield are used to capture the effect of interest rate movements on valuations of fixed income holdings. Changes in the BBB corporate bond spread are included to reflect changes in risk premia affecting the valuation of riskier fixed income securities.⁴⁶ The Board's choice of these variables over other macroeconomic indicators was supported by both economic rationale and the variables' superior statistical significance and in-sample fit compared to alternative specifications considered. These control variables parsimoniously capture the key valuation drivers of existing AUM and are likely to produce stable and economically meaningful projections, consistent with the stress testing principles of stability and simplicity.

The specification for the volume-based model for asset management is thus given by:

⁴⁵ See, e.g., Cochrane (2005) for an explanation of how equity market conditions may impact investor sentiment, risk appetite, and the valuation of securities. J. H. Cochrane, *Asset Pricing* (Revised Edition), Princeton, NJ: Princeton University Press.

⁴⁶ See M. Ghaderi, S. Plante, N. Roussanov, and S. B. Seo, *Reconstructing a Century of U.S. Corporate Bonds: Credit Risk in Historical Perspective*, National Bureau of Economic Research, No. w35578 (2026).

Equation A87 – Asset Management AUM Volume-Based Model

$$\log\left(\frac{AUM_t - Flow_t}{AUM_{(t-1)}}\right) = \alpha + \beta_1 \Delta \log DJI_t + \beta_2 \Delta BBB Spread_{t-1} + \beta_3 \Delta T10Y_{t-1} + \epsilon_t$$

where:

- AUM_t is industry aggregate AUM at time t ;
- $Flow_t$ is industry aggregate AUM net incoming flows at time t ;
- α is a constant intercept term;
- $\Delta \log DJI_t$ is quarterly change in the natural logarithm of the Dow Jones Total Stock Market Index, representing the change in equity market conditions;
- $\Delta BBB Spread_{t-1}$ is the quarterly change in the spread of the BBB corporate bond yield to the 10-year Treasury yield lagged one quarter, representing revaluation adjustments due to changes in the risk premium;
- $\Delta T10Y_{t-1}$ is the quarterly change in the 10-year Treasury yield lagged one quarter, representing changes in interest rate levels; and
- ϵ_t is a stochastic error term.

AUM is retrieved from FR Y-14Q, Schedule G.3, line item 35. Net incoming flows are retrieved from FR Y-14Q, Schedule G.3, line item 36. The industry AUM model is estimated on a quarterly sample from 2015:Q1 to 2024:Q4. The sample starts in 2015:Q1 due to data availability, as most firms subject to the stress test had begun to report relevant data by that time. The Board will evaluate and consider the addition of new data every year and determine the appropriateness of re-estimation on an extended sample.

Industry-level growth rate projections of client AUM are produced using the estimates of the AUM volume-based regression model and the supervisory severely adverse scenario paths for the Dow Jones Total Stock Market Index, the lagged BBB spread, and the lagged 10-year Treasury yield.

The proposed model also estimates the net incoming flow rate of AUM. In the model, net incoming flows are associated with households' ability to earn income and accumulate savings.

When households earn higher incomes, they have greater resources available for use beyond immediate consumption needs, which can be directed toward investment with asset managers. Consequently, higher household income should increase net incoming flows, while deteriorating household financial conditions should reduce flows.

The model captures these income dynamics through two complementary measures. First, the unemployment rate reflects labor market conditions that determine whether households are earning income in the first place—higher unemployment directly constrains the number of households with resources available to invest. Second, real disposable income growth measures the evolution of household purchasing power after taxes, capturing changes in the actual resources households can allocate to investment rather than consumption. Together, these variables proxy for the household sector’s capacity to generate flows into managed assets. The Board’s choice of these variables over other macroeconomic indicators was supported by both economic rationale and the variables’ superior statistical significance and in-sample fit compared to alternative specifications considered.

In an alternative specification, the Board tested modeling the net incoming flow rate using the Dow Jones Total Stock Market Index based on the hypothesis that flows chase market returns, but the estimated effect was not empirically significant. This likely reflects the behavior of investors, who respond to individual asset manager performance rather than overall market returns. Since asset managers employ diverse strategies with heterogeneous equity market exposures (with positive, negative, or zero correlation), these differential responses may wash out at the aggregate industry level. The lower sensitivity to market conditions may also reflect

the presence of institutional investors (e.g. pension funds), which are less responsive to market changes than retail investors.⁴⁷

The Board thus selected a model specification that estimates the net incoming flow rate of AUM based on the lagged unemployment rate and real disposable income growth. The proposed model estimates the flow rate as net flows divided by AUM because this ratio exhibits stability over time.

The specification for the volume-based model for the net incoming flow rate of AUM is given by:

Equation A88 – Noninterest Income on Asset Management: Flow Volume-Based Model

$$Flow\ Rate_t = \alpha + \beta_1 UR_{t-1} + \beta_2 DPI_t + \epsilon_t$$

where:

- $Flow\ Rate_t$ is net AUM flows, measured at quarter t , divided by the stock of AUM, measured at quarter $(t-1)$, calculated at the industry level;
- α is a constant intercept term;
- UR_t is the U.S. unemployment rate at time t , representing aggregate economic conditions;
- DPI_t is U.S. real disposable personal income growth (quarterly percent change, expressed at an annualized rate), representing consumer purchasing power and aggregate economic health; and
- ϵ_t is a stochastic error term.

The numerator for the flow rate is retrieved from FR Y-14Q, Schedule G.3, line item 36.

The denominator is retrieved from FR Y-14Q, Schedule G.3, line item 35. The industry flow rate

⁴⁷ See, e.g., Lakonishok et al. (1992), who find that pension funds and other institutional investors are less prone to herding and positive-feedback trading, suggesting they are more focused on fundamentals. See also Barber and Odean (2008), who show that individual investors are more likely to buy stocks with one-day extreme returns, abnormal trading volume, and stocks in the news. J. Lakonishok, A. Shleifer, and R. W. Vishny, *The impact of institutional trading on stock prices*, Journal of Financial Economics 32(1) (1992), 23–43; B. M. Barber and T. Odean, *All that glitters: The effect of attention and news on the buying behavior of individual and institutional investors*, Review of Financial Studies 21(2) (2008), 785–818.

model is estimated using quarterly sample data from 2015:Q1 to 2024:Q4. The sample starts in 2015:Q1 due to data availability, as most firms subject to the stress test had begun to report relevant data by that time. The Board will evaluate and consider the addition of new data every year and determine the appropriateness of re-estimation on an extended sample.

Industry-level projections of the AUM flow rate are produced using the estimates of the flow rate model and the supervisory severely adverse scenario paths for the lagged unemployment rate and real disposable income growth.

The Board would project total AUM growth by summing the AUM projected growth rate net of funds and the projected flow rate.

The projection of firm-level total AUM begins from an anchor, the geometric mean⁴⁸ of the firm's total AUM over the four quarters ending at jump-off. Firm-specific AUMs are calculated as:

Equation A89 – Asset Management Firm-Specific Starting AUM

$$\overline{AUM}_{b,t0} = \left(\prod_{i=0}^3 AUM_{b,t0-i} \right)^{\frac{1}{4}}$$

where:

- $\overline{AUM}_{b,t0}$ denotes the firm-specific starting value of total AUM for firm b .

The projected total AUM growth rate is applied to the firm-specific anchor and compounded forward so that each quarterly estimate grows from the value in the preceding quarter. An adjustment is applied to the first projected quarter to account for the application of a

⁴⁸ Details on the use of a geometric mean and related exception handling are provided in Appendix A.

quarterly growth rate to a four-quarter geometric mean for the liftoff; the geometric mean requires adjustment prior to use as a quarterly measure because it would otherwise capture impacts from deterministic elements of the time series in the four quarters it averages, such as seasonality. In this way, the projection horizon begins from a level consistent with the seasonal factors and macroeconomic variables applicable in the liftoff. Details of the adjustment are provided in Appendix A.

Applying the recursion repeatedly produces the firm-specific projected AUM level in any quarter of the projection horizon in terms of the anchor and the cumulative product of the projected growth rates. Firm-specific projected AUM for is thus calculated as:

Equation A90 – Projected Asset Management AUM Volume

$$\widehat{AUM}_{b,t0+h} = \widehat{AUM}_{b,(t0+h-1)} \times \left[e^{\log\left(\frac{\widehat{AUM}_{t0+h} - \widehat{Flow}_{t0+h}}{\widehat{AUM}_{t0+h-1}}\right)} + \widehat{FlowRate}_{t0+h} \right]$$

where:

- $\widehat{AUM}_{b,t0+h}$ is the projected dollar value of total AUM for firm b at period $t0 + h$; and
- $\widehat{FlowRate}_{t0+h}$ is the projected flow rate for firm b at period $t0 + h$; and
- $h \in \{1,2, \dots, 13\}$ is the projection horizon.

The result is the firm-specific dollar-value total AUM for every quarter of the projection horizon.

To estimate noninterest income from asset management, the Board would calculate an asset management fee rate to apply to total AUM. The fee rate is the firm-specific level of noninterest income earned per unit of AUM, and is calculated by dividing historical noninterest income on asset management for a given firm by that firm's historical value of total AUM:

Equation A91 – Asset Management Fee Rate

$$AMFeeRate_{bt} = \frac{AM\ Fees_{b,t}}{AUM_{b,t}}$$

where:

- $AMFeeRate_{bt}$ denotes the historical fee rate for firm b at time t ;
- $AM\ Fees_{b,t}$ denotes the historical noninterest income on asset management for firm b at time t ; and
- $AUM_{b,t}$ denotes the historical value of total AUM for firm b at time t .

Noninterest income on asset management is retrieved from FR Y-14Q, Schedule G.1, line item 19A.

The fee rate used in the projection of noninterest income from asset management is the median of the asset management fee rate over the four quarters ending at jump-off, and is given by:

Equation A92 – Median Asset Management Fee Rate

$$\overline{AMFeeRate}_{b,t0} = \text{median}(AMFeeRate_{b,t0-k})$$

where:

- $\overline{AMFeeRate}_{b,t0}$ is the fee rate for firm b at $t0$;
- $t0$ denotes the jump-off quarter; and
- $k \in \{0,1,2,3\}$.

The four-quarter median fee rate is used instead of the average so that the projection is not distorted by a single quarter in which either the income line item or the volume measure was atypical. Using a recent four-quarter window produces a fee rate that is consistent with firms' current pricing and product mixes.

Finally, projected noninterest income is estimated by multiplying projected AUM volume by the median asset management fee rate, as given by:

Equation A93 – Noninterest Income on Asset Management Projection

$$\widehat{AM\ Fees}_{b,t0+h} = \widehat{AUM}_{b,t0+h} \times \overline{AMFeeRate}_{b,t0}$$

where:

- $\widehat{AM\ Fees}_{b,t0+h}$ denotes the projected noninterest income on asset management for firm b at time $t0 + h$;
- $\widehat{AUM}_{b,t0+h}$ denotes the projected level of total AUM for firm b at time $t0 + h$; and
- $\overline{AMFeeRate}_{b,t0}$ is the starting constant firm-specific fee rate.

ii. Assumptions and Limitations

An assumption of the volume-based approach for noninterest income on asset management is that noninterest income on asset management is proportional to the industry level of the volume of AUM reported by stress test firms. The volume-based approach also implicitly assumes the industry level of asset management is representative for all firms under stress. The Board proposes to use an industry-level model in alignment with the stress testing principles of consistency and comparability. In contrast, individual firm-level models would create distinct regressions and coefficients, each responding with differing macroeconomic sensitivity to the same underlying scenario. The proposed industry-level approach ensures that projected noninterest income on asset management differs only due to a firm's scale and business volume.

An assumption underpinning the volume-based approach is that fee rates are relatively stable and do not vary over the projection horizon. This assumption reflects the fact that asset management fees are often set through contractual agreements, creating some persistence in fee rates and limiting adjustments to market conditions. Beyond adding simplicity to the model, keeping the fee rate fixed allows the model to parsimoniously capture the dynamics of noninterest income through volume changes, in accordance with the volume-based assumption

that deal volume is a driver of noninterest income. These model properties align with the stress testing principles of simplicity and stability.

A limitation of the model for noninterest income on asset management is the absence of a bond index variable, such as a corporate bond total return index, which is not available in the current scenario design. The BBB spread captures a rate spread relative to the 10-year Treasury rate but does not fully describe the performance of BBB bonds, which is also impacted by portfolio value, that would be reflected in a total return index. The Board determined that the variables included in the model capture substantively similar macroeconomic information and constitute a reasonable alternative given the lack of a bond index variable.

Finally, a limitation of the models for noninterest income on asset management is the lack of granularity of the models despite the availability of granular AUM volume data in the FR Y-14Q. A defining feature of this business line is that AUM, when measured net of flows, declines markedly in periods of economic stress featuring market downturns. When the Board assessed an approach that estimated AUM at the more granular level, the analysis did not identify stable relationships with scenario variables. The Board thus determined that the aggregate approach better captures stress in the asset management business line.

iii. Alternatives

The Board considered the availability of alternative approaches to calculate noninterest income on asset management in the supervisory stress test. In particular, the Board could estimate noninterest income on asset management using an approach that is similar to others described in this 2027 Proposed PPNR Model Documentation, including the regression and distribution-based haircut approaches.

In a regression approach, the Board could model the industry growth rates of noninterest income on asset management directly as a function of macroeconomic variables, rather than separately modeling AUM volume and applying a fixed fee rate. The model would then project noninterest income growth rates under the severely adverse scenario by applying the estimated coefficients to the scenario paths of the macroeconomic variables. Finally, the projected growth rates would be applied to a starting anchor value of noninterest income on AUM to recover the path of noninterest income over the projection horizon. However, noninterest income on asset management depends on both AUM volume and fee rates, with both components responding simultaneously to macroeconomic variables under the regression model. While AUM volume exhibits a stable relationship with macroeconomic variables, fee rates do not necessarily exhibit such a stable relationship. This asymmetry means that modeling noninterest income directly, without distinguishing between AUM volume and fee rates, can result in unstable projections, which would be inconsistent with the Board's stress testing principle of stability. The proposed volume-based approach addresses this challenge by separately modeling the AUM volume component, which exhibits a stable relationship with broad market-based variables, and calibrating the fixed fee rate based on recent data. Because data demonstrate that noninterest income typically comoves with AUM volume, this approach reflects this comovement while producing stable projections consistent with the Board's stress testing principle of stability.

In a distribution-based haircut approach, the Board could model noninterest income on asset management by setting projected noninterest income on asset management to a firm-specific four-quarter geometric mean of noninterest income multiplied by a haircut. The Board would analyze the distribution of growth rates in noninterest income on asset management across stress-tested firms, then select a growth rate from an appropriate haircut percentile. An

appropriate percentile could be the 7th percentile as described in the distribution-based model for noninterest income on sales and trading. If adopted, this approach would provide a simple way to incorporate historically adverse outcomes, but projected income would not be directly linked to economic conditions specified in the stress test.

The Board could alternatively model noninterest income on asset management fees by using the proposed volume-based approach with different macroeconomic scenario variables. For instance, as in the wealth management model described in section F, the Board is considering an alternative specification for modeling the incoming flow rate using financial variables such as interest rates, stock market indexes, and credit spreads. The Board proposed to use the unemployment rate and disposable income as explanatory variables because of the simple economic rationale that higher household employability and income increases saving capacity and thus incoming flows of funds to asset managers. These variables also showed both high statistical significance and in-sample model fit, producing stable projections. These model properties are in line with the Board's stress testing principles of simplicity and stability. The Board is seeking comments on the possibility of modeling flow rate as a function of financial variables.

The Board also considered modeling the growth rate of AUM net of flows separately by asset class (equity, fixed income, and other). Specifically, the growth rate of AUM net of flows for a specific asset class would be regressed on control variables likely to affect that asset class's valuation. For instance, the Dow Jones Total Stock Market Index would be used as a control for the growth rate of equity AUM since it captures the valuation of equity securities, whereas variables such as interest rates and credit spreads could be used as explanatory variables for the growth rate of fixed income AUM. Indeed, interest rates directly affect the present value of fixed

income securities' future cash flows, with rising rates reducing bond valuations, while credit spreads reflect changes in risk premia that influence the valuation of corporate and other non-Treasury fixed income holdings. Beyond economic rationale, the choice of control variables in the final regression specification would be based on both in-sample and out-of-sample model performance, as well as statistical criteria such as collinearity and the statistical significance of the considered variables. In the current proposed specification, the Board would model the total growth rate of AUM due to the simplicity of this approach and its reliable statistical relationship with broad-based market variables.

Lastly, the Board is considering the possibility of modeling total AUM growth rate instead of separately modeling the flow rate, similar to the model for noninterest income from investment services model in which total assets under custody are projected. Under this alternative specification, because total AUM reflects both the valuation changes of existing positions and incoming flows of new funds, the regression model would include as control variables both the macroeconomic factors that drive asset revaluations (such as the Dow Jones Total Stock Market Index, changes in the 10-year Treasury yield, and the BBB corporate bond spread) and the variables that influence client fund flows (such as the unemployment rate, disposable income, and financial variables). This combined approach would capture the dual drivers of AUM growth in a single model, potentially offering a more parsimonious specification while maintaining the economic intuition underlying both valuation effects and flow dynamics. The choice of control variables in the final regression specification would also be based on both in-sample and out-of-sample model performance, as well as statistical criteria such as collinearity and the statistical significance of the considered variables.

Additionally, within the volume-based approach as detailed in Appendix A, the Board proposes to apply an adjustment to the first projected quarter to compensate for the use of a four-quarter geometric mean for the liftoff. This adjustment supports the principle of robustness as it allows for more precise projections. However, its impact is small. To further the principle of simplicity, the Board is considering an alternative where this adjustment is omitted from the model.

The Board considered the availability of these alternative approaches and determined that the proposed volume-based approach for noninterest income on asset management was reasonably designed to achieve the goals of the stress test. The Board is interested in feedback on these alternative approaches, and whether they should be adopted to project noninterest income on asset management for the 2027 supervisory stress test.

iv. Questions

The Board is requesting public input on this proposed model for noninterest income on asset management including, but not limited to, input on the following questions.

Question 21: The Board seeks input on the proposed approach to model noninterest income on asset management. Should the Board consider an alternative approach to modeling noninterest income on asset management? Should the Board consider using financial variables in its projection of noninterest income on asset management? What are the advantages and disadvantages of the Board's approach and any potential alternatives? Are there alternative specifications, in terms of right-hand side variables (including financial variables), differences, lags, transformations, or the sample period of estimation, that the Board should consider; and

why? Should the Board consider an alternative measure of activity volume, or a different scaling method for the dependent variable, in this model?

Question 22: The Board seeks comment on using the mean four-quarter lookback and the associated weighted average adjustment for log differenced models. Are there alternative approaches or lookback periods that the Board should consider to mitigate volatility and seasonality from the liftoff values for the noninterest income on asset management model? Does the use of a four-quarter lookback period appropriately balance reflecting recent trends while mitigating volatility? What are the advantages and disadvantages of any such alternative?

Question 23: Should the Board adjust the first projection quarter to account for seasonality and the liftoff from a four-quarter geometric mean? Is the adjustment described in Appendix A appropriate? Should flows be adjusted in the first projection quarter to align with adjustments to stock, such as by taking a four-quarter mean to align with the four-quarter stock liftoff, and why? Alternatively, should the Board decline to adjust the first projection quarter? If so, what would be the advantages and disadvantages of doing so?

F. Noninterest Income on Wealth Management

i. Model Description

Financial institutions involved in wealth management generate revenue from managing individual client portfolios through personalized wealth management services, collecting fees as a percentage of total wealth management assets under management (AUM) plus transaction-based fees. Wealth management AUM represents the stock of client assets under the bank's custody, invested across different asset classes based on individual client needs and preferences.

The Board proposes to use a volume-based model to project noninterest income from wealth management. Under the proposed model, noninterest income from wealth management is expressed as the product of two components: (i) total wealth management AUM under stress and (ii) the wealth management fee rate. Total wealth management AUM under stress itself consists of two subcomponents: (1) existing client portfolio AUM and (2) net incoming flows.

The Board would first project growth rates for existing wealth management AUM by asset class (equities, fixed income, and other assets) and the aggregate flow rate of net incoming funds under stress. The Board would then recursively apply these existing portfolio AUM growth rates to the corresponding asset class liftoff AUM, summing across asset classes to derive total projected AUM net of flows under stress. The aggregate flow rates of incoming funds would also be recursively applied to the liftoff level of incoming funds to project the net incoming flows under stress. Finally, total AUM under stress would be calculated as projected AUM net of flows plus projected net incoming flows.

The model structure for noninterest income on wealth management is described in the next six subsections. The first three subsections explain the estimation and projection of the net-of-flows wealth management AUM growth rate per asset class (equities, fixed income, and other). The fourth subsection explains the estimation and projection of the flow rate of incoming (or outcoming) funds. The fifth subsection outlines the methodology to recursively project total wealth management AUM. The last section explains the projection of noninterest income on wealth management from the projected volume of AUM and the fixed wealth management fee rate. Parameter estimates are provided in Appendix B.

a. Noninterest Income from Wealth Management: Equities

The proposed model begins by estimating the growth rate of wealth management assets invested in equities. Equity portfolio valuation reflects the market valuation of client holdings in stocks, and responds to equity market performance, the expected path of future dividends, general market sentiment, and investors' risk appetites.⁴⁹

The Board proposes to estimate the growth rate of wealth management equity assets using a volume-based model. The proposed model estimates growth using the quarterly change in the natural logarithm of the Dow Jones Total Stock Market Index, which directly captures changes in equity market prices and their effects on portfolio valuations. Among available and relevant variables measuring equity prices, general market sentiment, and investors' risk appetites, the change in the natural logarithm of the Dow Jones Total Stock Market Index was selected for the proposed model because it has demonstrated explanatory power and produces reasonable projections for stress testing. Further, this variable generally provides a representative metric for equity prices, as well as for aggregate market sentiment, because broad equity valuations reflected in the Dow Jones Total Stock Market Index naturally encapsulate shifts in investors' expectations and cyclical willingness to bear macroeconomic risk.

⁴⁹ Standard asset pricing models dictate that equity valuations reflect the mathematical expectation of future cash distributions discounted by a stochastic variable representing investor risk aversion. *See* Cochrane (2005), *supra* note 57. Concurrently, these valuations are highly sensitive to shifting market sentiment, as investors periodically distort the expected path of those dividends through diagnostic overreactions to recent market performance. *See also* N. Gennaioli, and A. Shleifer, *A Crisis of Beliefs: Investor Psychology and Financial Fragility*, Princeton, NJ: Princeton University Press (2018), chapter 6.

The specification for the volume-based model for wealth management equity assets is thus given by:

Equation A94 – Volume-Based Wealth Management Equity AUM Model

$$\log\left(\frac{AUM_{eq,t} - Flow_{eq,t}}{AUM_{eq,t-1}}\right) = \alpha + \beta_1 \Delta \log DJI_t + \epsilon_t$$

where:

- $AUM_{eq,t}$ represents AUM for the equity segment;
- $Flow_{eq,t} \equiv (AUM_{eq,t-1}/AUM_{tot,t-1}) \times Flow_t$ represents the component of asset flow attributed to the equity segment;
- α is a constant intercept term;
- $\Delta \log DJI_t$ is the quarterly change in the log Dow Jones Total Stock Market Index, representing changes in equity market conditions; and
- ϵ_t is a stochastic error term.

Total asset flow into wealth management AUM is retrieved from the Wealth Management Net Inflows/Outflows from FR Y-14Q, Schedule G.3, line item 38. This total asset flow is summed across firms and multiplied by the industry share of equity wealth management to total AUM to retrieve the asset flow attributable to equity assets. The numerator of this industry share is the sum of equity AUM across firms, where each firm's equity AUM is retrieved from Equities AUM in Schedule G.3, line item 37A. The denominator of the industry share is the sum of total AUM across firms, where each firm's total AUM is retrieved from Schedule G.3, line item 37. The volume-based wealth management equity model is estimated using quarterly sample data from 2015:Q1 to 2024:Q4. The sample starts in 2015:Q1 due to data availability, as most firms subject to the stress test had begun to report relevant data by that time. The Board will evaluate and consider the addition of new data every year and determine the appropriateness of re-estimation on an extended sample. Firms are excluded from the estimation sample if they did

not report noninterest income in this business line or entered or exited the business line during the sample.⁵⁰

Industry-level growth rate projections of equity portfolios are produced using the estimates of the equities volume-based regression and the supervisory severely adverse scenario path for the Dow Jones Total Stock Market Index.

b. Noninterest Income from Wealth Management: Fixed Income

Next, the proposed volume-based model estimates the growth rate of wealth management assets invested in fixed income products. Fixed income portfolios reflect the market valuation of client holdings in bonds. This market valuation responds to credit market conditions, interest rate dynamics related to the term premium, and general market sentiment and risk appetite.⁵¹

The Board proposes to use a volume-based model to estimate the growth rate of wealth management fixed income assets using three independent macroeconomic variables. The proposed model estimates growth using (i) the quarterly change in the BBB corporate bond spread to reflect credit market conditions through changes in risk premia; (ii) the quarterly change in the term spread (the spread of the 10-year Treasury yield to the 3-month Treasury yield) to capture term premium effects;⁵² and (iii) the lag of the quarterly change in the natural

⁵⁰ Firms that did not report noninterest income in this business line have no data to be used in estimation. Firms that enter or exit the business line during the sample typically have one or more quarters in which the reported value for AUM is small. Since this number enters the denominator of the dependent variable in the volume-based model, a small value can create increased volatility in the dependent variable. Increased volatility due to a small-denominator issue could harm the estimation of the fundamental economic relationship between the dependent variable and the macroeconomic independent variables, and the reliability of the volume-based model. Given this risk, the Board chose to exclude these observations from the sample.

⁵¹ Fixed income portfolio valuations respond to interest rate dynamics through a fundamental stochastic discount factor that prices nominal payoffs across the entire term structure. This valuation framework adapts directly to macroeconomic states, where shifting credit market conditions and aggregate economic shocks alter the discount factors applied to future cash flows. Cochrane (2005), *supra* note 57, chapters 19, 21.

⁵² *See id.*, chapter 19.

logarithm of the Dow Jones Total Stock Market Index to represent changes in equity market conditions that may impact investor sentiment and risk appetite.⁵³

Among available and relevant variables measuring corporate credit market conditions, the change in BBB spread was selected for this volume-based model. This variable provides an effective measure of credit market conditions because it is highly responsive, as its positioning at the lowest tier of investment-grade debt (the BBB tier) allows the variable to capture shifts in credit risk pricing right before transition into high-yield default probabilities. Additionally, the literature recognizes credit spreads as a strong predictor for future corporate bond returns,⁵⁴ which supports the use of this variable to help predict the value of a fixed income portfolio. Second, the change in the 10-year minus 3-month spread was selected for this volume-based model because it provides an accurate measure of the term premium. Because it represents the maturity gap between immediate cash liquidity and a full economic cycle, it mirrors the banking sector's profit model while filtering out intermediate policy noise that could distort other metrics. Additionally, this spread measure is widely used by industry in valuation models, has demonstrated explanatory power in assessments of the proposed volume-based model, and produces reasonable projections. Finally, the change in the natural logarithm of the Dow Jones Total Stock Market Index was selected because this variable provides the most accurate metric for aggregate market sentiment because broad equity valuations naturally encapsulate shifts in investors' diagnostic expectations and cyclical willingness to bear macroeconomic risk.⁵⁵ When

⁵³ See *id.*, chapter 21.

⁵⁴ See Ghaderi et al. (2026), *supra* note 58.

⁵⁵ See Gennaioli and Shleifer (2018), *supra* note 63.

equity prices rise, both investor sentiment and risk appetite are expected to increase. Thus, investors are more likely to switch funds from the fixed income portfolio into riskier assets such as equity holdings.⁵⁶ Further, the change in the natural logarithm of the Dow Jones Total Stock Market Index measure has demonstrated explanatory power in assessments of this volume-based model and it produces reasonable projections.

The specification for the volume-based model for the wealth management fixed income portfolio is thus given by:

Equation A95 – Volume-Based Wealth Management Fixed Income AUM Model

$$\log \left(\frac{AUM_{FI,t} - Flow_{FI,t}}{AUM_{FI,t-1}} \right) \\ = \alpha + \beta_1 \Delta BBB Spread_t + \beta_2 \Delta Term Spread_t + \beta_3 \Delta \log DJI_{t-1} + \epsilon_t$$

where:

- $AUM_{FI,t}$ represents AUM for the fixed income segment;
- $Flow_{FI,t} \equiv (AUM_{FI,t-1}/AUM_{tot,t-1}) \times Flow_t$ represents the component of asset flow attributed to the fixed income segment;
- α is the intercept;
- $\Delta BBB Spread_t$ is the quarterly change in the spread of the BBB corporate bond yield to the 10-year Treasury yield, representing revaluation adjustments due to changes in the risk premium;
- $\Delta Term Spread_t$ is the quarterly change in the spread of the 10-year Treasury yield to the 3-month Treasury yield, representing the term premium;
- $\Delta \log DJI_{t-1}$ is the quarterly change in the log Dow Jones Total Stock Market Index in the previous quarter; and
- ϵ_t is a stochastic error term.

⁵⁶ As documented by Chen (2021), rising equity prices elevate investor sentiment and risk appetite, prompting a structural capital reallocation out of fixed-income assets and into riskier equity holdings. This shift creates a direct inverse relationship where positive stock market shocks trigger downward price pressure and outflows in the bond market. See W. Chen, *Equity investor sentiment and bond market reaction: Test of overinvestment and capital flow hypotheses*, Journal of Financial Markets 55 (2021), 100589.

Total asset flow into wealth management AUM is retrieved from the Wealth Management Net Inflows/Outflows from FR Y-14Q, Schedule G.3, line item 38. Total asset flow is summed across firms and multiplied by the industry share of fixed income wealth management to total AUM to produce the asset flow attributable to fixed income assets. The numerator of the industry share is the sum of fixed income AUM across all firms, where each firm's fixed income AUM is retrieved from Schedule G.3, line item 37B. The denominator of the industry share equals the sum of total AUM across firms, where each firm's total AUM is retrieved from Schedule G.3, line item 37. The volume-based wealth management fixed income model is estimated using quarterly sample data from 2015:Q1 to 2024:Q4. The sample starts in 2015:Q1 due to data availability, as most firms subject to the stress test had begun to report relevant data by that time. The Board will evaluate and consider the addition of new data every year and determine the appropriateness of re-estimation on an extended sample. Firms are excluded from the estimation sample if they did not report noninterest income in this business line or entered or exited the business line during the sample period, as described above.

Industry-level growth rate projections of wealth management fixed income products are produced using the estimates of the volume-based wealth management fixed income model and the supervisory severely adverse scenario paths for the Dow Jones Total Stock Market Index, the BBB spread, and term spread.

c. Noninterest Income from Wealth Management: Other

The proposed model also estimates the growth rate of wealth management assets invested in other assets. Other assets⁵⁷ include funds of funds (funds that invest in other investment funds rather than direct securities), real estate, infrastructure, and illiquid investments and have valuations that respond to equity market conditions, general market sentiment, investors' risk appetites, and broader macroeconomic performance.⁵⁸

The Board proposes to project the growth rate of other wealth management assets with a volume-based model that uses two independent macroeconomic variables: (i) the quarterly change in the natural logarithm of the Dow Jones Total Stock Market Index, which represents changes in equity market conditions that may impact investor sentiment, risk appetites, and the valuation of the other assets portfolio; and (ii) the two-quarter lagged real GDP growth, which represents broader macroeconomic conditions. Among available and relevant variables measuring equity market conditions, general market sentiment, and investors' risk appetites, the change in the natural logarithm of the Dow Jones Total Stock Market Index was selected for the volume-based model of wealth management other assets. As described above, this variable provides a representative metric for equity market conditions as well as for aggregate market sentiment because broad equity valuations naturally encapsulate shifts in investors' diagnostic expectations and cyclical willingness to bear macroeconomic risk. This measure has demonstrated explanatory power in this volume-based model and produces reasonable

⁵⁷ FR Y-14A, Schedule G3, line item 37C defines "Assets – Other" as total fee earning client assets "for which the investment cannot be classified as either Equities or fixed income. For example, include some types of alternative investments, currency products, etc."

⁵⁸ Alternative asset valuations are structurally bound to broader macroeconomic performance and equity market fluctuations because their payoffs are discounted using a universal, consumption-based stochastic framework that reflects aggregate investor risk appetite. Cochrane (2005), *supra* note 57, chapters 1, 21.

projections. Two-quarter lagged real GDP growth was selected because real GDP growth is expected to fundamentally influence the cash flow generation and default risks of underlying real assets, while simultaneously expanding investor wealth and lowering the macroeconomic risk premiums applied to alternative portfolios.⁵⁹ Real GDP growth lagged by two quarters demonstrated the greatest explanatory power in the volume-based model, among potential alternative variables, and produces reasonable projections.⁶⁰

The regression specification for the volume-based model for the growth rate of other wealth management assets is thus given by:

Equation A96 – Volume-Based Wealth Management Other AUM Model

$$\log\left(\frac{AUM_{oth,t} - Flow_{oth,t}}{AUM_{oth,t-1}}\right) = \alpha + \beta_1 \Delta \log DJI_t + \beta_2 \Delta \log GDP_{t-2} + \epsilon_t$$

where:

- $AUM_{oth,t}$ represents AUM for the other segment;
- $Flow_{oth,t} \equiv (AUM_{oth,t-1}/AUM_{tot,t-1}) \times Flow_t$ represents the component of asset flow attributed to the other segment;
- α is the intercept;
- $\Delta \log DJI_t$ is the quarterly change in the log Dow Jones Total Stock Market Index, representing changes in equity market conditions;
- $\Delta \log GDP_{t-2}$ is the quarterly percent change in the real gross domestic product lagged two quarters, representing changes in the overall macroeconomic environment; and

⁵⁹ This understanding is in alignment with Cochrane's (2005) consumption-based asset pricing framework. Cochrane (2005), *supra* note 57.

⁶⁰ The superior statistical fit of the two-quarter lag real GDP growth variable, when compared to the contemporaneous variable, could be related to delays in repricing of some assets by investors.

According to behavioral finance theory, investors could initially delay the repricing of assets after receiving negative economic news because their diagnostic expectations are heavily distorted by representativeness, meaning they dismiss early bad indicators as temporary aberrations and under-react until a critical mass of negative data forces a sudden, radical shift in their beliefs. This behavior would be more likely to be observed in more heterogeneous, less-standardized classes of assets, as is the case for the wealth management other assets portfolio. *See* Gennaioli and Shleifer (2018), *supra* note 63. Another possible explanation for the delay in repricing, given macroeconomic shocks, is that assets invested in this category are less frequently traded, which implies there is less abundant information about their prices. For example, the other category includes funds of funds, which invest in large-scale infrastructure and real estate projects as well as in firms that trade over-the-counter.

- ϵ_t is a stochastic error term.

Total asset flow into to the wealth management AUM is retrieved from the Wealth Management Net Inflows/Outflows from FR Y-14Q, Schedule G.3, line item 38. Total asset flow is summed across firms and multiplied by the industry share of other wealth management to total AUM to produce the asset flow attributable other assets. The numerator of the industry share is the sum of AUM in other assets, where each firm's Other AUM is retrieved from Schedule G.3, line item 37C. The denominator of the industry share equals total AUM summed across firms, where total AUM is retrieved from Schedule G.3, line item 37. The volume-based wealth management other model is estimated on a quarterly sample from 2015:Q1 to 2024:Q4. The sample starts in 2015:Q1 due to data availability, as most firms subject to the stress test had begun to report relevant data by that time. The Board will evaluate and consider the addition of new data every year and determine the appropriateness of re-estimation on an extended sample. Firms are excluded from the estimation sample if they did not report noninterest income in this business line or entered or exited the business line during the sample period, as described above.

Industry-level growth rate projections of other wealth management products are produced using the estimates of the volume-based wealth management other model and the supervisory severely adverse scenario paths for the Dow Jones Total Stock Market Index and real GDP product lagged by two quarters.

d. Net Incoming Flows from Wealth Management

In addition to estimating the growth rate for existing wealth management investments, the proposed model also estimates net incoming flows. Net incoming flows depend on client behavioral decisions, which are influenced by their ability and willingness to allocate additional

capital to wealth management services. Wealth management primarily serves high-net-worth individuals whose wealth is typically concentrated in financial markets.

The wealth management flow model would project the net flow rate of assets under management using one independent macroeconomic variable in its specification, the quarterly change in the Dow Jones Total Stock Market Index, which captures general stock market conditions and the wealth effects of investors. When stock prices rise and portfolios appreciate, high-net-worth clients have greater capacity and willingness to allocate additional funds to wealth management, creating positive flows.⁶¹ The opposite is true when stock prices decrease. The quarterly change in the natural logarithm of the Dow Jones Total Stock Market provides a representative metric for equity prices and equity market conditions, and consequently reflects fluctuations in wealth for high-net-worth investors. Among available and relevant variables measuring wealth effects for high net-worth individuals, the quarterly change in the natural logarithm of the Dow Jones Total Stock Market Index has demonstrated explanatory power and produces reasonable projections. Additionally, the Board proposes to model the wealth management flow rate as net flows divided by lagged wealth management AUM because this ratio exhibits stability over time.

The wealth management flow model differs from the asset management flow model to reflect divergent clientele composition and expected investor behavior. While wealth management involves affluent individuals, aggregate asset management flows primarily

⁶¹ Empirical evidence indicates that household equity inflows are highly procyclical, as rising asset prices trigger a wealth effect that expands capital capacity. Concurrently, this appreciation expands absolute wealth, which dynamically reduces relative risk aversion and drives high-net-worth investors to allocate more capital to risky assets and wealth management services. See J. A. Wachter and M. Yogo, *Why Do Household Portfolio Shares Rise in Wealth?* Wharton School at the University of Pennsylvania Rodney L. White Center for Financial Research Working Paper (2010); X. Gabaix, R. S. J. Koijen, F. Mainardi, S. Oh, and M. Yogo, *Asset Demand of U.S. Households*, Princeton University Working Paper (2023).

comprise mutual funds and institutional accounts like pension funds. Institutional investors utilize these large-scale collective vehicles to achieve diversification and operational efficiency.⁶² Consequently, banks generally structurally separate these business lines to balance individual advisory services with macro-level pool management. Institutional assets such as pension funds and mutual funds rely on programmatic payroll contributions, rendering their flows highly sensitive to employment fluctuations and wage income. In contrast, private wealth management capital is driven by high-net-worth rebalancing, which is less directly tied to immediate labor market conditions. Wealth management flows are therefore more sensitive to equity market performance, consistent with a high-net-worth client base whose income typically derives primarily from financial asset appreciation rather than labor income.⁶³

The specification of the volume-based model for the net flow rate of wealth management is thus given by:

Equation A97 – Noninterest Income on Wealth Management: Flow Model

$$Flow\ Rate_t = \alpha + \beta_1 \Delta \log DJI_t + \epsilon_t$$

where:

- $Flow\ Rate_t$ is net wealth management flows, measured at quarter t , divided by the stock of AUM, measured at quarter $t-1$, calculated at the industry level;
- α is a constant intercept term;
- $\Delta \log DJI_t$ is the quarterly change in the natural logarithm of the Dow Jones Total Stock Market index, representing changes in equity market prices; and
- ϵ_t is a stochastic error term.

⁶² See E. P. Davis and B. Steil, *Institutional Investors*, Cambridge, MA: MIT Press (2004). R. C. Pozen and T. Hamacher, *The Fund Industry: How Your Money is Managed* (2nd ed.), Hoboken, NJ: John Wiley & Sons (2015).

⁶³ See Wachter and Yogo (2010), *supra* note 75; Gabaix et al. (2023), *supra* note 75.

The data used to calculate net wealth management flows, the numerator of the flow rate, is retrieved from FR Y-14Q, Schedule G.3, line item 38. The stock of AUM calculated at the industry level, the denominator of the flow rate, is retrieved from FR Y-14Q, Schedule G.3, line item 37. The flow model is estimated on industry-level net wealth management flow data from 2015:Q1 to 2024:Q4. The sample starts in 2015:Q1 due to data availability, as most firms subject to the stress test had begun to report relevant data by that time. The Board will evaluate and consider the addition of new data every year and determine the appropriateness of re-estimation on an extended sample. Due to limited data granularity reported in the form FR Y-14Q, net flows are estimated at the aggregate level across all asset classes. Firms are excluded from the estimation sample if they did not report noninterest income in this business line or entered or exited the business line during the sample period, as described above.

Industry-level wealth management flow rate projections are produced using the estimates of the wealth management net flow rate model and the supervisory severely adverse scenario path for the Dow Jones Total Market Stock Index.

e. Projecting Total Wealth Management Assets Under Management

The proposed model projects total wealth management AUM using the volume-based projections and the income flows projections previously described.

The Board would calculate total wealth management AUM over the projection horizon, before growth and net flows, by first summing projected AUM per asset class, as given by:

Equation A98 – Total Projected Wealth Management

$$AUM_{b,(t_0+h),total} = \sum_a AUM_{b,(t_0+h),a}$$

where:

- $\widehat{AUM}_{b,(t_0+h),a}$ is the projected dollar value of wealth management AUM in asset class a for firm b at time $t_0 + h$;
- $\widehat{AUM}_{b,(t_0+h),total}$ is the projected dollar value of total wealth management AUM for firm b at time $t_0 + h$;
- $a \in \{Equities, Fixed Income, Other\}$ is the asset class;
- t_0 denotes the jump-off quarter; and
- $h \in \{1, 2, \dots, 13\}$ is the projection horizon.

The projection of a firm's wealth management AUM in a specific asset class begins from an anchor, the geometric mean⁶⁴ of the firm's AUM in that asset class over the four quarters ending at jump-off. Firm-specific, asset-specific AUMs are calculated as:

Equation A99 – Starting Firm-Specific, Asset-Specific AUM

$$\overline{AUM}_{b,t_0,a} = \left(\prod_{i=0}^3 AUM_{b,(t_0-i),a} \right)^{\frac{1}{4}}$$

where:

- $\overline{AUM}_{b,t_0,a}$ denotes the firm-specific starting value of wealth management AUM for firm b allocated in asset class a ; and
- $a \in \{Equities, Fixed Income, Other\}$ is the asset class.

Because the net incoming flow of funds is projected as the total flow across asset classes, the projection of total wealth management across asset classes also requires a separate anchor, the geometric mean⁶⁵ of the firm's total wealth management AUM:

Equation A100 – Firm-Specific Starting Total Wealth Management AUM

$$\overline{AUM}_{b,t_0,total} = \left(\prod_{i=0}^3 AUM_{b,(t_0-i),total} \right)^{\frac{1}{4}}$$

⁶⁴ Details on the use of a geometric mean and related exception handling are provided in Appendix A.

⁶⁵ Details on the use of a geometric mean and related exception handling are provided in Appendix A.

where:

- $AUM_{b,(t_0-i),total}$ denotes the total wealth management AUM, aggregated across all asset classes, for firm b at time $t_0 - i$; and
- $\overline{AUM}_{b,t_0,total}$ denotes the firm-specific starting value of total wealth management AUM for firm b .

The projected industry-level total AUM growth rates calculated above are applied to the firm-specific anchors and compounded forward so that each quarterly estimate grows from the value of the preceding quarter. An adjustment is applied to the first projected quarter to account for the application of a quarterly growth rate to a four-quarter geometric mean for the liftoff; the geometric mean requires adjustment prior to use as a quarterly measure because it would otherwise capture impacts from deterministic elements of the time series in the four quarters it averages, such as seasonality. In this way, the projection horizon begins from a level consistent with the seasonal factors and macroeconomic variables applicable in the liftoff. Details of the adjustment are provided in Appendix A.

The projection of the firm-specific AUM net of flows per asset class depends on each projected flow for such asset class, where the asset class projected flow equals the industry-level total projected flow multiplied by the firm-specific share of total AUM in the associated asset class, with this share fixed at its liftoff value. The recursion to project asset class-specific AUM is:

Equation A101 – Projected Wealth Management AUM by Asset Class

$$\widehat{AUM}_{b,(t_0+h),a} = \widehat{AUM}_{b,(t_0+h-1),a} \times e^{\log\left(\frac{\widehat{AUM}_{(t_0+h),a} - \widehat{Flow}_{(t_0+h),a}}{\widehat{AUM}_{(t_0+h-1),a}}\right)} + \widehat{Flow}_{b,(t_0+h),a}$$

such that:

$$\widehat{Flow}_{b,(t_0+h),a} = \widehat{Flow}_{b,(t_0+h),total} \times \left(\frac{\widehat{AUM}_{b,t_0,a}}{\widehat{AUM}_{b,t_0,total}} \right)$$

and:

$$\widehat{Flow}_{b,(t_0+h),total} = \widehat{FlowRate}_{b(t_0+h)} \times \widehat{AUM}_{b,(t_0+h-1),total}$$

where:

- $\widehat{AUM}_{b,(t_0+h),a}$ is the projected dollar value of wealth management AUM for firm b at period $t_0 + h$ and asset class a ;
- $\widehat{Flow}_{b,(t_0+h),a}$ is the projected net incoming flow of funds for firm b at time $t_0 + h$ and asset class a ;
- $\widehat{Flow}_{b,(t_0+h),total}$ is the total projected net incoming flow of funds for firm b at time $t_0 + h$;
- $\widehat{AUM}_{b,t_0,a}$ is the starting observed wealth management AUM of firm b allocated in asset class a ;
- $\widehat{AUM}_{b,t_0,total}$ is the starting observed total wealth management AUM of firm b ;
- $\widehat{AUM}_{b,(t_0+h-1),total}$ is projected dollar value of total wealth management AUM for firm b at time $(t_0 + h - 1)$ as defined in equation A98;
- $a \in \{Equities, Fixed Income, Other\}$ is the asset class; and
- $h \in \{1, 2, \dots, 13\}$ is the projection horizon.

Equations A101 and A98 define recursive rules to project total wealth management AUM. Starting from the anchor values for both total AUM and asset class-specific AUM, the model projects noninterest income on wealth management AUM forward one quarter at a time through the following recursive process:

1. The firm-specific total net flow of funds for quarter t is calculated by applying the projected flow rate to the previous quarter's total AUM (from quarter $t-1$).
2. The firm-specific total flow is allocated across the three asset classes (equities, fixed-income, and other) in proportion to each asset class's share of total AUM at liftoff. These proportions remain fixed throughout the projection horizon.

3. Each asset class's AUM for quarter t is calculated by: (i) modifying the previous quarter's AUM in that asset class using the projected net-of-flows growth rate, and (ii) adding the allocated flow for that asset class.
4. The projected total wealth management AUM for quarter t is calculated by summing projected AUM across all three asset classes.
5. This newly calculated total AUM for quarter t becomes the base for calculating flows in quarter $t+1$, and the recursion continues through the entire projection horizon.

The result is firm-specific total wealth management AUM for each quarter of the projection horizon.

f. Projecting Noninterest Income from Wealth Management

The Board proposes to estimate noninterest income from wealth management by multiplying firm-specific total projected wealth management AUM by a fixed fee rate. The fee rate is the firm-specific level of noninterest income earned per unit of total wealth management AUM:

Equation A102 – Wealth Management Fee Rate

$$WMFeeRate_{b,t} = \frac{WM\ Fees_{b,t}}{AUM_{b,t,total}}$$

where:

- $WMFeeRate_{b,t}$ denotes the historical fee rate on wealth management for firm b at time t ;
- $WM\ Fees_{b,t}$ denotes the historical noninterest income on wealth management AUM for firm b at time t ; and
- $AUM_{b,t,total}$ denotes the historical value of total wealth management AUM for firm b at time t .

Noninterest income on wealth management is retrieved from FR Y-14Q, Schedule G.1, line item 19B.

The fee rate used in the projections is the median of this rate over the four quarters ending at jump-off, and is given by:

Equation A103 – Median Wealth Management Fee Rate

$$\overline{WMFeeRate}_{b,t0} = \text{median}(WMFeeRate_{b,t0-k})$$

where:

- $\overline{WMFeeRate}_{b,t0}$ is the firm-specific rate used in the projections, fixed as of $t0$;
- $t0$ denotes the jump-off quarter; and
- $k \in \{0,1,2,3\}$.

The four-quarter median fee rate is used instead of the average so that the projection is not distorted by a single quarter in which either the income line item or the volume measure was atypical. Using a recent four-quarter window produces a fee rate that is consistent with firms' current pricing and product mixes.

Finally, projected noninterest income is estimated by multiplying projected wealth management AUM by the median wealth management fee rate, as given by:

Equation A104 – Noninterest Income on Wealth Management AUM Projection

$$\widehat{WMFees}_{b,t0+h} = \widehat{AUM}_{b,(t0+h),total} \times \overline{WMFeeRate}_{b,t0}$$

where:

- $\widehat{WMFees}_{b,t0+h}$ denotes the total projected noninterest income from wealth management for firm b at time $t0 + h$;
- $\widehat{AUM}_{b,(t0+h),total}$ denotes the total projected level of wealth management AUM for firm b at time $t0 + h$; and
- $\overline{WMFeeRate}_{b,t0}$ is the constant starting firm-specific fee rate.

ii. Assumptions and Limitations

An assumption underpinning the volume-based approach for noninterest income from wealth management is that fee ratios are relatively stable and do not vary over the projection horizon. This assumption is consistent with the Board's observation that aggregate fee ratios have exhibited stability over time, likely due to competitive pressures and client retention concerns.

Another assumption of the volume-based wealth management models is that noninterest income on wealth management is proportional to the industry level of the volume of AUM for each subcomponent as reported by firms participating in the supervisory stress test. This assumption implies that fluctuations in noninterest income projections for a particular business line under stress are driven only by variations in the associated business volume. In economic terms, this assumption has two implications. First, this assumption implies that the market for wealth management services is being driven by demand, since volume, not price, determines industry income during the projection period. This is equivalent to assuming that there is high elasticity of supply of services in wealth management. The Board considers this a reasonable assumption for the stress test because of the industry structure of wealth management. In wealth management services, pricing is typically standardized across business lines and previously negotiated with customers. Firms can typically adjust their supply of services with relatively little friction (over a period of time similar to the relevant stress testing horizon), which enables them to be elastic in the supply of services. Second, this assumption implies that firms will retain their market share over the projection horizon. The Board also considers this a reasonable

assumption for stress test, since in a hypothetical economic distress period and in a competitive environment, firms are likely to engage in competition to preserve their market share.

Additionally, the volume-based approach models aggregate business activity under stress and not firm-specific behavior in a particular business line under stress. Under this approach, all firms and business lines receive the same treatment under stress, consistent with the stress testing principles of consistency and comparability.

A limitation of the models for noninterest income on wealth management is that the proportion of flows into each subcomponent is not sensitive to macroeconomic conditions because the FR Y-14Q data only captures the total net inflows and outflows. In the absence of adequate data, the Board proposes to make a simplifying assumption that the proportion of flows into each subcomponent under the stress test scenarios is equal to their respective proportions at liftoff.

Another limitation of the models for noninterest income on fixed income wealth management is the absence of a bond index variable, such as a corporate bond performance index, which is not included in the set of macroeconomic variables provided in the stress test scenarios. A bond index variable may comove with noninterest income on fixed income wealth management in the same way that the equity index variable comoves with noninterest income on equity wealth management. The Board determined that the macroeconomic variables included in the model capture substantively similar information and their use is reasonable given data limitations.

iii. Alternatives

The Board considered the availability of alternative approaches to calculate noninterest income on wealth management in the supervisory stress test. In particular, the Board could estimate noninterest income on wealth management using an approach that is similar to others described in this 2027 Proposed PPNR Model Documentation, including the regression and distribution-based haircut approaches.

In a regression approach, the Board could model noninterest income on wealth management by modeling the growth rate of dollar income at the industry level as a function of macroeconomic variables. This model would then be used to project firm-specific growth rates in dollar income under the severely adverse scenario. Projected nominal dollar income would be calculated by multiplying the projected firm-specific growth rates by the average income at liftoff (either average income in the jump-off quarter or the previous four-quarter average income). Under this approach, the model would assume that the industry growth rate is representative for all firms and that industry income is sensitive to the macroeconomic environment via macroeconomic variables available in the stress test scenario.

In a distribution based-haircut approach, the Board could model noninterest income on wealth management by setting projected noninterest income on wealth management to a firm-specific four-quarter geometric mean of noninterest income multiplied by a haircut. The Board would analyze the distribution of growth rates in noninterest income on wealth management across stress-tested firms, then select a growth rate from an appropriate haircut percentile. An appropriate percentile could be the 7th percentile as described in the distribution-based model for noninterest income on sales and trading or a different conservative percentile. As discussed above (see, e.g., Section III.B.iii.a) for other sources of noninterest income, this approach would

provide a simple way to incorporate historically adverse outcomes, but projected income would not be directly linked to economic conditions specified in the stress test. This approach may be preferable if the relationship of noninterest income on wealth management with the broader macroeconomy is not well captured within a regression approach.

Within the volume-based approach, the Board could alternatively model noninterest income on wealth management in a less granular fashion by using one volume-based model of total wealth management income instead of the three volume-based models for each asset class (equities, fixed income, and other assets). Under this approach, the model would assume that the volume of total AUM in wealth management is sensitive to the macroeconomic environment via the macroeconomic variables available in the stress test scenario. If adopted, this approach would simplify the model but may capture less information about the specific composition of asset classes under management by each firm in its projections, as it would consider only the total volume of wealth management AUM.

The Board could also consider different model specifications for the three volume-based models for each asset class of noninterest income on wealth management (equities, fixed income, and other assets). For example, the Board could consider different macroeconomic scenario variables in any of the volume models for noninterest income on wealth management (equities, fixed income, other assets). Similarly, the Board could consider different lags of the macroeconomic variables currently proposed in any of the volume models for noninterest income on wealth management, such as lags of one, two, and three quarters for any of the macroeconomic variables.

Further, the Board could consider a different approach to model the net incoming flows from wealth management. For example, instead of the proposed flow model, which depends on

the macroeconomic conditions in the scenario, the Board could consider a constant (flatline) net flow projection that is based on (i) the firm-level long-term average flow; (ii) the firm-specific median over a period closer to the jump-off; or (iii) a zero net flow for all firms. A flatline approach to project net incoming flows would assume that the flow is not sensitive to macroeconomic conditions and that the flow is not expected to vary during a period of economic stress. The Board is also seeking comment on modeling the growth rate of total AUM instead of separately modeling the flow rate, similar to the investment services model.

The Board could also consider an alternative approach to the calculation of the wealth management fee rate instead of the proposed firm-specific method. For example, the Board could consider using a long-run firm-specific average fee rate instead of the proposed method that uses the median fee rate over the four quarters ending at jump-off. This alternative would assume that the long-run average fee rate for each firm is a better estimator for the firm-specific fee rate under the stress test scenario compared to the recent median. However, this alternative calculation method could limit the ability of the model to capture changes in the structure of the wealth management industry over time.

As detailed in Appendix A, the Board proposes to apply an adjustment to the first projected quarter to compensate for the use of a four-quarter geometric mean for the liftoff. This adjustment supports the principle of robustness as it allows for more precise projections. However, its impact is small. To further the principle of simplicity, the Board is considering an alternative where this adjustment is omitted from the model.

The Board considered the availability of these alternative approaches and determined that the proposed volume-based approach for noninterest income on wealth management was reasonably designed to achieve the goals of the stress test. The Board is interested in feedback

on these alternative approaches, and whether they should be adopted in any final PPNR model for the 2027 supervisory stress test.

iv. Questions

The Board is requesting public input on these proposed models for noninterest income on wealth management including, but not limited to, input on the following questions:

Question 24: The Board seeks input on the proposed approach to model noninterest income on wealth management. What are the advantages or disadvantages of the proposed approach? Should the Board instead model the growth rate of total assets under management? Are there alternative specifications, in terms of right-hand side variables, differences, lags, transformations, or the sample period of estimation, that the Board should consider, and why? Should the Board consider an alternative measure of activity volume, or a different scaling method for the dependent variable, in this model?

Question 25: The Board seeks comment on using the mean four-quarter lookback and the associated weighted average adjustment for log differenced models. Are there alternative approaches or lookback periods that the Board should consider to mitigate volatility and seasonality from the liftoff values for the noninterest income wealth management model? Does the use of a four-quarter lookback period appropriately balance reflecting recent trends while mitigating volatility? What are the advantages and disadvantages of any such alternative?

Question 26: Should the Board adjust the first projection quarter to account for seasonality and the liftoff from a four-quarter geometric mean? Is the adjustment described in Appendix A appropriate? Should flows be adjusted in the first projection quarter to align with adjustments to stock, such as by taking a four-quarter mean to align with the four-quarter stock

lift off, and why? Alternatively, should the Board decline to adjust the first projection quarter? If so, what would be the advantages and disadvantages of doing so?

G. Noninterest Income on Investment Services

i. Model Description

Financial institutions earn investment services fees by providing asset servicing and issuer services, collecting fees as a percentage of assets under custody (AUC). Noninterest income on investment services fees is expressed as the product of two components: (1) assets under custody (AUC); and (2) the investment services fee ratio. The Board proposes to use a volume-based approach to estimate noninterest income on investment services because this income is earned as fees charged on the volume of AUC. Consequently, the behavior of noninterest income under stress directly reflects the dynamics of AUC, which respond to changes in economic activity. Under this approach, the Board would first project AUC under stress and then multiply projected AUC by a fixed investment services fees-to-AUC ratio. The following paragraphs detail the methodology for projecting AUC and the investment services fee ratio. Parameter estimates are provided in Appendix B.

AUC can include both equity and fixed income securities, whose valuations are influenced by market conditions. To capture the valuation effects on equity securities, the Board selected the Dow Jones Total Stock Market Index, which directly reflects changes in equity market valuations relevant to equity holdings in custody.⁶⁶ To capture the valuation effects on fixed income securities, the Board selected the BBB corporate bond spread, which reflects

⁶⁶ See, e.g., Cochrane's (2005) explanation of how equity market conditions may impact the valuation of securities. Cochrane (2005), *supra* note 57.

changes in credit risk premia and broader credit market conditions affecting the returns of custodied fixed income assets.⁶⁷ The Board's choice of these variables was supported by both economic rationale and the variables' superior statistical significance and in-sample fit compared to alternative specifications considered. These variables parsimoniously capture the key valuation drivers of AUC and are likely to produce stable and economically meaningful projections, consistent with the stress testing principles of stability and simplicity.

The specification for the volume-based model for investment services is thus given by:

Equation A105 – Investment Services Volume-Based Model

$$\Delta \log AUC_t = \alpha + \beta_1 \Delta \log DJI_t + \beta_2 \Delta BBB Spread_{t-1} + \epsilon_t$$

where:

- AUC_t is assets under custody;
- α is a constant intercept;
- $\Delta \log DJI_t$ is the quarterly change in the log Dow Jones Total Stock Market index; representing the change in equity market conditions;
- $\Delta BBB Spread_{t-1}$ is the quarterly change in the spread of the BBB bond index yield to the 10-year Treasury yield lagged by one quarter, representing revaluation adjustments due to changes in the risk premium; and
- ϵ_t is a stochastic error term.

Investment services AUC is retrieved from FR Y-14Q, Schedule G.3, line item 40. The investment services model is estimated with aggregate industry data from 2014:Q1 to 2025:Q4. The sample starts in 2014:Q1 due to data availability, as most firms subject to the stress test had begun to report relevant data by that time. The Board will evaluate and consider the addition of new data every year and determine the appropriateness of re-estimation on an extended sample.

⁶⁷ See Ghaderi et al. (2026), *supra* note 58.

Firms are excluded from the estimation sample if they did not report noninterest income in this business line or entered or exited the business line during the sample period, as described above.

Industry-level growth rate projections are produced using the estimates of the investment services volume-based model and the supervisory severely adverse scenario paths for the Dow Jones Total Stock Market Index and the lagged BBB spread.

The projection of an individual firm's AUC begins from an anchor, the geometric mean of the firm's AUC over the four quarters ending at jump-off. Firm-specific starting AUC is calculated as:⁶⁸

Equation A106 – Investment Services Firm-Specific Starting AUC

$$\overline{AUC}_{b,t0} = \left(\prod_{i=0}^3 AUC_{b,t0-i} \right)^{\frac{1}{4}}$$

where:

- $\overline{AUC}_{b,t0}$ denotes the firm-specific starting dollar value of AUC for firm b .

Projected industry-level growth is applied to the firm-specific anchor and compounded forward so that each projected quarterly estimate grows from the value in the preceding quarter. An adjustment is applied to the first projected quarter to account for the application of a quarterly growth rate to a four-quarter geometric mean for the liftoff; the geometric mean requires adjustment prior to use as a quarterly measure because it would otherwise capture impacts from deterministic elements of the time series in the four quarters it averages, such as seasonality. In this way, the projection horizon begins from a level consistent with the seasonal factors and

⁶⁸ Details on the use of a geometric mean and related exception handling are provided in Appendix A.

macroeconomic variables applicable in the liftoff. Details of the adjustment are provided in Appendix A.

Applying the recursion repeatedly gives the firm-specific projected level of AUC in any quarter of the horizon directly in terms of the anchor and the cumulative sum of projected growth rates. Firm-specific projected AUC volume is thus calculated as:

Equation A107 – Projected AUC Volume

$$\widehat{AUC}_{b,t0+h} = \overline{AUC}_{b,t0} * \exp\left(\sum_{j=1}^h \Delta \log \widehat{AUC}_{t+j}\right)$$

where:

- $\widehat{AUC}_{b,t0+h}$ is the projected dollar value of AUC for firm b at period $t0 + h$; and
- $h \in \{1,2, \dots, 13\}$ is the projection horizon.

The result is a firm-specific projected dollar level of AUC for every quarter of the projection horizon.

The fee rate is the firm-specific level of noninterest income earned per unit of total AUC:

Equation A108 – Investment Services Fee Rate

$$ISFeeRate_{bt} = \frac{ISFees_{b,t}}{AUC_{b,t}}$$

where:

- $ISFeeRate_{bt}$ denotes the historical fee rate on investment services for firm b at time t ;
- $ISFees_{b,t}$ denotes the historical noninterest income earned on investment services for firm b at time t ; and
- $AUC_{b,t}$ denotes the historical value of assets under custody for firm b at time t .

Noninterest income on investment services is retrieved from FR Y-14Q, Schedule G.1, line item 20.

The fee rate used in the projection of noninterest income from investment services is the median of the fee rate over the four quarters ending at jump-off, and is given by:

Equation A109 – Median Investment Services Fee Rate

$$\overline{ISFeeRate}_{b,t0} = \text{median}(ISFeeRate_{b,t0-k})$$

where:

- $\overline{ISFeeRate}_{b,t0}$ is the firm-specific rate used in the projections, fixed as of $t0$;
- $t0$ denotes the jump-off quarter; and
- $k \in \{0,1,2,3\}$.

The four-quarter median fee rate is used instead of the average so that the projection is not distorted by a single quarter in which either the income line item or the volume measure was atypical. Using a recent four-quarter window produces a fee rate that is consistent with firms' current pricing and product mixes.

Finally, projected noninterest income from investment services is estimated by multiplying the projected volume of AUC by the median fee rate, as given by:

Equation A110 – Noninterest Income on Investment Services Projection

$$\widehat{ISFees}_{b,(t0+h)} = \widehat{AUC}_{b,(t0+h)} \times \overline{ISFeeRate}_{b,t0}$$

where:

- $\widehat{ISFees}_{b,(t0+h)}$ denotes the total projected noninterest income from investment services for firm b at time $t0 + h$;
- $\widehat{AUC}_{b,(t0+h)}$ denotes the total projected level of assets under custody for firm b at time $t0 + h$; and
- $\overline{ISFeeRate}_{b,t0}$ is the constant starting firm-specific fee rate.

ii. Assumptions and Limitations

An assumption underpinning the volume-based approach is that fee ratios are relatively stable and do not vary over the projection horizon. Aggregate investment services fee ratios have exhibited stability over time, likely due to competitive pressures and client retention concerns. Adopting the assumption that fee ratios remain flat also aligns with the principles of robustness and stability as outlined in the stress testing policy statement.

Another assumption of the volume-based approach is that firm-specific noninterest income on investment services is proportional to the industry level of the volume of AUC reported by stress testing firms. This assumption implies that fluctuations in noninterest income projections for a particular business line under stress are driven only by variations in associated AUC. The Board proposes to use an industry-level model in alignment with the stress testing principle of consistency and comparability. Individual firm-level models would create distinct regressions and coefficients, each responding with differing macroeconomic sensitivity to the same underlying scenario. The proposed industry-level approach ensures that projected noninterest income on investment services differs only due to a firm's scale and business volume.

One limitation of the proposed model is the lack of FR Y-14Q data on net inflows into AUC for investment services. The addition of data on net inflows into AUC would allow the Board to more accurately reflect the industry-wide growth of AUC under stress. The proposed approach consequently does not include inflow models, unlike the models for noninterest income on asset management and wealth management.

iii. Alternatives

The Board considered the availability of alternative approaches to calculate noninterest income on investment services in the supervisory stress test. In particular, the Board could estimate noninterest income on investment services using an approach that is similar to others described in this 2027 Proposed PPNR Model Documentation, including the regression and distribution-based haircut approaches.

In a regression approach, the Board could model the industry growth rates of noninterest income on investment services directly as a function of macroeconomic variables, rather than separately modeling the growth rate of AUC and applying a fixed fee rate. The model would then project the growth rate of noninterest income from AUC under the severely adverse scenario by applying the estimated coefficients to the scenario paths of the macroeconomic variables. Finally, the projected growth rate would be applied to a starting anchor value of noninterest income on investment services to recover the path of noninterest income over the projection horizon.

In a distribution-based haircut approach, the Board could model noninterest income on investment services by setting projected noninterest income on investment services to a firm-specific four-quarter geometric mean, or the median, of noninterest income multiplied by a haircut. The Board would analyze the distribution of growth rates in noninterest income on investment services across stress-tested firms, then select a growth rate from an appropriate haircut percentile. An appropriate percentile could be the 7th percentile as described in the distribution-based model for noninterest income on sales and trading. If adopted, this approach would provide a simple way to incorporate historically adverse outcomes, but projected income would not be directly linked to economic conditions specified in the stress test.

Additionally, as detailed in Appendix A, the Board proposes to apply an adjustment to the first projected quarter to compensate for the use of a four-quarter geometric mean for the liftoff. This adjustment supports the principle of robustness as it allows for more precise projections. However, its impact is small. To further the principle of simplicity, the Board is considering an alternative where this adjustment is omitted from the model.

The Board considered the availability of these alternative approaches and determined that the proposed volume-based approach for noninterest income on investment services was reasonably designed to achieve the goals of the stress test. The Board is interested in feedback on these alternative approaches, and whether they should be adopted in any final PPNR model for noninterest income from investment services for the 2027 supervisory stress test.

iv. Questions

The Board is requesting public input on this proposed model for noninterest income on investment services including, but not limited to, input on the following questions:

Question 27: The Board seeks input on the proposed approach to model noninterest income on investment services. What are the advantages and disadvantages of the proposed approach? Are there alternative specifications, in terms of right-hand side variables, differences, lags, transformations, or the sample period of estimation, that the Board should consider, and why? Should the Board consider an alternative measure of activity volume, or a different scaling method for the dependent variable, in this model?

Question 28: The Board seeks comment on using the use of the four-quarter lookback period and the associated weighted average adjustment for log differenced models. Are there alternative approaches or lookback periods that the Board should consider to mitigate volatility

and seasonality from the liftoff values for the noninterest income on investment services model? Does the model provide the right tradeoff between reflecting recent trends while mitigating volatility when it uses a lookback period of four quarters? What are the advantages and disadvantages of any such alternative?

Question 29: Should the Board adjust the first projection quarter to account for seasonality and the liftoff from a four-quarter geometric mean? Is the adjustment described in Appendix A appropriate? Alternatively, should the Board decline to adjust the first projection quarter? If so, what would be the advantages and disadvantages of doing so?

H. Noninterest Income on Other Retail Lending

i. Model Description

Noninterest income on other retail lending represents revenue earned from international retail lending and small business lending activities. The Board proposes to use a regression model to project noninterest income from other retail lending. Specifically, the Board proposes to model the growth rate of noninterest income on other retail lending scaled by loan balances using an industry-level regression as a function of macroeconomic variables. The estimated growth rate is applied to firm-specific anchors for noninterest income scaled by loan balances to obtain projected ratios of ORL fee income to loan balances. The projected ratios are then multiplied by firms' loan balances at liftoff to recover dollar values of projected noninterest income over the projection horizon. The following paragraphs detail the methodology for projecting noninterest income on ORL. Parameter estimates are provided in Appendix B.

The proposed model begins by using a regression to estimate the growth rate of the ratio of noninterest income from other retail lending. The industry-level regression for noninterest

income on other retail lending is modeled as the ratio of other retail lending fee income to loan balances. This normalization allows for the consistent comparability of the ratio over time.

The regression model for noninterest income on other retail lending assumes the ratio of other retail lending income to loan balances responds to the change in the natural logarithm of real GDP. Other retail and small business lending revenues respond to economic expansion through shifts in borrower financial health and credit appetite: economic expansion directly improves borrowers' creditworthiness and debt-service capacity, drives small business demand for working capital and growth financing, and strengthens local purchasing power and credit demand in international retail markets. The change in the natural logarithm of real GDP captures these aggregate economic conditions that affect lending activity and fee generation.

The Board would estimate the noninterest income on other retail lending using a regression model. Generally, the demand for other retail lending and related fee income generally varies with overall economic activity. Among available and relevant variables measuring the broader economy for use in the regression, real GDP growth was selected as the sole macroeconomic variable for the regression because it demonstrates explanatory power and produces reasonable projections. The Board also considered nominal GDP growth, DPI growth, and unemployment given their connection to macroeconomic health but chose not to include them in the model specification because they did not exhibit statistical significance. Real GDP exhibits a procyclical relationship with noninterest income on other retail lending and, therefore, the model produces a conservative projection for noninterest income on other retail lending under stress, consistent with the stress testing principles of conservatism and being forward-looking.

The specification for the regression model to project the ratio of noninterest income from other retail lending to loan balances is:

Equation A111 – Noninterest Income on Other Retail Lending Regression

$$\Delta \log ORLBalance_t = \alpha + \beta_1 \Delta \log GDP_t + \epsilon_t$$

where:

- $ORLBalance_t$ is the aggregate ratio of noninterest income from other retail lending at time t to the relevant lagged loan balances, at time $(t-1)$;
- $\Delta \log ORLBalance_t$ is the quarterly change of the natural logarithm of $ORLBalance_t$;
- α is a constant intercept;
- $\Delta \log GDP_t$ is the quarterly change in the natural logarithm of the real gross domestic product, representing changes in the overall macroeconomic environment; and
- ϵ_t is a stochastic error term.

Other retail lending is retrieved from FR Y-14Q, Schedule G.1, as the sum of line items 14S and 14T. The relevant loan balances are sourced from FR Y-14Q, Schedule M.1 and lagged by one quarter.⁶⁹ Balances are lagged to reflect the fact that fee income primarily accrues on the balance of loans at the beginning of the period. The other retail lending regression model is estimated on a quarterly sample from 2016:Q2 to 2024:Q4. The sample starts in 2016:Q2 due to data availability and model fit. The Board will evaluate and consider the addition of new data every year and determine the appropriateness of re-estimation on an extended sample. Firms are excluded from the estimation sample if their noninterest income from other retail lending

⁶⁹ The relevant lagged balances from FR Y-14Q, Schedule M.1 include CALBP368, CALBP376, CALBP837, CALBP876, CALBP880, CALBP881, CALBP883, CALBP901, CALBR663, CALBR664, CALBR665, CALBR666, CALBR667, CALBR668, CALBR669, CALBR670, CALBR675, CALBR676, CALBR677, CALBR678, CALBR679, CALBR680, CALBR681, CALBR682, CALBR683, CALBR684, CALBR685, CALBR686, CALBP330, CALBP334, CALBP338, CALBP342, CALBP331, CALBP335, CALBP339, CALBP343, CALBR657, CALBR661, CALBR658, and CALBR662.

reporting practices changed or if they entered or exited the business line during the sample period, as described above.

Industry-level growth rate projections are produced using the estimates of the other retail lending regression model and the supervisory severely adverse scenario path for the GDP growth rate.

The projection of a firm's individual noninterest income on other retail lending begins from an anchor, the geometric mean⁷⁰ of the firm's ratio of other retail lending to the relevant loan balances over the four quarters ending at jump-off. Firm-specific starting ratios are calculated as:

Equation A112 – Firm-Specific Starting Fees to Balance Ratio for Other Retail Lending

$$\overline{ORLBalance}_{b,t0} = \left(\prod_{i=0}^3 ORLBalance_{b,t0-i} \right)^{\frac{1}{4}}$$

where:

- $\overline{ORLBalance}_{b,t0}$ denotes the firm-specific starting value for the ratio of other retail lending revenue to average loan balances for firm b .

Projected industry-level growth is applied to the firm-specific anchor and compounded forward so that each projected quarterly estimate grows from the value in the preceding quarter. An adjustment is applied to the first projected quarter to account for the application of a quarterly growth rate to a four-quarter geometric mean for the liftoff; the geometric mean requires adjustment prior to use as a quarterly measure because it would otherwise capture impacts from deterministic elements of the time series in the four quarters it averages, such as seasonality. In

⁷⁰ Details on the use of a geometric mean and related exception handling are provided in Appendix A.

this way, the projection horizon begins from a level consistent with the seasonal factors and macroeconomic variables applicable in the liftoff. Details of the adjustment are provided in Appendix A.

Applying the recursion repeatedly and multiplying by loan balances at jump-off produces the firm-specific projected level in any quarter of the horizon directly in terms of the anchor and the cumulative sum of projected growth rates. Firm-specific noninterest income on other retail lending is thus calculated as:

Equation A113 – Projected Noninterest Income on Other Retail Lending Fees

$$ORL\hat{Fees}_{b,t0+h} = Balance_{b,t0} * \overline{ORLBalance}_{b,t0} * \exp\left(\sum_{j=1}^h \Delta ORL\widehat{Balance}_{t0+j}\right)$$

where:

- $ORL\hat{Fees}_{b,t0+h}$ is projected noninterest income on other retail lending revenue for firm b at projection period $t0 + h$;
- $Balance_{b,t0}$ is the level of relevant loan balances at jump-off for firm b ; and
- $h \in \{1,2, \dots, 13\}$ is the projection horizon.

The result is a firm-specific projected level of noninterest income from other retail lending for every quarter of the projection horizon.

ii. Assumptions and Limitations

The proposed model for noninterest income from other retail lending assumes that all firms react equally and symmetrically to changes in the macroeconomic variable included in the regression. The Board proposes to use an industry-level model in alignment with the stress testing principles of consistency and comparability. In contrast, individual firm-level models would create distinct regressions and coefficients, each responding with differing

macroeconomic sensitivity to the same underlying scenario. The proposed industry-level approach ensures that projected noninterest income on other retail lending differs only due to a firm's scale and business volume. Additionally, the proposed model does not capture heterogeneity in the types of lending included in the other retail lending portfolio due to the small sample size of relevant data, which would make it difficult produce statistically significant separate estimates.

One limitation of the proposed model is that it may duplicate the measurement of fair value adjustments on other retail lending as modeled by the Fair Value Option (FVO) models. The Board assessed the potential overlap of mark-to-market losses for other retail lending portfolios and determined any overlap would be immaterial to firm projections. The Board may explore options to expand FR Y-14Q data collection in order to further evaluate or address the impact of mark-to-market adjustments for these reporting items.

iii. Alternatives

The Board considered the availability of alternative approaches to calculate noninterest income on other retail lending in the supervisory stress test. In particular, the Board could estimate noninterest income on other retail lending using an approach that is similar to others described in this 2027 Proposed PPNR Model Documentation, including the volume-based, flatline, and distribution-based haircut approaches.

In a volume-based approach, the Board could model other retail lending noninterest income by modeling the growth of underlying balances in other retail lending as a function of macroeconomic variables. The projected growth rate of the volume of relevant other retail lending balances would then be multiplied by a fee ratio calculated as the ratio of noninterest

income from other retail lending to the volume of balances in other retail lending. In the absence of firm-specific volume data associated with other retail lending in the FR Y-14Q, the growth rate projected in the previous step would be multiplied directly by the four-quarter geometric mean of a firm's noninterest income on other retail lending to project dollar-value noninterest income on other retail lending. If adopted, this approach would require the identification and evaluation of an appropriate data source that accurately reflects the relevant business volume generating the other retail lending revenue stream.

In a flatline approach, the Board could model noninterest income on other retail lending by setting projected noninterest income on other retail lending equal to the firm-specific four-quarter geometric mean, or the median, of noninterest income on other retail lending, as described above. Under this approach, the model would assume that noninterest income on other retail lending would not vary with the broader macroeconomy under a severely adverse scenario. However, in the context of other retail lending, this approach would conflict with the stress testing principle of conservatism and would not be forward-looking, as it fails to capture the observed macroeconomic sensitivity of other retail lending fee income under historical adverse conditions.

In a distribution based-haircut approach, the Board could model noninterest income on other retail lending by setting projected noninterest income on other retail lending to a firm-specific four-quarter arithmetic mean of noninterest income multiplied by a haircut. The Board would analyze the distribution of growth rates in noninterest income on other retail lending across stress-tested firms, then select a growth rate from an appropriate haircut percentile. An appropriate percentile could be the 7th percentile as described in the distribution-based model for noninterest income on sales and trading or a different conservative percentile. As discussed

above (see, e.g., Section III.B.iii.a) for other sources of noninterest income, this approach would provide a simple way to incorporate historically adverse outcomes, but projected income would not be directly linked to economic conditions specified in the stress test, although in contrast to a pure flatline this distribution based-haircut approach would assume a level of decline under stress.

Within the proposed regression approach, as detailed in Appendix A, the Board proposes to apply an adjustment to the first projected quarter to compensate for the use of a four-quarter geometric mean for the liftoff. This adjustment supports the principle of robustness as it allows for more precise projections. However, its impact is small. To further the principle of simplicity, the Board is considering an alternative where this adjustment is omitted from the model.

The Board considered the availability of these alternative approaches and determined that the proposed regression approach for noninterest income on other retail lending was reasonably designed to achieve the goals of the stress test. The Board is interested in feedback on these alternative approaches, and whether they should be adopted in any final PPNR model for noninterest income from other retail lending for the 2027 supervisory stress test.

iv. Questions

The Board is requesting public input on the proposed regression model for noninterest income on other retail lending, including, but not limited to, input on the following questions.

Question 30: The Board seeks input on the proposed approach to model noninterest income on other retail lending. What are the advantages and disadvantages of the proposed approach? Are there alternative specifications, in terms of right-hand side variables,

differences, lags, transformations, or the sample period of estimation, that the Board should consider, and why? What are the advantages or disadvantages of these alternatives?

Question 31: Are there additional variables that the Board should consider when modeling noninterest income on other retail lending? What other data sources could the Board use to incorporate those additional factors, and how could they be incorporated into the model?

Question 32: The Board seeks comment on using the four-quarter lookback period and the associated weighted average adjustment for log differenced models. Are there alternative approaches or lookback periods that the Board should consider to mitigate volatility and seasonality from the liftoff values for the noninterest income on other retail lending model? Does the use of a four-quarter lookback period appropriately balance reflecting recent trends and mitigating volatility? What are the advantages and disadvantages of any such alternative?

Question 33: Should the Board adjust the first projection quarter to account for seasonality and the liftoff from a four-quarter geometric mean? Is the adjustment described in Appendix A appropriate? Alternatively, should the Board decline to adjust the first projection quarter? If so, what would be the advantages and disadvantages of doing so?

Question 34: The Board seeks comment on collecting additional data in FR Y-14Q in order to account for mark-to-market adjustments noninterest income on other retail lending, as well as potential methods for this adjustment. What types, granularity, and frequency of data would facilitate such adjustments?

I. Noninterest Income on Treasury Services

i. Model Description

Treasury services fees represent revenue earned from commercial payment activities, cash management services, and deposit account management provided to corporate and institutional clients. The Board proposes to model noninterest income from treasury services using a regression model. Specifically, under the Board's proposal, the growth rate of treasury revenues is projected under stress using an industry-level regression as a function of macroeconomic variables. The estimated growth rate is applied to firm-specific anchor value of treasury revenue to obtain the path of noninterest income over the projection horizon. The following paragraphs detail the Board's proposed methodology. Parameter estimates are provided in Appendix B.

The Board proposes to estimate noninterest income on treasury services using a regression model. Generally, the demand for treasury services and related fees income varies with overall economic activity. Among available and relevant variables measuring the broader economy, unemployment and inflation rates were selected as the macroeconomic drivers for the regression because they have demonstrated explanatory power and produce reasonable projections. The Board also considered disposable personal income (DPI) growth, as well as real and nominal GDP growth, but chose not to include them in the model specification because they did not exhibit statistical significance.

In addition, the aggregate time series for noninterest income on treasury services featured apparent seasonal variation that may be attributable to systematic patterns in corporate treasury activity, including quarter-end and year-end cash management concentrations, tax payment

cycles, and seasonal fluctuations in business transaction volumes across industries with predictable operational patterns. The Board thus proposes to model this component using the unemployment and inflation rates and quarterly seasonal dummies as controls. Unemployment rate exhibits a procyclical relationship with noninterest income on treasury services while inflation has a positive relationship with noninterest income on treasury services, reflecting the nominal appreciation of fees income under high inflationary environments. The model, which incorporates these variables, consequently produces a reasonable projection for noninterest income on treasury services under stress, in line with the stress test principles of conservatism and being forward-looking.

The proposed model begins by using a regression to estimate the growth rate of aggregate treasury services revenue. Inflation generally increases the nominal value of payments and balances, raising fee income, while higher unemployment generally reduces business activity and payment flows. The Board thus proposes to model this component using inflation and unemployment rates.⁷¹

The Board would begin by estimating the noninterest income on treasury services using a regression model. Generally, the demand for treasury services and related fees income varies with overall economic activity. Among available and relevant variables measuring the broader economy, unemployment and inflation rates were selected as the macroeconomic drivers for the regression because they have explanatory power and produce reasonable projections.⁷² The

⁷¹ For this specific model, the Board observed that the inclusion of a dummy variable for the Covid pandemic period did not improve model explainability. Thus, the model has no indicator variable for the pandemic period.

⁷² These variables and their related historical data are reported in the Board's published supervisory stress test scenarios each year. *See, e.g.*, Board, 2026 Stress Test Scenarios (Feb. 2026), tables 2–4, available at <https://www.federalreserve.gov/publications/files/2026-final-supervisory-stress-test-scenarios-20260204.pdf>.

Board also considered DPI growth, as well as real and nominal GDP growth, but chose not to include them in the model specification because they did not exhibit statistical significance. In addition, the aggregate time series for noninterest income on treasury services featured apparent seasonal variation which may be attributable to systematic patterns in corporate treasury activity, including quarter-end and year-end cash management concentrations, tax payment cycles, and seasonal fluctuations in business transaction volumes across industries with predictable operational patterns. Consequently, the Board proposes to model this component using the unemployment and inflation rates and quarterly seasonal dummies as controls. The unemployment rate exhibits a procyclical relationship with noninterest income on treasury services while inflation has a positive relationship with noninterest income on treasury services, reflecting the nominal appreciation of fee income under high inflationary environments. Therefore, the model produces a conservative projection for noninterest income on treasury services under stress, consistent with the stress testing principles of conservatism and being forward-looking.

The specification for the treasury services model is given by:

Equation A114 – Noninterest Income on Treasury Services Regression

$$\Delta \log Treasury\ Services_t = \alpha + \beta_1 \Delta UR_t + \beta_2 \Delta CPI_t + \gamma_t + \varepsilon_t$$

where:

- $Treasury\ Services_t$ is industry aggregate treasury services revenue;
- α is a constant intercept;
- ΔUR_t is the quarterly change in the U.S. unemployment rate, representing changes in aggregate economic conditions;
- ΔCPI_t is the quarterly change in the Consumer Price Index inflation rate, representing the increasing or decreasing pace of price changes;
- γ_t represents quarter fixed effects for quarters 2, 3, and 4; and
- ε_t is a stochastic error term.

Noninterest income from treasury services is retrieved from FR Y-14Q, Schedule G.1, line item 21. The weighted average adjustment detailed in Appendix A is applied to the first projected growth rate. The treasury services model is estimated using industry aggregate data from 2015:Q1 to 2024:Q4. The sample starts in 2015:Q1 due to data availability, as most firms subject to the stress test had begun to report relevant data by that time. The Board will evaluate and consider the addition of new data every year and determine the appropriateness of re-estimation on an extended sample. Firms are excluded from the estimation sample if they did not consistently report noninterest income from treasury services or entered or exited the business line during the sample period, as described above.

Industry-level growth rate projections are produced using the estimates of the treasury services regression model and the supervisory severely adverse scenario paths for the unemployment rate and the consumer price index.

The projection of a firm's individual noninterest income on treasury services begins from an anchor, the geometric mean⁷³ of the firm's treasury services revenue over the four quarters ending at jump-off. Firm-specific treasury services revenue is calculated as:

Equation A115 – Firm-Specific Liff for Treasury Services Revenue

$$\overline{Treasury\ Services}_{b,t0} = \left(\prod_{i=0}^3 Treasury\ Services_{b,t0-i} \right)^{\frac{1}{4}}$$

where:

- $\overline{Treasury\ Services}_{b,t0}$ denotes the firm-specific liftoff value of treasury services revenues for firm b .

⁷³ Details on the use of a geometric mean and related exception handling are provided in Appendix A.

Projected growth is applied to the firm-specific anchor and compounded forward so that each quarterly estimate grows from the value in the preceding quarter. An adjustment is applied to the first projected quarter to account for the application of a quarterly growth rate to a four-quarter geometric mean for the liftoff; the geometric mean requires adjustment prior to use as a quarterly measure because it would otherwise capture impacts from deterministic elements of the time series in the four quarters it averages, such as seasonality. In this way, the projection horizon begins from a level consistent with the seasonal factors and macroeconomic variables applicable in the liftoff. Details of the adjustment are provided in Appendix A.

Applying the recursion repeatedly gives the firm-specific projected level of noninterest income from treasury services in any quarter of the horizon directly in terms of the anchor and the cumulative sum of projected growth rates. Firm-specific noninterest income from treasury services is thus calculated as:

Equation A116 – Projected Noninterest Income on Treasury Services

$$\widehat{Treasury\ Fees}_{b,t0+h} = \overline{Treasury\ Services}_{b,t0} * \exp\left(\sum_{j=1}^h \Delta \log \widehat{Treasury\ Services}_{(t0+j)}\right)$$

where:

- $\widehat{Treasury\ Fees}_{b,t0+h}$ is projected noninterest income on treasury services for firm b at projection period $t0 + h$;
- $\overline{Treasury\ Services}_{b,t0}$ denotes the firm-specific liftoff value of treasury services revenues for firm b ; and
- $h \in \{1,2, \dots, 13\}$ is the projection horizon.

The result is a firm-specific projected level of noninterest income on treasury services for every quarter of the projection horizon.

ii. Assumptions and Limitations

The treasury services model assumes that firms' treasury services portfolios will respond proportionally and symmetrically to changes in macroeconomic variables. This assumption is appropriate given the lack of FR Y-14Q data on firms' individual treasury services activities and the relatively homogeneous composition of treasury services observed across large banks. The Board determined that a regression model was reasonable to estimate noninterest income from treasury services due to data limitations and the characteristics of the treasury services business line. The collection of additional FR Y-14Q data to facilitate different modeling choices would impose an increased burden on reporting firms with limited expected improvement in model performance.

iii. Alternatives

The Board considered the availability of alternative approaches to calculate noninterest income on treasury services in the supervisory stress test. In particular, the Board could estimate noninterest income on treasury services using an approach that is similar to others described in this 2027 Proposed PPNR Model Documentation, including the volume-based, flatline, and distribution-based haircut approaches.

In a volume-based approach, the Board could model noninterest income on treasury services by projecting the growth of underlying treasury services business volume under stress. The projected underlying volume would then be multiplied by estimated noninterest income earned per unit of underlying business volume. In this approach, the Board would begin by modeling the growth of aggregate treasury services business volume as a function of one or more macroeconomic variables, such as real GDP or unemployment. The projected growth rate of

treasury services balances would then be multiplied by a fee ratio—calculated as noninterest income from treasury services divided by the volume of treasury services business activity. This fee ratio could be calculated at the firm-specific or industry level. In the absence of firm-specific volume data associated with treasury services in the FR Y-14Q, the growth rate projected in the previous step would then be multiplied directly by the four-quarter geometric mean of a firm's noninterest income on treasury services to project dollar-value noninterest income on treasury services. This approach would require data on the aggregate business volume generating noninterest income on treasury services. In addition, the volume-based approach would assume that the underlying volume is representative of all firms in the banking industry. If adopted, the Board would need to identify and consider an appropriate data source that accurately reflects the relevant business volume generating the treasury services revenue stream.

In a flatline approach, the Board could model noninterest income on treasury services by setting projected noninterest income on treasury services to the firm-specific four-quarter geometric mean, or the median, of noninterest income on treasury services, as described above. Under this approach, the model would assume that noninterest income on treasury services would not vary with the broader macroeconomy under a severely adverse scenario.

In a distribution based-haircut approach, the Board could model noninterest income on treasury services by setting projected noninterest income on treasury services to a firm-specific four-quarter arithmetic mean of noninterest income multiplied by a haircut. The Board would analyze the distribution of growth rates in the ratio of treasury services noninterest income to underlying business volume across stress-tested firms, then select a growth rate from an appropriate haircut percentile. An appropriate percentile could be the 7th percentile as described in the distribution-based model for noninterest income on sales and trading or a different

conservative percentile. As discussed above (see, e.g., Section III.B.iii.a) for other sources of noninterest income, under this approach, the model would assume that noninterest income would not vary with the broader macroeconomy under a severely adverse scenario, although in contrast to a pure flatline, this distribution based-haircut approach would assume a level of decline under stress.

Additionally, within the proposed regression approach, the Board proposes to apply an adjustment to the first projected quarter to compensate for the use of a four-quarter geometric mean for the liftoff, as detailed in Appendix A. This adjustment supports the principle of robustness as it allows for more precise projections. However, its impact is small. To further the principle of simplicity, the Board is considering an alternative where this adjustment is omitted from the model.

The Board considered the availability of these alternative approaches and determined that the proposed regression approach for noninterest income on treasury services was reasonably designed to achieve the goals of the stress test. The Board is interested in feedback on these alternative approaches, and whether they should be adopted in any final PPNR model for the 2027 supervisory stress test.

iv. Questions

The Board is requesting public input on the proposed regression model for noninterest income from treasury services, including, but not limited to, input on the following questions.

Question 35: The Board seeks input on the proposed approach to model noninterest income from treasury services. What are the advantages and disadvantages of the proposed approach? Are there alternative specifications, in terms of right-hand side variables,

differences, lags, transformations, or the sample period of estimation, that the Board should consider, and why? What would be the advantages and disadvantages of each alternative?

Question 36: Are there additional variables that the Board should consider incorporating in its modeling of noninterest income from treasury services? If so, what are they? What data source could the Board use to incorporate those additional factors, and how could they be incorporated into the model? What would be the advantages and disadvantages of incorporating those additional factors?

Question 37: The Board seeks comment on using the four-quarter lookback period and the associated weighted average adjustment for log differenced models. Are there alternative approaches or lookback periods that the Board should consider to mitigate volatility and seasonality from the liftoff values for the noninterest income from treasury services model? Does the use of a four-quarter lookback period appropriately balance reflecting recent trends while mitigating volatility? What are the advantages and disadvantages of any such alternative?

Question 38: Should the Board adjust the first projection quarter to account for seasonality and the liftoff from a four-quarter geometric mean? Is the adjustment described in Appendix A appropriate? Alternatively, should the Board decline to adjust the first projection quarter? If so, what would be the advantages and disadvantages of doing so?

J. Noninterest Income on Insurance Services

i. Model Description

Banks generate insurance services fees through brokerage services, underwriting certain products, and providing administrative and consulting services to clients. The Board proposes to use a regression model to estimate noninterest income from insurance services. Specifically,

under this approach, the growth rate of insurance revenues is projected under stress using an industry-level regression as a function of macroeconomic variables. The estimated growth rate is applied to a firm-specific insurance revenue anchor value to obtain the path of noninterest income over the projection horizon. The following paragraphs detail the Board’s proposed methodology. Parameter estimates are provided in Appendix B.

The model begins by estimating noninterest income on insurance services using a regression. Generally, the demand for insurance products and related fee income varies with overall economic activity. Among available and relevant variables measuring the broader economy, nominal GDP growth was selected as the sole macroeconomic variable for the regression because it has explanatory power and produces reasonable projections. The Board also considered real GDP growth and unemployment but chose not to include them in the model specification because they did not exhibit as strong of a statistical fit. In addition, the aggregate time series for noninterest income on insurance services featured apparent seasonal variation, which may be attributable to annual enrollment cycles and year-end planning. The Board thus proposes to model this component using the nominal GDP growth rate and quarterly seasonal dummies as controls. Nominal GDP exhibits a procyclical relationship with noninterest income on insurance services and, therefore, the model produces a conservative projection for noninterest income on insurance services under stress, consistent with the stress testing principles of conservatism and being forward-looking. The specification for the regression model to project noninterest income on insurance services is given by:

Equation A117 – Noninterest Income on Insurance Services Regression

$$\Delta \log InsSrv_t = \alpha + \beta_1 \Delta \log NominalGDP_t + QuarterlyDummies_t + \epsilon_t$$

where:

- $InsSrv_t$ is noninterest income on insurance services aggregated at the industry level, at time t ;
- α is a constant intercept;
- $\Delta \log NominalGDP_t$ is the quarterly change in the natural logarithm of nominal gross domestic product, representing changes in the overall macroeconomic environment;
- $QuarterlyDummies$ represents dummy variables for quarters 2, 3, and 4 which are equal to 1 only if the period t is in quarter 2, 3, or 4, respectively, and zero otherwise; and
- ϵ_t is a stochastic error term.

Noninterest income on insurance services is retrieved from FR Y-14Q, Schedule G.1, line item 22. The model is estimated using data from 2014:Q1 to 2024:Q4. The sample starts in 2014:Q1 due to data availability, as most firms subject to the stress test had begun to report relevant data by that time. The Board will evaluate and consider the addition of new data every year and determine the appropriateness of re-estimation on an extended sample. Firms are excluded from the estimation sample if they have exited the business line during the sample period, as described above.

Industry-level growth rate projections are produced using the estimates of the insurance services regression model and the supervisory severely adverse scenario path for the nominal GDP growth rate.

The projection of a firm's own noninterest income on insurance services begins from an anchor, the geometric mean⁷⁴ of the firm's insurance services revenue over the four quarters ending at jump-off:

Equation A118 – Firm-Specific Liftoff for Insurance Services Revenue

$$\overline{InsSrv}_{b,t0} = \left(\prod_{i=0}^3 InsSrv_{b,t0-i} \right)^{\frac{1}{4}}$$

⁷⁴ Details on the use of a geometric mean and related exception handling are provided in Appendix A.

where:

- $\overline{InsSrv}_{b,t0}$ denotes the firm-specific starting value of insurance services revenues for firm b .

Projected growth is applied to the firm-specific anchor and compounded forward so that each quarterly estimate grows from the value from the preceding quarter. An adjustment is applied to the first projected quarter to account for the application of a quarterly growth rate to a four-quarter geometric mean for the liftoff; the geometric mean requires adjustment prior to use as a quarterly measure because it would otherwise capture impacts from deterministic elements of the time series in the four quarters it averages, such as seasonality. In this way, the projection horizon begins from a level consistent with the seasonal factors and macroeconomic variables applicable in the liftoff. Details of the adjustment are provided in Appendix A.

Applying the recursion repeatedly gives the firm-specific projected level of noninterest income on insurance services in any quarter of the horizon directly in terms of the anchor and the cumulative sum of projected growth rates. Firm-specific noninterest income from insurance services is thus calculated as:

Equation A119 – Projected Noninterest Income on Insurance Services

$$Ins \hat{Fees}_{b,t0+h} = \overline{InsSrv}_{b,t0} * \exp \left(\sum_{j=1}^h \Delta \log \widehat{InsSrv}_{(t0+j)} \right)$$

where:

- $Ins \hat{Fees}_{b,t0+h}$ is projected noninterest income on insurance services for firm b at projection period $t0 + h$;
- $\overline{InsSrv}_{b,t0}$ denotes the starting value of insurance services revenues for firm b ;
- and
- $h \in \{1,2, \dots, 13\}$ is the projection horizon.

The result is a firm-specific projected level of noninterest income on insurance services for every quarter of the projection horizon.

ii. Assumptions and Limitations

The proposed regression model assumes that firms' noninterest income from insurance services will respond proportionally and symmetrically to changes in macroeconomic variables. Given the lack of detailed data in the FR Y-14Q on relevant business volumes, which prevents the development of a volume-based model, and the relatively homogenous composition of services across firms, the Board determined that a regression model was reasonable to estimate noninterest income on insurance services. The collection of additional data to facilitate different modeling choices would impose an increased burden on reporting firms with limited expected improvement in model performance.

iii. Alternatives

The Board considered the availability of alternative approaches to calculate noninterest income on insurance services in the supervisory stress test. In particular, the Board could estimate noninterest income on insurance services using an approach that is similar to others described in this 2027 Proposed PPNR Model Documentation, including the volume-based and distribution-based haircut approaches.

In a volume-based approach, the Board could model noninterest income on insurance services by modeling the growth of the volume of aggregate policies sold by the banking system as a function of macroeconomic variables. This model would then be used to project the growth of the volume of policies sold under the severely adverse scenario. In the absence of a firm-specific volume associated with insurance services in the FR Y-14Q, the growth rate projected in

the previous step would be multiplied directly by the four-quarter geometric mean of a firm's noninterest income on insurance services to project dollar-level income on insurance services. Under this approach, the model would require data on the aggregate dollar value of insurance services sold by the banking industry and assume that this volume of insurance services is representative for all firms in the banking industry. The model would also assume that the level of insurance services is proportional to the aggregate dollar volume of insurance policies sold by the banking sector. If adopted, this approach would require the identification of an appropriate data source. Additionally, aggregate insurance policies sold may not reflect the true income source for firms, as noninterest income on insurance services may be contingent on premium collection or other factors.

In a distribution based-haircut approach, the Board could model noninterest income on insurance services by setting projected noninterest income on insurance services to a firm-specific four-quarter arithmetic mean of noninterest income multiplied by a haircut. The Board would analyze the distribution of growth rates in noninterest income on insurance services across stress-tested firms, then select a growth rate from an appropriate haircut percentile. An appropriate percentile could be the 7th percentile as described in the distribution-based model for noninterest income on sales and trading or a different conservative percentile. As discussed above (see, e.g., Section III.B.iii.a) for other sources of noninterest income, this approach would provide a simple way to incorporate historically adverse outcomes, but projected income would not be directly linked to economic conditions specified in the stress test. In contrast to a pure flatline, this distribution based-haircut approach would assume a level of decline under stress.

Within the regression approach, the Board proposes to apply an adjustment to the first projected quarter to compensate for the use of a four-quarter geometric mean for the liftoff, as

detailed in Appendix A. This adjustment supports the principle of robustness as it allows for more precise projections. However, its impact is small. To further the principle of simplicity, the Board is considering an alternative where this adjustment is omitted from the model.

The Board considered the availability of these alternative approaches and determined that the proposed regression approach for noninterest income on insurance services was reasonably designed to achieve the goals of the stress test. The Board is interested in feedback on these alternative approaches, and whether they should be adopted in the noninterest income for insurance services model for the 2027 supervisory stress test.

iv. Questions

The Board is requesting public input on the proposed regression model for noninterest income on insurance services, including, but not limited to, input on the following questions.

Question 39: The Board seeks input on the proposed approach to model noninterest income from insurance services. What are the advantages and disadvantages of the proposed approach? Are there alternative specifications, in terms of right-hand side variables, differences, lags, transformations, or the sample period of estimation, that the Board should consider, and why?

Question 40: Are there alternative models or adjustments that the Board should consider to project noninterest income from insurance services? What would be the advantages and disadvantages of using those alternatives or adjustments?

Question 41: Are there additional variables available in the macroeconomic scenario that the Board should consider incorporating in its model of noninterest income from insurance services? If so, what are they? What data source could the Board use to incorporate those

additional variables, and how could they be incorporated into the model? What would be the advantages and disadvantages of incorporating those additional variables?

Question 42: The Board seeks comment on using the four-quarter lookback period and the associated weighted average adjustment for log differenced models. Are there alternative approaches or lookback periods that the Board should consider to mitigate volatility and seasonality from the liftoff values for the noninterest income from insurance services model? Does the use of a four-quarter lookback period appropriately balance reflecting recent trends and mitigating volatility? What are the advantages and disadvantages of any such alternative?

Question 43: Should the Board adjust the first projection quarter to account for seasonality and the liftoff from a four-quarter geometric mean? Is the adjustment described in Appendix A appropriate? Alternatively, should the Board decline to adjust the first projection quarter? If so, what would be the advantages and disadvantages of doing so?

K. Noninterest Income on Commercial Lending, Merchant Banking and Private Equity, and Miscellaneous

As described above in section II.D, the Board is proposing a flatline projection methodology to model noninterest income from other credit card fees, MHE other, commercial lending, merchant banking and private equity, and miscellaneous noninterest income. Because the commercial lending, merchant banking equity, and miscellaneous noninterest income component flatline models share certain characteristics, they are considered together in the following sections.

i. Model Description

a. *Noninterest Income on Commercial Lending*

Noninterest income from commercial lending includes fee income—as opposed to interest income—generated as part of extending or servicing commercial loans. Commercial lending fees reported on FR Y-14Q, Schedule G.1 may include loan origination and commitment fees, unused facility fees, prepayment penalties, and amendment and waiver fees. Fees earned on treasury services, deposits, or investment banking services provided to commercial clients are reported elsewhere in FR Y-14Q, Schedule G.1 and are projected in other models discussed above. For commercial lending, it is not possible under current reporting practices to distinguish between loans that were valued under the fair value option (and would therefore be included in the FVO Model) and loans that were not. Therefore, to avoid projecting losses that would already be included in projections through the FVO Model and thus result in duplicative measurement, the Board proposes to estimate noninterest income from commercial lending using a flatline model without a haircut.

The Board proposes to model noninterest income from commercial lending using a flatline projection based on the most recent firm-level four-quarter median. The four-quarter median is used to mitigate the impact of input data volatility across quarters.

The starting value for noninterest income on commercial lending is calculated as:

Equation A120 – Starting Noninterest Income on Commercial Lending

$$\overline{Commercial}_{b,t0} = \text{median}(Commercial_{b,t0-k})$$

where:

- $\overline{Commercial}_{b,t0}$ is the median of the noninterest income on commercial lending for firm b at quarter $t0$; and

- $Commercial_{b,t0-k}$ is the noninterest income on commercial lending for firm b at quarter t .

Firm-specific noninterest income on commercial lending under the flatline model is set equal to the starting value for all projection quarters, as given by:

Equation A121 – Flatline Projection for Noninterest Income on Commercial Lending

$$\hat{Commercial}_{b,t0+h} = \overline{Commercial}_{b,t0}$$

where:

- $\hat{Commercial}_{b,t0+h}$ is the dollar-level projection for noninterest income on commercial lending for firm b at projection horizon $t0 + h$, where $t0$ is the jump-off quarter and $h \in \{1, 2, \dots, 13\}$.

The median is calculated from the ratio of noninterest income on commercial lending from FR Y-14Q, Schedule G.1, line item 15 to commercial and industrial loan balances and commercial real estate loan balances as reported in FR Y-14Q, Schedule G.2, line items 3 and 4.

The Board proposes to use a median flatline approach to mitigate the potentially duplicative measurement of fair value adjustments included in the FVO Model as compared to alternative models with macroeconomic sensitivity. The Board will explore options to collect additional data in the FR Y-14Q to capture fair value adjustments from this reporting item as well as options for a macroeconomically sensitive approach to modeling the non-FVO portion of this component. For example, the Board is proposing to add a line item for commercial lending fair value adjustments as well as an “other” line item that would allow for the reporting of items like fee generation or other revenue streams not associated with fair value adjustments.⁷⁵

⁷⁵ See Board, 2027 Models and Reporting Proposal, available at <https://www.federalreserve.gov/supervisionreg/dfa-stress-tests-2027.htm> (“2027 Models and Reporting Proposal”).

b. Noninterest Income on Merchant Banking and Private Equity

Noninterest income on merchant banking and private equity, as defined in the FR Y-14Q, includes revenue from sponsoring, managing, or investing in long-term investment vehicles, such as private equity funds or hedge funds, or managing long-term investment vehicles. Other noninterest income on merchant banking and private equity consists of noninterest income not included in other subcomponents of merchant banking and private equity, as well as a firm's proportionate share of income from investees that use the equity method of accounting.

The Board proposes to model noninterest income on merchant banking and private equity using a flatline projection. The Board's proposal models noninterest income net of investment mark-to-market revenue from merchant banking and private equity to eliminate the potential duplicative measurement of mark-to-market losses projected by the FVO Model. The remaining merchant banking and private equity subcomponents of interest are management fees and other. The Board reviewed FR Y-14Q data reported for the management fees and other subcomponents of the merchant banking and private equity segment and observed that this data was volatile, heterogeneous across firms, and did not exhibit statistical sensitivity to macroeconomic variables. Additionally, noninterest income from merchant banking and private equity was generally not material across firms and in the aggregate. Consequently, the Board proposes to use a flatline projection as a conservative approach given the characteristics of merchant banking and private equity investments.

Noninterest income from merchant banking and private equity is projected as the most recent firm-level four-quarter median of management fees and other revenues from merchant banking and private equity. The four-quarter median is used to mitigate the impact of input data volatility across quarters, as discussed above.

The starting value for merchant banking and private equity is calculated as:

Equation A122 – Starting Noninterest Income on Merchant Banking and Private Equity

$$\overline{MBPE}_{b,t0} = \text{median}(MBPE_{b,t0-k})$$

where:

- $\overline{MBPE}_{b,t0}$ is the median of the noninterest income on merchant banking and private equity for firm b at quarter $t0$; and
- $MBPE_{b,t0-k}$ is the noninterest income on merchant banking and private equity for firm b at quarter t .

Firm-specific noninterest income on merchant banking and private equity under the flatline model is set equal to the starting value for all projection quarters, as given by:

Equation A123 – Flatline Projection for Noninterest Income on Merchant Banking and Private Equity

$$M\hat{B}PE_{b,t0+h} = \overline{MBPE}_{b,t0}$$

where:

- $M\hat{B}PE_{b,t0+h}$ is the dollar-level projection for the noninterest income on merchant banking and private equity for firm b at projection horizon $t0 + h$, where $t0$ is the jump-off quarter and $h \in \{1, 2, \dots, 13\}$.

The median is calculated from the respective revenues from FR Y-14Q, Schedule G.1, line items 17B and 17C. The flatline model does not include mark-to-market revenue from FR Y-14Q, Schedule G.1, line item 17A to eliminate the potential duplicative measurement of mark-to-market losses projected by the FVO Model. Noninterest income from the remaining components of merchant banking and private equity, using the four-quarter median, were reviewed and found to be generally immaterial. In addition, such noninterest income does not

appear to be sensitive to macroeconomic stress according to available FR Y-14Q data, making a flatline projection appropriate.

c. Miscellaneous Noninterest Income

Miscellaneous noninterest income is defined to include the FR Y-14Q categories of noninterest income from retirement/corporate benefits products, corporate/other products, and optional immaterial business segments (“noninterest income on Miscellaneous”).⁷⁶ Noninterest income from retirement/corporate benefits includes premiums, fees, and other noninterest income from annuities, guaranteed interest products, and separate account contracts. Noninterest income on corporate/other includes noninterest income associated with capital and asset-liability management activities, run-off or liquidating businesses, non-financial businesses, corporate support functions, and other non-core revenues not included in other segments. Noninterest income from optional immaterial business segments is a bucket defined by the Board for the purposes of the stress test for segments too small to warrant standalone reporting and that do not exceed ten percent of total revenue. Additionally, transfer pricing revenues for foreign banking organizations are included in noninterest income on miscellaneous.

The Board proposes to model noninterest income on miscellaneous using a flatline projection based on the firm-level four-quarter median. The Board reviewed the FR Y-14Q data and found that firm-reported data for noninterest income on miscellaneous was volatile, heterogeneous across firms, and did not exhibit statistical sensitivity to macroeconomic variables. The Board proposes to use a flatline to avoid imposing stress on a category of business that does

⁷⁶ Board, Instructions for the Capital Assessments and Stress Testing information collection (Reporting Form FR Y-14Q) (Mar. 31, 2026), <https://www.federalreserve.gov/apps/reportingforms/Download/DownloadAttachment?guid=2fb30d8e-77ac-47bf-8cd3-151c188a8e7c>, Line item 12 Optional Immaterial Business Segments.

not clearly decline under stress. The four-quarter median is used to mitigate the impact of input data volatility across quarters.

The starting value for noninterest income on miscellaneous is calculated as:

Equation A124 – Starting Noninterest Income on Miscellaneous

$$\overline{Misc}_{b,t0} = \text{median}(Misc_{b,t0-k})$$

where:

- $t0$ is the jump-off quarter and $k \in \{0,1,2,3\}$;
- $\overline{Misc}_{b,t0}$ is the median of the noninterest income on miscellaneous for firm b at quarter $t0$; and
- $Misc_{b,t0-k}$ is noninterest income on miscellaneous for firm b at quarter t .

Firm-specific noninterest income on miscellaneous under the flatline model is set equal to the starting value for all projection quarters, as given by:

Equation A125 – Flatline Projection for Noninterest Income on Miscellaneous

$$\hat{Misc}_{b,t0+h} = \overline{Misc}_{b,t0}$$

where:

- $\hat{Misc}_{b,t0+h}$ is the dollar-level projection for the noninterest income on miscellaneous for firm b at projection horizon $t0 + h$, where $t0$ is the jump-off quarter and $h \in \{1,2, \dots, 13\}$.

The Board proposes to calculate the four-quarter median from the firm-specific noninterest income from retirement/corporate benefits products, corporate/other, and optional immaterial business segments from FR Y-14Q, Schedule G.1, line items 23, 24, and 25.

A haircut was not considered for this component because no apparent uniform responses to stress could be inferred from the data. Additionally, transfer pricing revenues for foreign banking organizations tend to be robust under stress because a portion of these revenues fund

business lines on a pre-planned, ongoing basis. The use of the flatline mitigates the impact of transfer pricing revenues for foreign banking organizations compared to an alternative model with macroeconomic sensitivity.

ii. Assumptions and Limitations

The Board proposes to use flatline models to address the specific characteristics of the commercial lending, merchant banking and private equity, and miscellaneous noninterest income streams.

A central assumption of the flatline model is that the noninterest income component being modeled is not sensitive to the macroeconomic scenario. This assumption is motivated by several considerations. In some cases, the noninterest income component does not exhibit statistical macroeconomic sensitivity in the historical FR Y-14Q data at the level of granularity currently available. In addition, the use of a flatline approach can help address the risk of duplicative measurement of losses across models. Furthermore, the flatline approach can also address the specific characteristics (and the expected path of income under stress) of certain lines of noninterest income, such as transfer pricing revenue, and avoids projecting declines in revenue for segments that are historically noncyclical.

The Board recognizes that flatline projections will not vary with the macroeconomic scenario. However, the Board understands that, for these particular noninterest income components, a projection method that is insensitive to the macroeconomic scenario is a reasonable and appropriate option for the purposes of the stress test, given the specific characteristics of the revenue streams, the available data, and the risk of duplicative measurement of losses across models.

iii. Alternatives

a. *Alternatives for Noninterest Income on Commercial Lending*

The Board considered alternative approaches aligned with other general models described in this proposal such as volume-based, regression, or a distribution-based haircut. In a volume-based approach, the Board could model noninterest income on commercial lending by modeling the growth of the commercial loan volumes as a function of macroeconomic variables. This model would then be used to project the growth of the volume of commercial loan balances under the severely adverse scenario. In a regression model, the Board could model noninterest income on commercial lending by estimating the growth rate of dollar income at the industry level as a function of macroeconomic variables. This model would be used to project industry growth rates in dollar income under the severely adverse scenario. In a distribution based-haircut approach, the Board could model noninterest income on commercial lending by setting projected noninterest income on commercial lending to a firm-specific four-quarter arithmetic mean of noninterest income multiplied by a haircut. The Board would analyze the distribution of growth rates in the ratio of treasury services noninterest income to underlying business volume across stress-tested firms, then select a growth rate from an appropriate haircut percentile.

Given the possibility of duplicative measurement between this model and the FVO Model, these alternative approaches would require the identification of more granular data sources or methodologies that would allow for the separation of revenue streams on FVO and non-FVO loans within the commercial lending category. This approach could include changes in current reporting, special collections, or empirical assumptions related to the proportion of FVO loans in the population of commercial loans.

b. Alternatives for Noninterest Income on Merchant Banking and Private Equity

The Board considered alternative approaches aligned with other general models described in this proposal, including the volume-based, regression, and distribution-based haircut approaches. In a volume-based approach, the Board could model noninterest income on merchant banking and private equity by modeling the growth of the underlying business volume as a function of macroeconomic variables. This model would then be used to project the growth of the volume of merchant banking and private equity balances under the severely adverse scenario. In a regression approach, the Board could model the growth rate of dollar income on merchant banking and private equity net of mark-to-market at the industry level as a function of macroeconomic variables. This model would be used to project industry growth rates in dollar income under the severely adverse scenario. In a distribution based-haircut approach, the Board could model noninterest income on merchant banking and private equity net of mark-to-market by setting projected noninterest income equal to a firm-specific four-quarter arithmetic mean of noninterest income multiplied by a haircut. The Board would analyze the distribution of growth rates in noninterest income on merchant banking and private equity net of mark-to-market across stress-tested firms, then select a growth rate from an appropriate haircut percentile.

These alternative approaches would require identifying more granular data sources or methodologies that accurately capture the underlying balances generating noninterest income from merchant banking and private equity net of mark-to-market revenue streams. A volume-based approach would require the Board to first identify and evaluate alternatives to the volume of private equity investments, the best proxy for the business line under the current FR-Y14Q, that better reflect the actual revenue-generating activities. Similarly, a regression model would require establishing material and statistically significant relationships between merchant banking

and private equity net of mark-to-market revenues and relevant macroeconomic variables. These approaches could require changes to current reporting, special collections, or the use of another source with enhanced data granularity to properly attribute revenues to their underlying drivers before implementation.

c. Alternatives for Miscellaneous Noninterest Income

The Board considered alternative approaches aligned with other general models described in this proposal such as volume-based, regression, or a distribution-based haircut. In a volume-based approach, the Board could model noninterest income on miscellaneous either at the aggregate component level or at the subcomponent level, by modeling the growth of the volume of relevant underlying business activities as a function of macroeconomic variables. This model would then be used to project the growth of the relevant volume under the severely adverse scenario. In a regression approach, the Board could model noninterest income on miscellaneous either at the aggregate component level or at the subcomponent level at the industry level as a function of macroeconomic variables. The regression could feature macroeconomic scenario variables, including, but not limited to, measures of broad macroeconomic conditions such as nominal and real GDP. In a distribution based-haircut approach, the Board could model noninterest income on miscellaneous by setting projected noninterest income on miscellaneous to a firm-specific four-quarter arithmetic mean of noninterest income multiplied by a haircut, as discussed above. The Board would analyze the distribution of growth rates in noninterest income on miscellaneous across stress-tested firms, then select a growth rate from an appropriate haircut percentile. An appropriate percentile could be the 7th percentile as described in the

distribution-based model for noninterest income on sales and trading or a different conservative percentile.

If adopted, these alternative approaches would require identifying more granular data sources or methodologies that accurately capture the underlying activities generating miscellaneous revenues. A volume-based approach would need to identify and evaluate the underlying balance variables that best reflect the revenue-generating activities. Similarly, a regression model would attribute macroeconomic sensitivity to the noninterest income on miscellaneous component. Both approaches could involve changes to current reporting, special collections, or another source with enhanced data granularity to establish credible relationships between miscellaneous revenues and macroeconomic drivers before implementation.

iv. Questions

The Board is requesting public input on the flatline projection models for noninterest income components, including, but not limited to, input on the following questions.

Question 44: Should the Board consider adjustments or alternatives to the use of the recent four-quarter median for the flatlined noninterest income components? If so, what are they? What would be the advantages and disadvantages of the adjustments or alternatives?

Question 45: Should the Board consider using medians or other nonparametric approaches based on ratios to project noninterest income from merchant banking and private equity and other remaining noninterest income on miscellaneous? If so, what fields and data sources should the Board consider in the denominator of the ratios?

Question 46: Are there additional factors that the Board should consider in modeling all other interest income? If so, what are they? What data sources could the Board use to

incorporate those additional factors, and how could they be incorporated into the model? What would be the advantages and disadvantages of addressing those additional factors?

Question 47: Should the Board consider alternative approaches to account for transfer pricing revenue sharing agreements? If so, what are they? What would be the advantages and disadvantages of any such alternatives?

Question 48: Should the Board consider separating the line items in the noninterest income on miscellaneous category defined above, and model them separately? Should the Board consider alternatives to a flatline model for these individuals line items, such as a volume-based model, a regression model, or a distribution-based haircut model?

L. Noninterest Income on Sales and Trading

i. Model Description

Sales and trading income includes net trading gains and losses, dealer revenues, and associated fees across all trading asset classes. The Board proposes to use a distribution-based haircut approach to project noninterest income on sales and trading (“trading revenue”). This approach projects the ratio of trading revenue to trading assets using a tail percentile of the unconditional historical distribution of changes in that ratio across firms. To ensure the consistency and comparability of results, the approach assumes that the projected relative change in the ratio is uniform across firms. The Board proposes to account for firm-specific variation by applying the uniform projected relative change to a firm-specific starting value of the ratio. The firm-specific ratio is stressed in the first projection quarter and then held constant at that stressed level over the projection horizon.

The distribution-based haircut approach assumes that a historically observed severe decline in the ratio of trading revenue to trading assets is realized during the stress horizon. To incorporate stressful trading outcomes in the supervisory framework, the projected severe decline in trading revenue captures market dislocations and trading liquidity constraints that could occur during severe macroeconomic stress.

The proposed approach addresses challenges in modeling trading revenue related to the dynamic characteristics of the trading business line. Unlike banking-book revenues, trading revenue is influenced not only by broad market conditions such as changes in market volatility, market returns, and credit spreads, but also by time-varying, firm-specific factors such as portfolio composition, client order flow, and business strategy.⁷⁷ While data supports the observation that trading revenue can severely decline under stress,⁷⁸ the factors driving such declines could vary over time and across firms. Therefore, the Board considered alternative approaches but assessed that it is difficult to: (i) reliably represent the trading revenue dynamics with macroeconomic explanatory variables using a regression approach; or (ii) find stable and representative measures of trading volume and fees using a volume-based approach at the level of granularity supported by the available FR Y-14 data.

The proposed distribution-based haircut approach avoids making complex parametric assumptions required in other approaches for modeling trading revenue. The proposed approach does not rely on firms' projections, which are a source of opacity in the discount-factor approach

⁷⁷ See A. Falato, D. Iercosan, and F. Zikes, *Banks as Regulated Traders*, *Journal of Financial Economics* 170(3) (2025), 104080; U. Albertazzi and L. Gambacorta, *Bank Profitability and the Business Cycle*, *Journal of Financial Stability* 5(4) (2009), 393–409.

⁷⁸ See K. J. Stiroh, *Diversification in Banking: Is Noninterest Income the Answer?* *Journal of Money, Credit, and Banking* 36(5) (2004), 853–82; Falato et al. (2025), *supra* note 101.

described in the Final 2026 PPNR model, or on unstable and non-robust macroeconomic relationships seen in the alternative models discussed later in this document. The distribution-based approach instead relies on historically observed stressed realizations of trading revenues that could be similarly realized during future severe stress circumstances.

Under the proposed distribution-based approach, total noninterest income on sales and trading, sourced from FR Y-14Q, Schedule G.1, line item 18, is modeled as a single component. The ratio of trading revenue to trading assets is constructed using trading assets reported in FR Y-14Q, Schedule G.2, line item 30. The approach uses quarterly data from 2016:Q1 through 2024:Q4. The Board will evaluate and consider the addition of new data every year and determine the appropriateness of re-estimation on an extended sample.

This sample of data excludes periods during which banks were substantially engaged in proprietary trading activities. Consequently, the observed variation in the trading revenue-to-asset ratio is predominantly driven by transaction volume, trading spread, and fee dynamics rather than mark-to-market gains and losses on longer positions. Analysis of data on trading revenues reported in form FR VV-1 (Volcker Data) supports the assumption that most trading revenues are associated with market-making activities as opposed to mark-to-market gains and losses on longer term positions.

As described in greater detail below, the Board proposes to model noninterest income on sales and trading by first constructing a time series of firm-level quarterly log changes in the trading revenue-to-assets ratio. Then, the Board proposes to remove seasonal variation and firm-specific means from the time series of changes in the ratio and pool all observations in one distribution. Third, the Board proposes to select the growth rate from the 7th value-weighted percentile of this distribution of changes in the ratio and apply it to each firm's starting ratio.

Finally, the Board proposes to assume that the stressed firm-specific ratio remains constant during the projection horizon. Finally, projected dollar trading revenue for each firm is obtained by multiplying the corresponding projected stressed ratio by the firm's starting level of trading assets.

The Board proposes to project the ratio of trading revenue to trading assets rather than dollar values because, unlike dollar values, ratios are comparable across time periods and institutions despite differences in business size. Thus, the use of a ratio partially controls for balance sheet size changes over the historical period.

First, as discussed above, under the proposed approach, the Board would construct a time series of firm-specific quarterly growth rates by computing the log difference between each quarter's trading revenue-to-assets ratio and the ratio based on trailing four-quarter averages, for each firm i at quarter t . The growth rate $g_{b,t}$ is defined as:

Equation A126 – Growth Rate Definition

$$g_{b,t} \equiv \log(Ratio_{b,t}) - \log(\overline{Ratio}_{b,t-1})$$

where:

$$Ratio_{b,t} = \frac{Trading\ Revenue_{b,t}}{Trading\ Assets_{b,t}}$$

$$\overline{Ratio}_{b,t-1} = \frac{(\sum_{j=t-4}^{t-1} Trading\ Revenue_{b,j})/4}{(\sum_{j=t-4}^{t-1} Trading\ Assets_{b,j})/4}$$

- $Trading\ Revenue_{b,t}$ is the total noninterest income on sales and trading for firm b at quarter t ; and
- $Trading\ Assets_{b,t}$ is total trading assets for firm b at quarter t .

Total noninterest income on sales and trading is retrieved from FR Y-14Q, Schedule G.1, line item 18 and trading assets are retrieved from FR Y-14Q, Schedule G.2, line item 30. Scaling revenue by trading assets makes the revenue measure comparable across time and firms. The use of a growth rate of the ratio of four-quarter average trading revenues to four-quarter average trading assets mitigates large quarter-to-quarter changes due to quarterly volatility.

Second, the Board proposes to remove seasonality and firm-specific means from the time-series of firm-specific growth rates. To do so, the Board proposes to use a panel regression analysis and regress quarter-firm growth rates on quarterly dummy variables and firm-specific fixed effects. The regression is specified as:

Equation A127 – Seasonality and Firm-specific Means Extraction Regression.

$$g_{b,t} = \alpha_b + QuarterlyDummies_t + \epsilon_{b,t}$$

where:

- α_b is the firm-fixed effect for firm b , which represents the firm-specific average growth rate;
- $QuarterlyDummies_t$ are dummy variables for quarters 2, 3, and 4 which are equal to 1 only if the period t is in quarter 2, 3, or 4, respectively; and
- $\epsilon_{b,t}$ is a residual for firm b in quarter t .

The quarterly firm-level residuals from this regression are growth rates without seasonality or firm-specific means. Because trading revenues exhibit significant seasonality, removing seasonality makes growth rate observations applicable to any jump-off quarter and makes projections independent of the quarter when stress starts within a given year. Removing firm-specific means makes growth rate observations comparable across firms and suitable for pooling observations in one distribution.

Third, the Board proposes to calibrate the haircut to the 7th trading assets-weighted percentile of the historical distribution of quarterly growth rates. Percentiles of the pooled distributions are adjusted using weights proportional to each observation's trading assets. As a result of trading assets-weighting, observations from firms with larger trading assets receive greater representation in each percentile of the distribution.⁷⁹ Trading assets-weighting thus reduces the impact of potential outlier growth observations with extreme values caused by the relatively small value of the denominator in the trading-revenue-to-trading-assets ratio for firms with smaller trading assets.

The Board selected the 7th percentile of the distribution to calibrate the severity of trading revenue decline. This calibration choice is consistent with the severity calibration in distribution-based models used elsewhere in the supervisory stress test (e.g., in the operational risk historical simulation model and the trading issuer default loss model). As described in the modeling methodology for operational risk losses, the 7th percentile is the probability estimate of a hypothetical severely adverse shock unconditionally starting in any given year, producing a conservative projection consistent with the stress testing principle of conservatism.

The haircut factor is calculated as follows:

Equation A128 – Haircut Factor Calculation

$$\text{HaircutFactor} = \exp(7th\ prt l)$$

where:

- *7th prt l* is the 7th percentile of the historical distribution of pooled firm-quarterly trading assets-weighted growth rates; and
- *exp* represents the exponential function.

⁷⁹ In the trading assets-weighted percentile calculation, observations for firms with more trading assets receive higher weights in the empirical distribution. This implies that the selected growth rate from a given percentile more greatly reflects observations from firms holding larger trading assets.

Applying this calculation to data reported in FR Y-14Q over the sample period from 2016:Q1 through 2024:Q4 results in a 0.72 haircut factor (i.e., a 28 percent haircut), which is uniformly applied to the firms in the sample.

The Board considered an alternative approach using an industry-aggregated growth rates distribution instead of the proposed value-weighted pooled distribution, which is based on firm-quarter growth rates. Due to a relatively short time series of available FR-Y14 data, the Board's analysis showed that this proposed firm-quarter approach produces more stable estimates of the tail percentiles because the firm-quarter time series includes a greater number of observations. The use of the firm-quarter approach is thus consistent with the stress testing principles of robustness and stability.⁸⁰ Additionally, the proposed firm-level approach captures firm-level variability that would otherwise be averaged out in the industry-aggregated distribution.

Fourth, the Board would apply the uniform haircut factor calculated above to the firm-level starting ratio to project trading revenue over the projection horizon, calculated as:

Equation A129 – Projected Ratio of Trading Revenue to Trading Assets

$$Ratio_{b,t0+h} = \overline{Ratio_{b,t0}} * HaircutFactor$$

where:

$$\overline{Ratio_{b,t0}} = \frac{(\sum_{j=t0-3}^{t0} Trading\ Revenue_{b,j})/4}{(\sum_{j=t0-3}^{t0} Trading\ Assets_{b,j})/4}$$

- $h \in \{1,2,\dots,13\}$ represents projection period quarters;

⁸⁰ Under this industry-aggregate approach, trading revenue and trading assets were first aggregated across institutions to obtain the industry-level totals for each quarter. The industry-level trading revenue-to-assets ratio was then calculated for each quarter, and the distribution of its quarterly growth rates was used to estimate the haircut. Under this approach, however, the number of observations was insufficient to support a robust and stable estimate of the 7th percentile.

- b represents the firm, t_0 is the last historical quarter preceding the projection period; and
- $\overline{Ratio}_{b,t_0}$ denotes the average trading revenue-to-assets ratio for firm b over the four quarters preceding the first projection quarter.

The projected ratio $Ratio_{b,t_0+h}$ is held constant over the projection period, as discussed further in the Assumptions and Limitations section below.

The dollar revenue for each quarter for each firm in the projection period is then calculated as:

Equation A130 – Projected Trading Revenue

$$Trading\ Revenue_{b,t_0+h} = (Ratio_{b,t_0+h} * \overline{Trading\ Assets}_{b,t_0})$$

where:

- $h \in \{1,2,\dots,13\}$ and $\overline{Trading\ Assets}_{b,t_0}$ for each firm b is calculated using the following formula:

$$\overline{Trading\ Assets}_{b,t_0} = \frac{1}{4} \sum_{j=t_0-3}^{t_0} Trading\ Assets_{b,j}$$

ii. Assumptions and Limitations

The distribution-based haircut model relies on five key assumptions. First, this approach assumes that the range of historical growth rates of the trading revenue-to-assets ratio is representative of future potential outcomes during hypothetical scenarios. This assumption limits the model's sensitivity to variables included in the stress test's baseline and severely adverse scenario. Moreover, new regulations, market structure evolution, and unprecedented events may not be reflected in historical distributions. In adopting this assumption, the Board prioritizes stability in results over less stable alternatives that would link projections to macroeconomic factors, consistent with the stress testing principles of robustness and stability.

Second, the distribution-based haircut approach assumes that the 7th percentile of historical growth rates is appropriate for estimating stressed changes in the trading revenues-to-assets ratio from the starting level during a severe stress scenario. This assumption limits the model's ability to project more severe potential outcomes. Additionally, the sample lacks a stress period that would be similar to a severely adverse scenario used in the stress test. While the COVID period is included in the sample, it is not representative of severe stress due to the unique origins of that episode as well as the extraordinary level of government support provided to markets, among other factors. These assumptions—the 7th percentile calibration and the lack of a representative sample—mean that the model may not capture the full range of potential outcomes under stress. Nevertheless, the Board believes that, on balance, the chosen calibration is appropriate to capture economic stress and well-aligned with similar approaches in other stress testing models.

Third, the Board assumes a constant trading revenues-to-assets ratio during the projection horizon and does not capture time-variation in projected trading revenues, such as potential recoveries after an initial decline. To assess whether this assumption is plausible and not overly conservative, the Board conducted benchmarking analyses of historical firm-level FR Y-14Q data. For example, the Board identified all firm-specific quarterly observations with ratio growth rates under the 7th percentile. For each of these identified firm-quarter observations, the Board calculated the average level of the ratio over the nine quarters. The results showed that a substantial share of identified stressful firm-quarter periods have average ratios lower than the model-projected constant ratio. This analysis suggests that maintaining a depressed projected ratio after an initial shock is appropriate, as low ratios occur regularly in the historical data in episodes of stress. In addition, a constant trading revenues-to-assets ratio aligns with the stress

testing principle of simplicity because the method does not require more complex assumptions on a time-varying projection profile.

Fourth, the Board assumes that trading assets are an appropriate scaling measure for trading revenue. Other variables, such as the volume of trading activities, could be considered as alternative scaling measures. To determine whether trading assets are a reasonable scaling metric for trading revenue, the Board analyzed the ratio of trading revenues to trading assets across banks and time in the FR Y-14Q and found them to be largely consistent and comparable.⁸¹ The use of trading assets as a scaling metric for trading revenue thus aligns with the stress testing principles of consistency and comparability.

Finally, the proposed distribution-based haircut approach assumes that a uniform single haircut is appropriate for all firms, regardless of size or institutional type. An alternative approach could segment firms into distinct groups and calculate separate haircuts for each group. The Board explored several grouping methodologies: (i) regulatory classifications (GSIB, LBO, and FBO), (ii) trading assets-based market size tiers (large, medium, and small firms based on each firm's trading assets as a percentage of total industry assets), and (iii) trading revenue-based market size tiers (large, medium, and small firms based on each firm's trading revenue as a percentage of total industry revenue). Across all grouping approaches investigated, smaller firms consistently received more conservative (i.e., larger) haircuts compared to those received under the Board's proposed single-haircut methodology. This result is attributable to the single-

⁸¹ The Board validated that trading assets serve as an appropriate scaling variable by examining the relationship between trading assets (FR Y-14Q, Schedule G.2, line item 30) and trading revenue (FR Y-14Q, Schedule G.1, line item 18) across banks and time period. The strong positive correlation and high explanatory power observed in this analysis indicate that trading assets effectively capture the scale of trading operations, making cross-firm comparisons meaningful.

distribution asset-weighted approach, which allows larger firms to exert a greater influence on the location of the 7th percentile ratio growth threshold, effectively pulling it higher toward the growth rates that are more representative of firms with larger, typically more established trading activities.

The use of a single, industry-level haircut approach represents a methodological trade-off. While the alternative segmented methods may capture heterogeneous risk profiles across firm sizes more explicitly, the Board's analysis, described above, does not support fundamentally different risk profile among smaller firms. The differences in trading revenue changes may arise from differences in accounting practices, asset classification, or other measurement inconsistencies that are more prevalent among institutions with lower trading activities. In the absence of clear evidence disentangling these structural and accounting effects from genuine differences in risk profiles, calibrating separate haircuts for smaller firms may embed measurement noise into the methodology. The proposed single-haircut approach offers consistency and simplicity while preventing potentially excessive conservatism for smaller firms, without meaningfully reducing conservatism for larger firms. This choice is also consistent with the stress testing principle of comparability because the same haircut is applied to all firms throughout the projection horizon.

iii. Alternatives

The Board considered several alternative modeling approaches to project trading revenue, as mentioned above. These alternatives include regression models and volume-based approaches. The Board also considered these approaches in light of the public input received on

the 2025 PPNR Model.⁸² Each alternative approach has benefits and drawbacks. On balance, the Board prefers the proposed distribution-based haircut approach to each of the alternatives as discussed below.

a. Alternative: Regression Approach to Noninterest Income on Sales and Trading

To focus on market-making revenue, the Board considered modeling trading revenue excluding revenues from prime brokerage, equity commission and fees, and commodities commission and fees using a regression approach. Market-making revenue is impacted by the bid-ask spread and the volume of executed trades.

The Board considered several regression specifications using a sample of quarterly data from the 2016–2025 FR Y-14Q. The independent variables in these specifications included various combinations of the CBOE Volatility Index (VIX), equity index price growth, the 10-year Treasury yield, and the BBB corporate spread. These variables were considered to capture market activity, investor sentiment, and credit availability. While these models produced satisfactory model fit, they had several shortcomings. First, the models exhibited specification sensitivity, with statistical significance changing based on minor changes to the set of included variables. Second, model fit was primarily driven by observations during the COVID period; removal of observations from 2020 resulted in the loss of significance for all the macroeconomic factors included as independent variables. The Board consequently determined that the models were not appropriate for use given their sensitivity to variable selection and sample period.

Trading revenue from prime brokerage was modeled separately in assessing the alternatives because it exhibited distinct behavior from other sales and trading market-making

⁸² See 90 FR 51856 (Nov. 18, 2025).

revenue. The prime brokerage model, estimated to assess the alternatives, was specified as a function of the growth rate of equity prices, the change in the 3-month Treasury rate, the change in the BBB yield, and seasonal dummies. The model exhibited good model fit. Trading revenue from commission and fees was assumed to be constant at its four-quarter mean value. Although the models for these remaining components of trading revenue could be deemed reasonable for use on a stand-alone basis, the Board determined not to propose the models without a suitable companion model for market-making revenue that would allow for similar treatment of all trading revenues within this component.

In addition, the Board considered modeling net interest revenue on trading assets and noninterest trading revenue jointly in a regression model but determined not to adopt this approach due to the observed worse statistical fit of these models in the Board's analysis compared to modeling noninterest trading revenue independently.

b. Alternative: Volume-Based Approach

The Board also considered a volume-based approach to model noninterest income from sales and training. As for the other components to which the Board would apply a volume-based approach, under this alternative, the Board considered an approach using historical Volcker Rule (FR VV-1) data on the volume of business activity to model the response of trading revenue to changes in macroeconomic variables as a result of stress. The data is aggregated to the quarterly level and spans the first quarter of 2021 to the last quarter of 2025. A calibrated fee was then applied to the modeled volume of business activity to produce stressed projections of trading revenue.

A volume-based approach for trading revenue could be appropriate in the post-Volcker Rule environment. Since the Volcker Rule’s finalization in 2013, banks have been substantially restricted from proprietary trading and have shifted their trading activities to market-making—intermediating securities transactions and earning bid-ask spreads.⁸³ The volume-based approach could be well-suited to this context as it treats trading volume, rather than gains and losses, as the primary quantity of interest.

To test this alternative approach, the Board used noninterest income on sales and trading data from FR Y-14Q, Schedule G.1, line item 18. Trading volume was retrieved from reporting form FR VV-1 (Volcker Data) Part 5 (Transaction Volumes) and was calculated as the sum of the gross market value of all securities transacted (sum of line items 1, 5, and 9) plus the gross notional value of all derivatives transacted (sum of line items 3, 5, and 7).

Under this alternative approach, quarterly log changes of trading volume were regressed on quarterly log changes of the VIX and the Dow Jones Total Stock Market indexes. The Board chose to include the VIX index given that trading activity could vary during periods of uncertainty when market participants reprice their portfolios. Since the measure of trading volume includes the market value of transacted securities, the Dow Jones Total Stock Market Index proxies for valuation changes of these financial assets. The regression was estimated using a panel dataset of all firms reporting Volcker data from 2021:Q1 to 2025:Q4, the period for which trading volume data is available. The data sample does not include all firms subject to the

⁸³ See, e.g., Falato et al. (2025), who document that banks substantially reduced exposure to aggregate risk factors since the initiation of the Volcker Rule, consistent with proprietary trading restrictions imposed by regulation. Falato et al. (2025), *supra* note 101. Similarly, see Lu and Wallen (2025), who show that bank trading desks bear little to no market risk, essentially profiting from the intermediation of customer trading volume. L. Lu and J. Wallen, *What Do Bank Trading Desks Do?* Harvard Business School Working Paper, No. 26-035 (2025).

stress test because only GSIB firms report Volcker data. The Board used a panel instead of an industry aggregate time-series model to mitigate the risk that a few firms with the largest trading volumes would dominate parameter estimates, which could arise since the number of stress-tested firms reporting Volcker Data is small. The model omits fixed effects to project a representative growth rate of trading volume that can be applied to all stress tested firms.

Under this volume-based approach, the Board would generate firm-level volume projections by applying the growth rate of trading volume to a firm's four-quarter mean trading volume. The firm-level trading volume projection would be multiplied by a fee ratio calibrated at the firm level. The Board could calibrate a firm's fee ratio to the four-quarter median of the firm's noninterest income on sales and trading to trading volume.

A limitation of this alternative volume-based approach is the substantial variation in calibrated fee ratios across firms and over time. This volatility makes the calibration of projected fees, and therefore revenue projections, unreliable. The variation in fee ratios (corresponding to market-maker spreads) may be attributable to two sources. First, volume distribution across asset classes may shift over time. As typical spreads vary by asset class, aggregate fee ratios would fluctuate accordingly. While a natural extension of the model would be to analyze Volcker data at the asset-class level, more granular data segmentation could result in less stable projections. Second, market-making profits may change as spreads respond to trading order characteristics or dealers' hedging capacity in volatile markets. The firm-specific median fee assumption could be less appropriate during severe market stress, requiring an alternative approach (e.g., the selection of a more conservative percentile from the historical distribution of fee ratios, as opposed to the four-quarter median, to reflect uncertainty regarding the ratio that would apply under stress). Additionally, because trading volume is only available for banks

reporting Volcker Rule data, an inherent model limitation is that trading volume must be inferred for non-reporting banks.⁸⁴ Given these limitations, the Board chose not to propose a volume-based approach to project noninterest income from sales and trading.

iv. Questions

The Board is requesting public input on the proposed distribution-based haircut approach, including but not limited to, input on the following questions.

Question 49: What are the advantages and disadvantages of the proposed approach to model noninterest income on sales and trading?

Question 50: Should the Board consider different methods or measures for constructing a distribution for the noninterest income on sales and trading model? What are the advantages and disadvantages of these proposed methods and measures?

Question 51: What alternative regression methods or specifications should the Board consider to ensure the robustness of volume and fee estimations and estimation results in an alternative model for noninterest income on sales and trading? What are the advantages and disadvantages of using these alternative methods?

⁸⁴ For a firm not reporting Volcker Data, the Board proxies trading volume at a quarter by multiplying the firm's trading assets to the ratio of aggregated trading volume to aggregated trading assets of banks reporting Volcker Rule Data. Quarterly trading assets are sourced from FR Y-14Q, Schedule G.2, line item 13.

IV. Treatment of Outliers and Non-Recurring Revenues

i. Outliers

The Board is considering establishing a systematic process for screening regulatory data used as inputs to the PPNR models to identify and treat unusual observations and outliers. Data could be flagged if, for example:

- an observation exceeds a statistically significant threshold relative to its recent historical average (e.g., beyond a specified number of standard deviations from the mean over a defined recent period);
- the historical variability of an item's time series (e.g., coefficient of variation) exceeds a specified threshold relative to its mean;
- the quarter-over-quarter change exceeds a specified threshold; or
- an observation surpasses a materiality threshold as a percentage of a bank's overall PPNR or PPNR component.

The Board would evaluate flagged items using regulatory filings and other public information, such as earnings reports. Where appropriate, the Board would address these outliers through removal, truncation, reversal of reclassifications, or other appropriate adjustments. The Board would conduct this screening process on all historical data from firms subject to the stress test, and then on a routine basis as new regulatory submissions from stress test firms become available, and would also screen all historical data from new stress test panel entrants.

Question 52: What should the data screening framework and procedures entail? For example, is it appropriate to use a combination of visual scans and an algorithm to screen relevant time series? Should the algorithm incorporate both statistical thresholds and materiality

thresholds? Once identified and confirmed, should the Board treat outliers through removal, truncation, reversal of reclassifications, or other appropriate adjustments? Should the Board apply this systematic process to other PPNR models?

ii. Non-Recurring Revenues

Consistent with the Board's process for identifying and removing non-recurring expenses in the Final 2026 PPNR models, the Board is evaluating the use of the same criteria to remove non-recurring revenues from the noninterest income models' estimation and projection steps. Non-recurring revenues may be excluded from the stress testing exercise on the grounds that there is no expectation they would occur in the hypothetical scenario being tested. Similar to the treatment of non-recurring expenses, qualifying non-recurring revenues could be those which are either (i) driven by business divestitures, gains or other income from consolidated investment entities (CIEs), or mergers and acquisitions (M&A); or (ii) not reasonably likely to recur within two years and with no similar item reported within the prior two years. Any adjustments to data processes, such as removing non-recurring revenue items, may affect the noninterest expense model that relies on the same data for calculating revenue shares and efficiency ratios.

Question 53: Would the above criteria provide an appropriate framework for identifying non-recurring revenue items? What other considerations should the Board consider when identifying non-recurring revenues, and what additional data sources should be utilized? Should other PPNR models that rely on the same underlying data, such as the noninterest expense model, apply this same exclusion methodology to ensure consistency across the stress test?

V. Analysis of Proposed Model Changes

This section analyzes the potential effects of implementing the proposed noninterest income model described in this document. These proposed model changes are estimated to meet the Board’s adopted criteria for a material model change, though, across various stress test scenarios and jump-off points, the proposed changes are not expected to notably affect stress capital buffer (SCB) requirements for firms subject to the supervisory stress test in aggregate.⁸⁵ The analysis estimates that the proposed model changes could be expected to result in somewhat lower projected stressed pre-provision net revenue based on analysis of past stress tests. This lower projected revenue results in a slight increase in the aggregate projected stressed common equity tier 1 (CET1) capital decline. Table A2 demonstrates the potential effects of this model change on the 2024, 2025, and 2026 stress tests, after incorporating the effects of the models finalized at the time of the publication of the enhanced transparency and public accountability final rule, which the Board has concurrently adopted. In this analysis, the effects of these model changes would be equivalent to an increase in SCB requirements of approximately 3 basis points in aggregate.

Table A2 – Aggregate Effect of Proposed Model Changes on Projected Stressed CET1 Capital Ratio Decline

Year	Aggregate Projected CET1 Capital Ratio Decline (%)	
	Current	With Proposed Model Change
2026	1.5	1.5
2025	1.4	1.4

⁸⁵ See 12 CFR 238.132(e)(2); 12 CFR 252.44(e)(2). Under the final rule established in parallel to this proposal, a “material model change” is defined as any model change resulting in either (i) an impact of 20 basis points or more to the projected common equity tier 1 capital ratio of certain firms subject to the stress test, or (ii) a change of 10 basis points or more in the average of the absolute value of changes in the projected common equity tier 1 capital ratio for certain firms subject to the stress test.

2024	2.1	2.2
Average	1.7	1.7

Note: The current decline reflects the projected stressed CET1 capital decline using the models finalized in the enhanced transparency and public accountability final rule. Estimates are based on a balanced sample of 30 firms subject to the 2024 stress test. All numbers are in percentage points.

Appendix A

(A1) Weighted Average Adjustment for Log Differenced Models

The Board proposes to use a four-quarter mean liftoff value in many noninterest income models. Using a four-quarter mean liftoff mitigates the volatility of projections that would result from using a single-quarter liftoff. However, using a moving-average liftoff value requires an adjustment to the growth rate applied in the first projection quarter to reflect the fact that the anchor value is an average, rather than the value of the dependent variable in the jump-off quarter. Consequently, the difference between the value in the first projected quarter and the anchor value is not a quarter-on-quarter change as specified in the log difference model. The adjustment described in the following paragraphs accounts for this fact, which is a unique consideration for the first projection quarter.

Many noninterest income pre-provision net revenue components are modeled in log differences and take the general form:

Equation A131 – General Log Difference Model Form

$$y_t - y_{t-1} = \gamma_t + \beta X_t + \varepsilon_t \equiv g_t + \varepsilon_t$$

where:

- $y_t \equiv \ln Y_t$ is the log of variable Y_t in quarter t ;
- X_t is a vector of macroeconomic variables in quarter t ;
- $\gamma_t = \alpha + \alpha_2 D_{2t} + \alpha_3 D_{3t} + \alpha_4 D_{4t}$, where $D_{it} \equiv 1[Q_t = i]$, is the deterministic component of Δy_t composed of the drift term and quarterly dummies;
- ε_t is the error term of the model; and
- g_t denotes the expected growth rate in y from time $t-1$ to t , conditional on X_t .

Consider the following expression for the first projection quarter growth rate in y relative to the four-quarter mean liftoff:

$$y_1 - \frac{1}{4} \left[\sum_{i=1}^4 y_{1-i} \right].$$

The expected value of this growth rate is:

Equation A132: Expected First Projection Quarter Growth Rate Relative to the Four-Quarter Mean Liftoff

$$\frac{1}{4} E \left[\sum_{i=1}^4 y_1 - y_{1-i} \right].$$

Expression A2 can be expanded as follows:

$$E[y_1 - y_0] = \gamma_1 + \beta X_1 = g_1$$

$$E[y_1 - y_{-1}] = y_1 - y_0 + y_0 - y_{-1} = g_1 + g_0$$

$$E[y_1 - y_{-2}] = g_1 + g_0 + g_{-1}$$

$$E[y_1 - y_{-3}] = g_1 + g_0 + g_{-1} + g_{-2}$$

Summing the above and dividing by four yields the following expression:

$$E \left[y_1 - \frac{1}{4} (y_0 + y_{-1} + y_{-2} + y_{-3}) \right] = \frac{1}{4} (4g_1 + 3g_0 + 2g_{-1} + g_{-2}).$$

The right-hand side of the above expression is the growth rate applied to the four-quarter mean liftoff in order to obtain the projected value of y for the first projection quarter. For all other projection quarters, projections are obtained via the estimated version of Equation A131.

(A2) Liftoff Handling

In all of the noninterest income models, projections use a four-quarter average to reduce volatility in liftoff values. The derivation of the weighted average adjustment, described in the previous section, depends on the assumption that the smoothed liftoff is computed using the geometric mean rather than another average function such as the arithmetic mean. A limitation

of the geometric mean is that it can only be calculated for positive inputs. There are components that require exception handling for negative values. If any of the four-quarter lookback observations are zero or negative, the geometric mean is replaced by the arithmetic mean in order to approximate the geometric mean. If the arithmetic mean is negative or zero, the projection is flatlined to avoid unintuitive projections. In these cases where a firm-specific flatline is required as an exception, the proposed approach differs depending on the noninterest income component being modeled. For noninterest income on international and other loans, the projection is flatlined at zero to mitigate the impact of FVO and mark-to-market adjustments, as described earlier. Because these adjustments are modeled by the FVO model elsewhere in the stress test, flatlining the projection in the PPNR model suite avoids stressing these values twice. For other noninterest income components, the flatline is set to the four-quarter median if the model does not control for seasonality in its specification above, as described above. If the modeled component does control for seasonality in the specification above, the flatline is set to the four-quarter geometric mean.

Appendix B

This appendix provides the parameters estimates for the proposed models. Table B1 presents the parameters of volume-based models, Table B2 presents the parameters for regression models, and Table B3 presents the parameter for the Sales and Trading Model.

Table B1 – Volume-Based Model Coefficient Estimates

Model	Variable	Estimate	Standard Error
Credit Card Interchange Fees	Intercept	-0.090***	0.005
	Change in Unemployment Rate	-0.035***	0.005
	Change in CPI Inflation Rate	0.005***	0.001
	2020:Q2 Dummy	0.092**	0.042
	Quarter 2 Dummy	0.186***	0.008
	Quarter 3 Dummy	0.081***	0.008
	Quarter 4 Dummy	0.125***	0.007
MHE Production	Intercept	-0.017	0.031
	Change in Mortgage Rate	-0.172**	0.078
MHE Servicing Fees	Intercept	-0.007**	0.003
	Change in Mortgage Rate	0.017**	0.007
	Lag in Log Difference of Serviced Balance	0.379***	0.134
Debit Interchange Fees	Intercept	-0.045***	0.008
	Change in Unemployment Rate	-0.014**	0.006
	Change in CPI Inflation Rate	0.006***	0.002
	2020:Q2 Dummy	0.016	0.059
	Quarter 2 Dummy	0.104***	0.011
	Quarter 3 Dummy	0.037***	0.011
	Quarter 4 Dummy	0.046***	0.011
Investment Banking: Advisory Deal Volume	Intercept	-0.093	0.060
	Second Lag of Log Difference of Dow Jones Total Stock Market Index	1.195*	0.630
	Quarter 4 Dummy	0.265**	0.115
	Lag of Log Difference of Advisory Deal Volume	-0.431***	0.128
	Intercept	-0.077	0.053

Investment Banking: ECM Deal Volume	Log Difference of Dow Jones Total Stock Market Index	2.468***	0.638
Investment Banking: DCM Deal Volume	Intercept	0.300***	0.043
	Change in BBB Spread	-0.227**	0.085
	Change in Term Spread	-0.134**	0.059
	2020:Q1 and 2020:Q2 Dummy Variable	0.317**	0.117
	Quarter 2 Dummy	-0.388***	0.058
	Quarter 3 Dummy	-0.493***	0.059
	Quarter 4 Dummy	-0.422***	0.060
Investment Banking: SCL Deal Volume	Intercept	-0.059	0.043
	Change in 10-year Treasury Rate	0.199*	0.114
	Quarter 4 Dummy	0.227**	0.091
Asset Management AUM	Intercept	-0.001	0.002
	Log Difference of Dow Jones Total Stock Market Index	0.463***	0.029
	Lag of Change in BBB Spread	-0.016*	0.008
	Lag of Change in 10-year Treasury Rate	0.012*	0.007
Wealth Management Equity AUM	Intercept	-0.004	0.007
	Log Difference of Dow Jones Total Stock Market Index	0.920***	0.081
Wealth Management Fixed Income AUM	Intercept	0.017**	0.007
	Lag of Log Difference of Dow Jones Total Stock Market Index	-0.208**	0.091
	Change in BBB Spread	-0.081***	0.025
	Change in Term Spread	-0.034**	0.016
Wealth Management Other AUM	Intercept	-0.01	0.009
	Log Difference of Dow Jones Total Stock Market Index	0.253**	0.095
	Second Lag of Real GDP Growth Rate	0.003***	0.001
Investment Services	Intercept	0.004*	0.002
	Log Difference of Dow Jones Total Stock Market Index	0.424***	0.030
	Lag of Change in BBB Spread	-0.014*	0.008

Notes: Statistical significance levels of 1%, 5%, and 10% are indicated as ***, **, and *, respectively.

Table B2 – Regression Model Coefficient Estimates

Model	Variable	Estimate	Standard Error
MSR Carry Value	Intercept	-0.008	0.013
	Change in Mortgage Rate	0.100***	0.033
Non-sufficient Funds Fees	Intercept	-0.108***	0.016
	Change in Unemployment Rate	-0.039***	0.011
	2020:Q2 Dummy	-0.335***	0.114
	Quarter 2 Dummy	0.101***	0.023
	Quarter 3 Dummy	0.162***	0.022
	Quarter 4 Dummy	0.080***	0.022
Other Deposit Fees	Intercept	-0.022**	0.008
	Change in Unemployment Rate	-0.025***	0.005
	Change in 3-month Treasury Rate	0.054***	0.020
Asset Management Flow	Intercept	1.791***	0.538
	Lag of Unemployment	-0.206*	0.105
	Disposable Income Growth Rate	0.031**	0.014
Wealth Management Flow	Intercept	1.110***	0.120
	Log Difference of Dow Jones Total Stock Market Index	1.429*	0.742
	Quarter 2 Dummy	-0.557***	0.170
	Quarter 3 Dummy	-0.411**	0.169
	Quarter 4 Dummy	-0.362**	0.172
Other Retail Lending	Intercept	-0.015	0.012
	Real GDP Growth Rate	0.006***	0.001
Treasury Services	Intercept	-0.020*	0.011
	Change in Unemployment Rate	-0.021***	0.004
	Change in CPI Inflation Rate	0.007**	0.003
	Quarter 2 Dummy	0.065***	0.016
	Quarter 3 Dummy	0.013	0.015
	Quarter 4 Dummy	0.02	0.015
Insurance Services	Intercept	-0.046***	0.011
	Nominal GDP Growth Rate	0.803***	0.265
	Quarter 2 Dummy	0.023	0.014
	Quarter 3 Dummy	0.057***	0.015
	Quarter 4 Dummy	0.068***	0.014

Notes: Statistical significance levels of 1%, 5%, and 10% are indicated as ***, **, and *, respectively.

Table B3 – Sales and Trading Model Parameter

Model	Parameter	Estimate
Sales and Trading	Haircut factor	0.72