Exploratory Scenarios in the 2024 Stress Tests: Why Transparency is Important

Francisco Covas, Laura Suhr Plassman & Benjamin Gross | April 24, 2024

The stress-testing framework implemented by the Federal Reserve serves a crucial function in assessing the capital adequacy of large banks. Critics argued that the Fed had failed to incorporate a scenario that accounted for rising interest rates before the failure of Silicon Valley Bank in March 2023. In response to this criticism, the Fed introduced "exploratory" scenarios to complement the severely adverse scenario in the 2024 stress tests, with the objective of including a broader range of potential economic outcomes.[1] The exploratory scenarios will not affect a bank's capital requirement.

Projections of net interest income are a critical component of the Federal Reserve's stress testing framework, as they are highly sensitive to changes in interest rates and play a crucial role in assessing the severity of the exploratory scenarios in the 2024 stress tests. This post takes a deep dive into the net interest income projections to better understand the implications of the exploratory scenarios and highlight the importance of transparency in the stress testing process.

The Fed's stress-testing methodology involves projecting various components of net interest income using a range of models and assumptions, considering banks' recent performance and balance-sheet composition. However, the information provided in the stress-testing methodology documentation is insufficient to fully replicate the Fed's projections, as some assumptions, parameters and adjustments used in the models are not disclosed.

In addition, the funding shocks incorporated into the 2024 stress tests appear to lack a coherent and well-defined standard. The Federal Reserve's description of the shocks raises several concerns, including insufficient justification for the calibration of the shocks, the assumption of an instantaneous shift in deposits and the failure to consider bank-specific factors and the scope of the shocks. Moreover, the approach seems inconsistent with the overall logic of the stress test design, which aims to project bank performance based on macroeconomic assumptions. To improve the robustness and comparability of the stress testing results, the Federal Reserve should develop a more refined and standardized approach to modeling funding shocks, ensuring a clear link to the macroeconomic scenarios and providing a more accurate assessment of banks' resilience to potential funding stresses.

[1] See Covas, Francisco, "How Did Regulatory Tailoring Affect SVB's Capital Requirements?" for a perspective on why introducing rising interest rates in the stress tests would have not prevented SVB from failing. https://bpi.com/how-did-regulatory-tailoring-affect-svbs-capital-requirements/.

Projections of Net Interest Income

A key building block of the exploratory scenarios is the projections of net interest income, the difference between interest earned on assets and interest paid on liabilities. This component is highly sensitive to changes in interest rates and is therefore a critical component of the exploratory scenarios in this year's stress tests. To better understand the implications of the exploratory scenarios and the importance of transparency in the stress testing process, we will take a deep dive into the net interest income projections.

The Fed's stress-testing methodology involves projecting various components of net interest income, such as interest income on loans and securities, as well as interest expenses on deposits and other borrowings. The Fed uses a range of models and assumptions to generate these projections, considering banks' recent performance and balance-sheet composition.

However, the information in the stress-testing methodology documentation is insufficient to replicate the Fed's projections of net interest income. The Fed does not disclose some of the assumptions, parameters and other adjustments used in its models. Despite these limitations, following the Fed's general methodology and using publicly available data can reasonably approximate the stress scenarios and impact of funding shocks on the projections of net interest income. Therefore, the first step of our analysis is to align our approach with the Fed's methodology to the greatest extent possible.

According to the 2024 stress test methodology document, the Fed's framework for projecting net interest income in supervisory stress testing consists of 15 components:

- *Eight components of interest income*: (1) fed funds and repurchase agreements; (2) interest-bearing balances; (3) loans; (4) mortgage-backed securities; (5) other securities; (6) trading assets; (7) U.S. Treasuries; and (8) all other interest income; and
- *Seven components of interest expense*: (1) domestic time deposits; (2) federal funds and repurchase agreements; (3) foreign deposits; (4) other domestic deposits; (5) subordinated debt; (6) trading liabilities and other borrowed money; and (7) all other interest expense.

The Fed projects most core net interest income components using an autoregressive model specification. This specification is based on *pro forma* historical regulatory data, primarily drawn from firms' quarterly regulatory FR Y-9C filings. However, a few components of interest income and expense follow simpler approaches or more structural models using granular data on banks' own portfolios. For instance, some components may be modeled using the median of the firm's ratio over the most recent eight quarters, fostering a straightforward approach to forecasting these components. An example of a structural model is the subordinated debt model that relies on security-level data on banks' individual positions, collected from banks' confidential quarterly filings on the FR Y-14Q.

The autoregressive econometric models used in the supervisory stress tests have the following generic structure:

$$Ratio(b,t) = f\left(\sum_{j=1}^{4}\frac{Ratio(b,t-j)}{4}, FE(b), FE(b)\times Ind(T-Q<t\leq T), Z(t), X(b,t)\right). \quad (1)$$

In each component of the Fed's models for net interest income, the dependent variable is defined as a ratio, calculated by taking the specific item related to income or expense and normalizing it through dividing it by a relevant asset or liability category. This normalization controls for the size of the bank and makes the income or expense item comparable across different institutions and time periods. For instance, when modeling interest income on loans, the dependent variable would be the ratio of interest income on loans divided by the total value of loans held by the bank. This ratio is then used as the variable that the model aims to predict.[2] The

[2] Table 1 on page 21 of the 2024 Supervisory Stress Test Methodology document includes a comprehensive list of the dependent variables used in each component of the net interest income model.

autoregressive term (a key component of the model specification) is calculated by taking the mean of the dependent variable over the prior four quarters.

In addition to the autoregressive term, each of these models includes several other components to capture the unique characteristics of individual firms and the broader economic environment. One of these components is a firm fixed effect (FE(b)), which accounts for the persistent differences in the dependent variable across firms not explained by the model's other covariates. This fixed effect helps to control for the unobserved time-invariant characteristics of each bank that may influence its income or expense ratios.

Another component is a trailing multi-year firm fixed effect, which captures each firm's average performance over recent years. This term is designed to account for the fact that a bank's current performance may be influenced by its performance in the recent past, beyond what is captured by the autoregressive term. By including this trailing fixed effect, the model can better incorporate the medium-term trends in each bank's income or expense ratios.

The models also include year fixed effects, denoted as Z(t), which capture the common shocks or trends affecting all firms in a given year. These fixed effects help to control for the overall economic and financial conditions that may affect banks' performance, such as changes in interest rates, economic growth or regulatory environment.

In addition to these fixed effects, the models incorporate other explanatory variables, such as macroeconomic factors and bank-specific characteristics (X(b,t)). The specific set of variables included in each model is tailored to the particular income or expense component being modeled. For example, yields on U.S. Treasuries are key variables in the models for interest income and expense components, since they serve as important benchmarks for the rates at which banks borrow and lend money.[3]

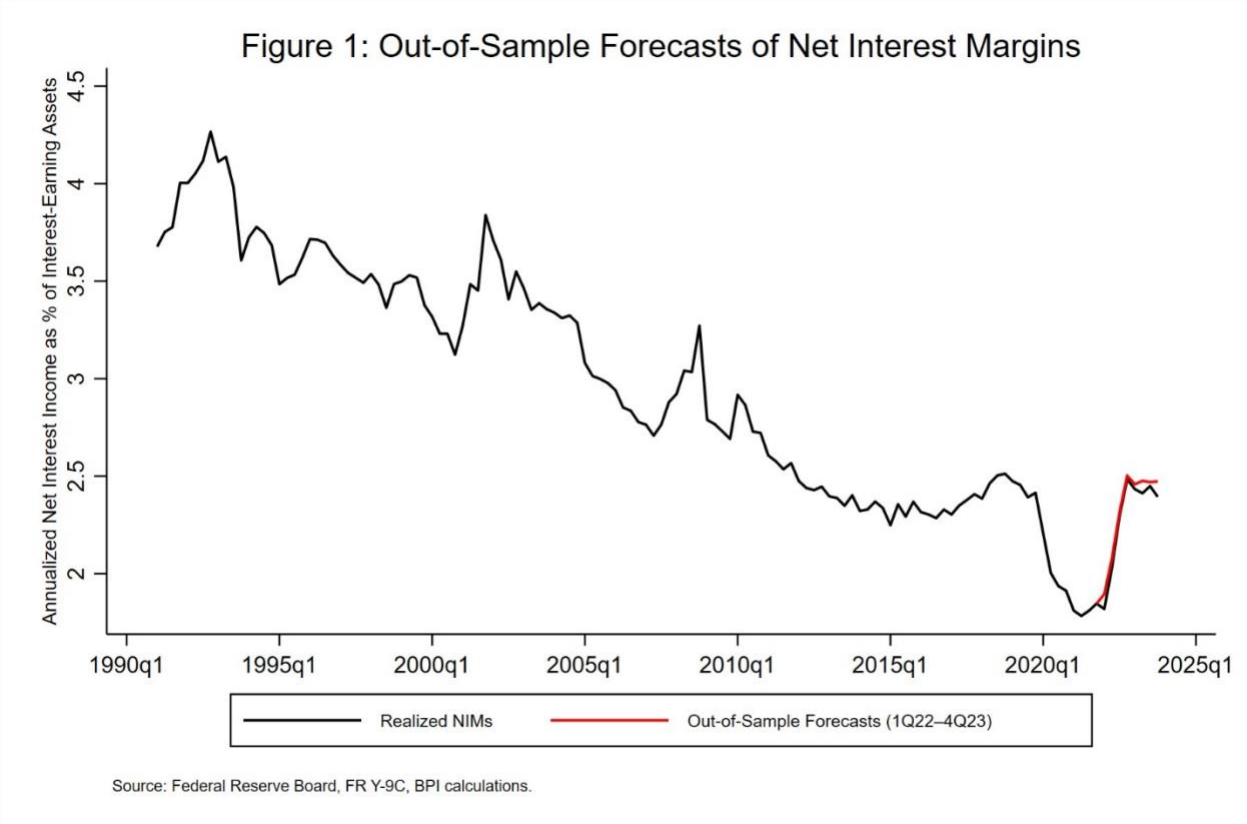
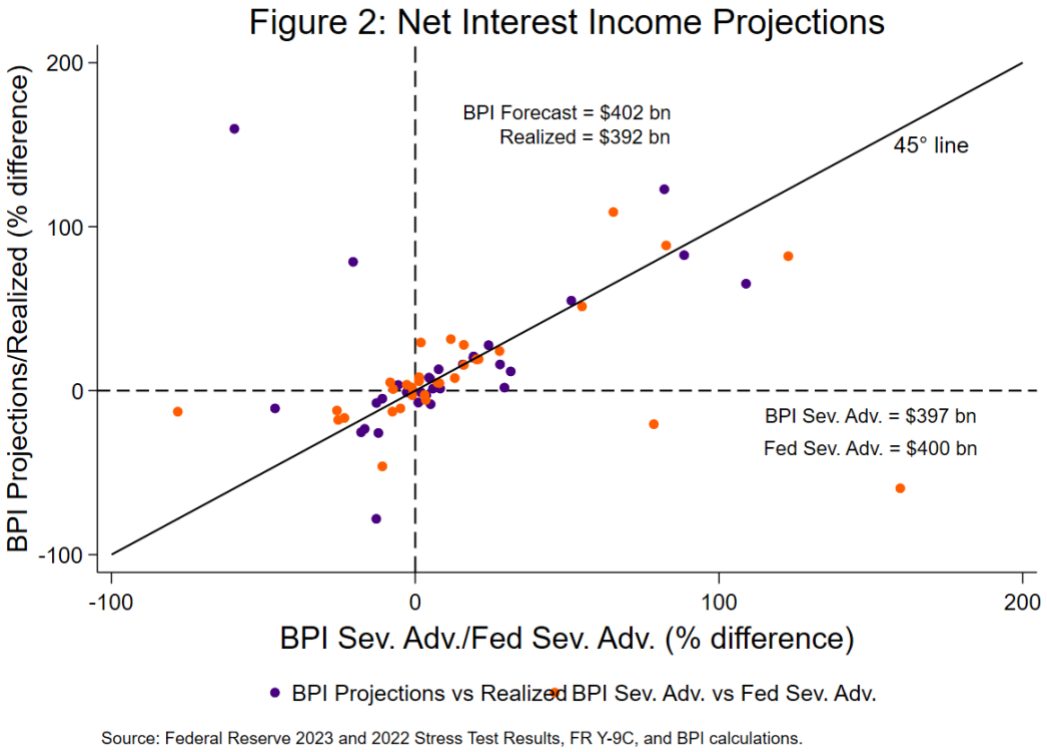


Figure 1 presents the out-of-sample forecasts for net interest margins, defined as net interest income divided by interest-earning assets. The red line represents our replication of the Fed's methodology, which involves

[3] The denominator of the ratio is not modeled separately because the Federal Reserve assumes that banks' balance sheets remain unchanged over the nine-quarter planning horizon.

forecasting individual components of net interest income separately and then aggregating them to arrive at the overall net interest income projection. Interestingly, the granular specification for net interest income shows a reasonable out-of-sample forecast performance. This finding suggests that by modeling the individual components of net interest income separately and then aggregating them, the Fed's methodology can accurately capture the dynamics of net interest income, at least at the aggregate level.

Figure 2 analyzes firm-level projections in both the data and the stress tests. The y-axis compares BPI projections for 2022 and 2023 against actual realizations, while the x-axis compares BPI projections under the severely adverse scenario versus the Fed's own projections. At an aggregate level, BPI projections are similar to those in the data and those of the Fed, indicating that our replication of their methodology is reasonably accurate. More precisely, we estimate an average annual net interest income of $402 billion for 2022 and 2023, while the data shows $392 billion. Similarly, we project $397 billion under the severely adverse scenario, while the Fed's projections are about $400 billion annually.[4]



Source: Federal Reserve 2023 and 2022 Stress Test Results, FR Y-9C, and BPI calculations.

However, when we examine the projections at the individual bank level, we find that there can be significant differences between our model's projections and those of the Federal Reserve. Although the majority of banks lie along the 45-degree line, indicating that BPI and Fed projections agree, in some cases the projections diverge substantially.

For example, the two dots in the top left quadrant of Figure 2 represent banks for which BPI projections overstate the data (likely because our model is not sufficiently granular) while materially understating the Fed's projections. Conversely, for the two banks in the bottom-right quadrant, BPI projections materially understate the data while significantly overstating the Fed's projections.

We believe these differences are driven by the Fed's modeling choices that are not fully disclosed in the stress-

[4] To obtain annual projections, we divided the Fed's nine-quarter projections by 2.25.

testing methodology document. One example is the length of the trailing multi-year firm fixed effect used and the specific components of interest income and expense that rely on the autoregressive model we described.

Effect of Funding Shocks in the 2024 Stress Tests

This section examines how the different stress-test scenarios designed by the Federal Reserve for 2024—the severely adverse scenario and two exploratory scenarios—affect projections of net interest income for banks. Net interest income is the difference between the interest banks earn on their assets (such as loans) and the interest they pay on their liabilities (such as deposits).

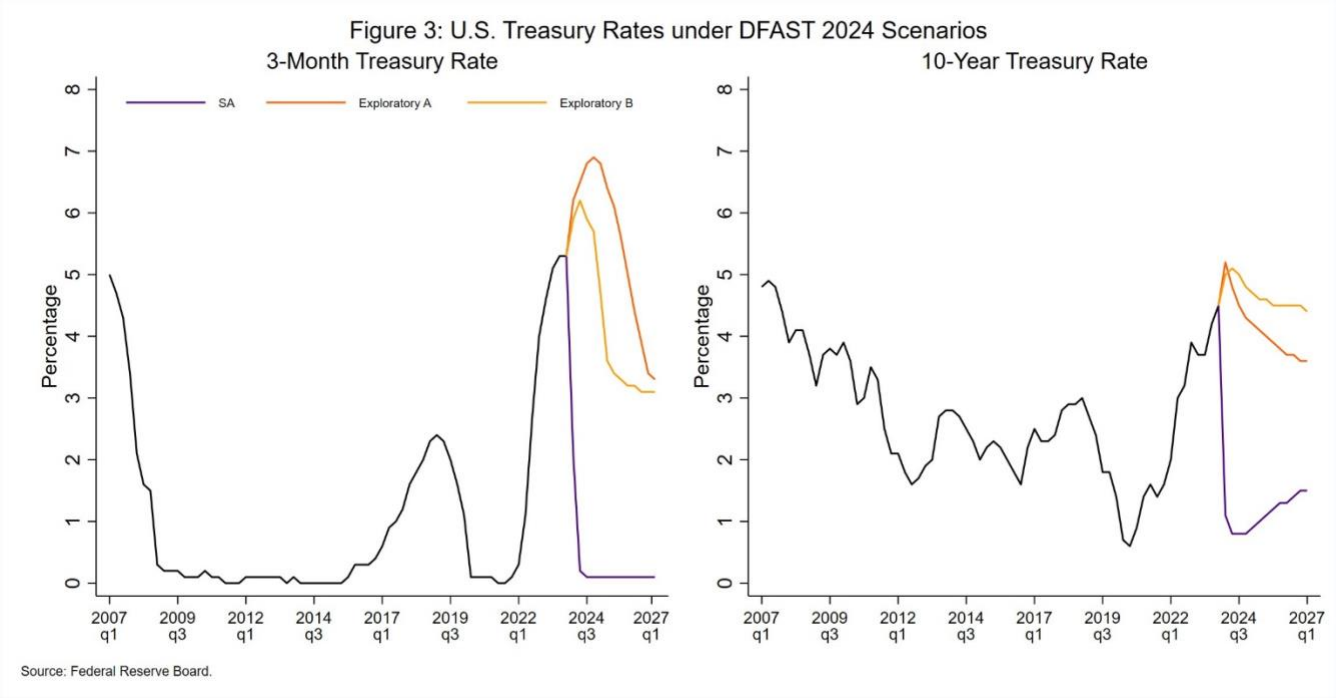


Figure 3 illustrates the trajectories of short-term and long-term interest rates under the three scenarios. In a typical recession, both short-term and long-term interest rates tend to decline, which is the assumption in the Fed's severely adverse scenario. This scenario simulates a significant economic downturn and aims to assess how banks would fare under such conditions.

However, the two exploratory scenarios deviate from this pattern and assume rising interest rates. The first exploratory scenario contemplates supply disruptions that lead to an increase in inflation expectations. Supply disruptions could be caused by a variety of factors (such as natural disasters, geopolitical events or pandemics) that can reduce the availability of goods and services, driving up prices and inflation expectations.

The second exploratory scenario combines a severe recession with persistently high inflation and increasing interest rates. This scenario presents a particularly challenging combination of economic contraction and inflationary pressures that are unusual because aggregate demand tends to contract dramatically during economic recessions. One question that arises is whether this scenario is plausible and consistent with severe U.S. post-war recessions as defined in the policy statement on the scenario design framework for stress testing. For more transparency, the Fed should specify the models and assumptions that would result in the unemployment rate rising by 6.3 percentage points and inflation increasing from 2.8 percent to 6 percent.[5]

[5] Similarly, in the severely adverse scenario, the 3-month Treasury rate declines too quickly from 5.3 percent to 0.1 percent in two quarters. That appears to be implausible.

Moreover, each of the two exploratory macroeconomic scenarios is augmented with explicit shocks to simulate funding stress in a rising interest rate environment, in the spirit of the bank stress we saw in the spring of 2023. The Fed described two types of shocks in the exploratory analysis summary:

1. On the funding side, 20 percent of noninterest bearing deposits shift into time deposits, supposedly at the start of the stress testing exercise; and
2. On the revenue side, the projections would limit interest income on MBS and mortgage loans.

The shock to interest expense appears to be straightforward to simulate, but there is little justification for adding of these funding shocks. Based on our analysis of the FR Y-9C data, the size of the shift from noninterest-bearing deposits to time deposits appears to be at the high end of what was observed in the spring of 2023. This suggests that further analysis and calibration will be necessary to ensure that the shock is realistic and properly reflects the potential risks faced by banks.

For example, the description of the exploratory analysis scenario suggests that the shock to noninterest-bearing deposits is instantaneous, meaning that it occurs suddenly and all at once. However, as shown in Table 1, the actual decline in noninterest-bearing deposits tends to be more gradual and less sharp than the scenario suggests. This discrepancy highlights the need for a more nuanced approach to modeling the shock, one that considers the typical pace and magnitude of deposit outflows during stress periods.

Table 1: The Impact of the Spring 2023 Mini Banking Crisis on Noninterest Bearing Deposits

Date	Aggregate Ratio	10th Percentile	1st Quartile	Median	3rd Quartile	90th Percentile
2022 Q4	100	100	100	100	100	100
2023 Q1	98	90	92	96	98	103
2023 Q2	90	82	84	88	92	97
2023 Q3	86	77	79	84	88	100
2023 Q4	84	75	76	83	87	98

Note: Total noninterest-bearing deposits are normalized to 100 in the fourth quarter of 2022.

Furthermore, the data in Table 1 also reveal considerable dispersion among banks in terms of their noninterest-bearing deposit balances and the severity of the shocks they experience. This variation underscores the importance of considering bank-specific factors when calibrating the shock, such as the composition and stability of each bank's deposit base, as well as their overall capital and liquidity positions. And finally, the description of the funding shocks does not specify whether the shock affects only domestic noninterest-bearing deposits or if it also includes foreign deposits. This distinction is relevant, because the inclusion of foreign deposits could significantly alter the magnitude and impact of the shock on the interest expenses of some banks.

More broadly, the deposit funding shock appears to be inconsistent with the overall logic of the Federal Reserve's stress test approach. The stress tests aim to project the income and balance sheet of banks based on a set of macroeconomic assumptions. To maintain consistency, it would be more appropriate for the Fed to project the behavior of bank deposit levels and rates in response to the assumed increase in short-term rates and other macroeconomic developments. By allowing itself to specify the behavior of certain balance sheet and income items, such as deposit funding, the Federal Reserve risks setting a precedent that could potentially extend to other areas, like specifying a specific path for loan losses. If taken to an extreme, this approach could lead to a situation where the Fed's ability to generate sought-after bank capital outcomes becomes unconstrained.

The shock to interest income appears more unclear and harder to discern based on the description in the Fed's summary. For this analysis, we assume that interest income on mortgage loans remains unchanged and does not rise with the increase in interest rates, since most mortgage loans are fixed-rate loans.

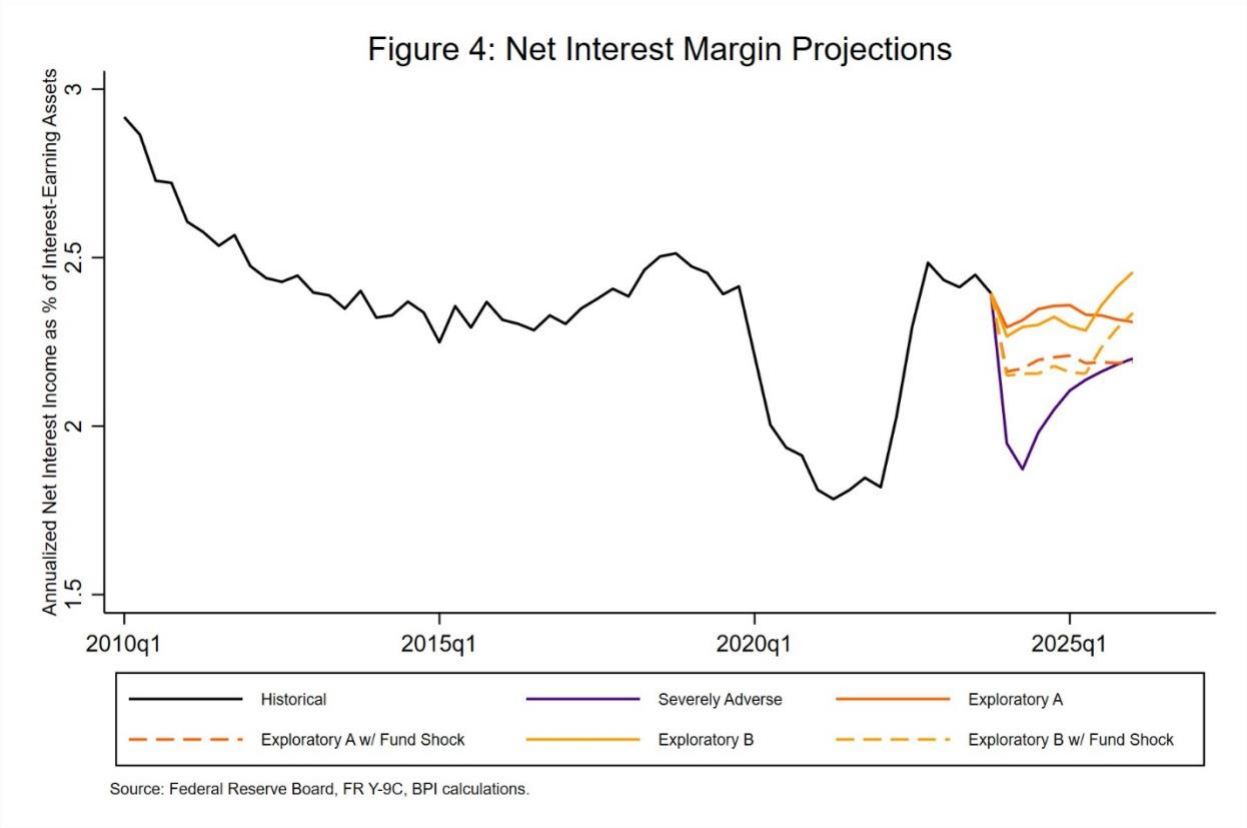
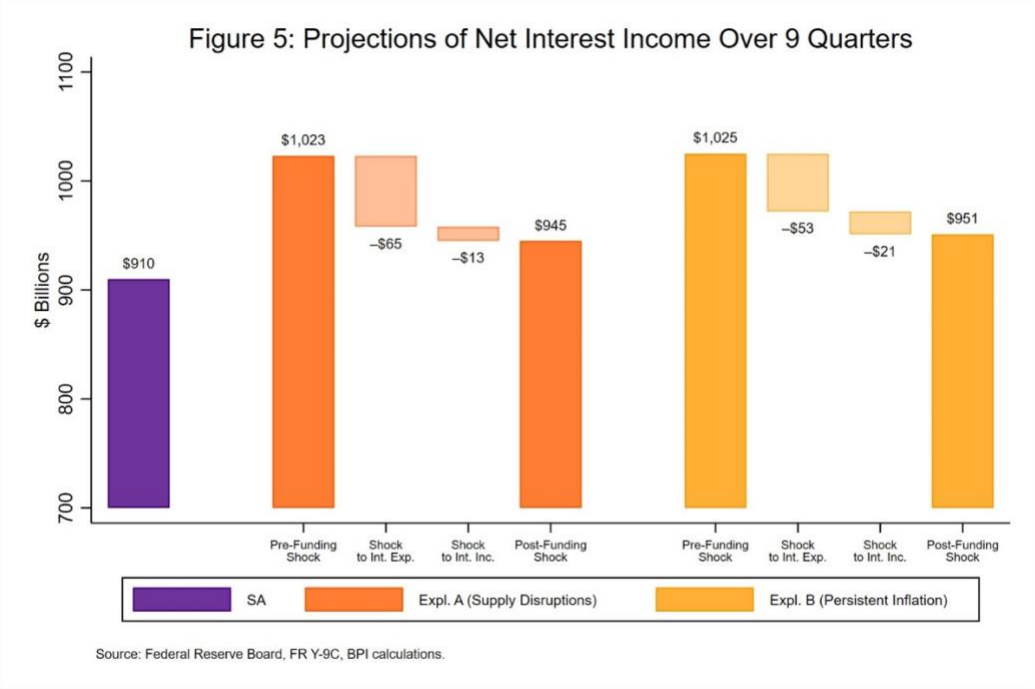


Figure 4 presents the aggregate projections of net interest margins (NIMs) under the three scenarios. Under the severely adverse scenario, NIMs are projected to decline sharply driven by lower funding costs and the abrupt decline in short-term rates. The response of NIMs at the bank level varies by each bank's business model. For example, banks more involved in capital market activities tend to have more non-deposit-type funding that is more sensitive to changes in short-term interest rates. Under the two exploratory scenarios, which reflect a rising interest rate environment, most banks in our sample would experience increases in interest income, because loans they originate tend to have floating-rate contracts.

In addition, deposits typically reprice at a slower pace than interest rates, which helps boost net interest income. The difference between the solid and dashed lines in Figure 4's exploratory scenarios estimates the size of the funding shock add-on, which we will discuss in more detail.



The estimates presented in Figure 5 decompose the effect of the different paths of interest rates and the funding shocks on the projections of net interest income. As shown by the bar graphs, the funding shocks reduce net interest income by $78 billion in the Exploratory A scenario and $74 billion in the Exploratory B scenario. Despite these funding shocks, the aggregate projections of net interest income are still increasing relative to the severely adverse scenario. This suggests that the positive impact of rising interest rates on net interest income outweighs the negative effect of the funding shocks.

However, we must note that the results vary at the bank-specific level. Some banks have liabilities that reprice at a rate similar to their assets, meaning that their funding costs increase at a pace comparable to their interest income. This tends to be the case for custodian banks and some of the largest banks in the sample. As a result, these banks may not benefit as much from the rising interest rate environment, since their net interest margins may remain relatively stable or even compress.

The heterogeneity in bank-specific results highlights the importance of considering individual bank characteristics and business models when assessing the impact of interest rate changes and funding shocks on net interest income.

Final Remarks

In conclusion, the Federal Reserve's stress testing models and scenarios raise several concerns that warrant further examination. First, the Fed's models lack transparency, which makes it difficult to assess the validity and reliability of the results. To improve confidence in the stress testing process, the Fed needs to share more information about the underlying assumptions and methodologies employed. Second, to ensure the plausibility of the macroeconomic scenarios, the Fed should provide more transparency in terms of the models and assumptions that result in such outcomes. Finally, to enhance the robustness and comparability of the stress testing results, the Fed should develop a more refined and standardized approach to model funding shocks with a direct link to the macroeconomic scenario.

_____

Disclaimer: The views expressed do not necessarily reflect those of the Bank Policy Institute's member banks, and are not intended to be, and should not be construed as, legal advice of any kind.