

# Reserve Balances, Noninterest Expenses, and Bank Performance in the Stress Tests

April 1, 2021



The performance of banks in the supervisory stress tests depend importantly on the projections of noninterest expense over the 9-quarter planning horizon. These projections include material items, such as total compensation to employees; expenditures on fixed assets; and other expenses, such as advertising and marketing expenses and consulting, among others. The supervisory models generate projections of each major expense type relative to total assets and use total assets at the start of the stress test to transform noninterest expense projections into dollar amounts.

The projections for noninterest expense were 9.4 percent higher in the December 2020 stress test relative to the June test. Consequently, projected bank pre-provision net revenue fell even more, and projected post-stress capital ratios declined further. While it is natural for noninterest expenses to increase in a downturn, the large increase in stressed expense projections between the two consecutive tests was unexpected (and procyclical). So, why did the Federal Reserve's estimates of noninterest expense increase in the December tests?

The rise in noninterest expenses was driven by the expansion of bank balance sheets over the first half of the year, because supervisory models use total assets to transform noninterest expense projections into dollar amounts—regardless of the nature of those assets. An important driver of the increase in total assets was the \$850 billion increase in reserve balances that resulted from the Federal Reserve's massive purchases of Treasury securities and agency MBS between March and June 2020 at banks that participated in the stress tests. Nearly half of the increase in total assets during the first six months of 2020 is attributable to the growth of reserve balances.

Although an increase in reserves results in practically no increase in bank expenses (or incomes), the stress test assumes noninterest expenses would increase in proportion to the growth of reserves. Under the stress test, there are also components of income that depend on total assets, such as other noninterest income. For the same reason, the increase in reserves also helped improve the projections of noninterest income. The effect on revenues, however, appears significantly smaller than the effect on expense, so they do not offset one another since expenses are generally a larger item.

In the first part of the note, we propose a simple adjustment to the supervisory projections of noninterest expense and estimate its impact in each bank's capital ratio under stress. We find that the increase in reserves over the first half of 2020 overestimates the decline in the common equity Tier 1 (CET1) capital ratio by approximately 23 basis points for the median bank. Moreover, banks that reported larger increases in reserve balances and reached the trough in their capital ratios toward the end of the planning horizon would have experienced an increase in their post-stress minimum CET1 capital ratio of more than 60 basis points. The adjustment to income components that depend on total assets is more imprecise because our models have less granularity than those used by the Federal Reserve. Even if almost all noninterest income projections depend on total assets, the minimum CET1 ratio of the median bank would increase 12 bps, and seven banks would experience an increase of 27 basis points or more in their CET1 capital ratio.

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A more robust solution would be to abandon using total assets to transform the projections of noninterest expenses into dollar amounts, because total assets have no significant explanatory power over noninterest expenses, as the recent episode of increasing reserve balances has demonstrated. Instead, the Fed could follow industry practice and generate projections for the ratio of noninterest expenses to operating income (also known as the efficiency ratio) and use the projected operating income in the stress tests to transform noninterest expenses into dollar amounts. In the last section of the note, we show that this approach would increase the post-stress minimum CET1 capital ratio of the median bank nearly 1 percentage point. Moreover, adjusting the noninterest income components that depend on total assets has almost no impact on bank performance because when projected revenues fall in the efficiency ratio model, noninterest expense is also projected to decline over the planning horizon since the historical data supports a quick reversion of the efficiency ratio to normal values.

## Background on the Supervisory Noninterest Expense Model

Revenues that banks generate over the stress planning horizon are the first line of defense against the losses projected over that horizon. Specifically, pre-provision net revenue (PPNR) allows a bank to fund increases in provisions for loan losses in the stress test. Such revenue also helps offset the increase in mark-to-market and counterparty losses and operational risk losses banks experience over the stress planning horizon. PPNR has three components—net interest income, noninterest income, and noninterest expense—and is derived as the sum of the two forms of income, less noninterest expense. The most recent DFAST 2020: Supervisory Stress Test Methodology states that the Fed uses 24 different models to project the various subcomponents of PPNR.

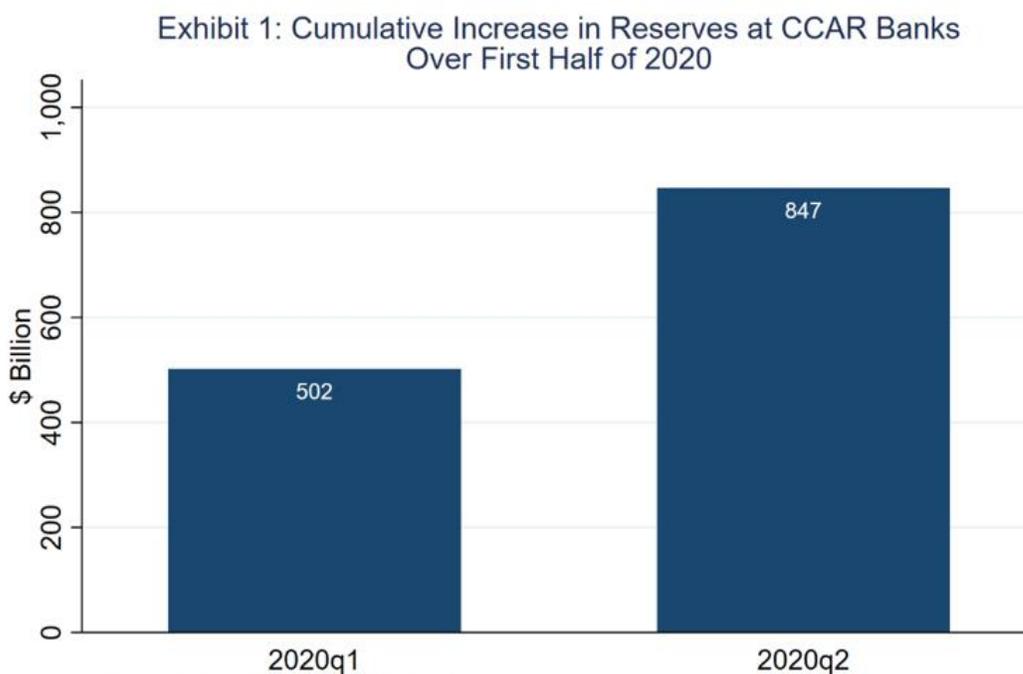
In this note, we propose adjustments to the projections of noninterest expense (NIE) to account for the sharp increase in bank assets since the start of the pandemic as a result of banks absorbing government stimulus actions to support the economy. The Fed uses three different models to project each of the three components of NIE in the stress tests: compensation expense; fixed assets expense; and all other noninterest expense, excluding operational risk losses and OREO expenses. The projections are based on autoregressive models that relate each of a bank's noninterest expenses (expressed as a share of total assets) to macroeconomic variables, previous values of the expenses, bank fixed effects, and other bank-specific variables.

The projections for each component of NIE are made by forecasting the ratio of each expense component relative to total assets. However, to simulate the projections of each bank's net income and CET1 ratio, the NIE projections must be translated into dollar amounts. The mapping between projected ratios and expenses is done using the level of total assets at the start of the stress tests. For example, if during the first quarter of the projection horizon the ratio of compensation expenses to assets is 1 percent and the bank's total assets are \$500 billion, the compensation expense would be  $0.01 \times \$500$  billion, or \$5 billion.

In the December 2020 stress tests, the Federal Reserve projected that, in the aggregate under the severely adverse scenario, the 33 subject banks would book \$1,260 billion in noninterest expense cumulatively over the 9 quarters of the stress planning horizon. This represents a 9.4-percent increase relative to the NIE projections in the June stress tests. We will show that the increase in NIE is largely driven by an increase in total assets observed between 4Q19 and 2Q20, nearly half of which is attributable to the expansion in reserve balances.

## Growth in Reserve Balances During the First Half of 2020

As a result of the extraordinary shock triggered by the COVID-19 pandemic, the Federal Reserve purchased large amounts of Treasury securities and agency MBS between March and June 2020. Mechanically, when the Federal Reserve expands its assets, the deposits commercial banks have at the Federal Reserve Banks increase as well. This occurs in the first instance because the Fed purchases those securities from dealers and funds those purchases by crediting the accounts of dealers' custodian banks.<sup>1</sup> As a result of the purchases of Treasury securities and agency MBS, reserve balances rose more than \$1.1 trillion between March and June, of which \$850 billion were on the balance sheets of the 33 banks that participated in the December stress tests (Exhibit 1). When the Fed buys a Treasury security, its assets go up by the amount of the purchase. The corresponding liability item that increases is reserve balances – deposits of depository institutions (banks) at Federal Reserve Banks. The banking system as a whole must hold those deposits, so holding other assets equal, the assets of the banking system will go up.



Source: Federal Reserve Board, FR Y-9C.

Note: Data include all 33 banks subject to December 2020 Stress Tests.

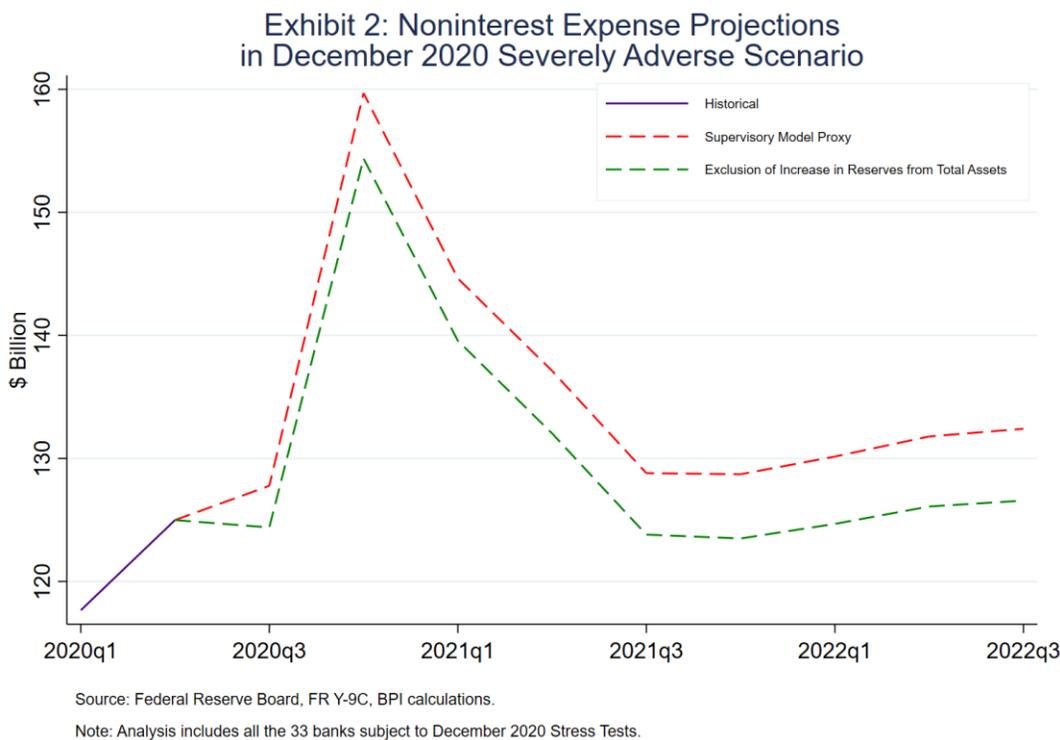
Banks also absorbed a portion of the rapidly increasing stock of Treasury securities as a result of the government response to the coronavirus. The 33 banks subject to the stress tests absorbed more than \$300 billion in Treasury securities over the first half of 2020, in addition to the \$850 billion in reserves, for a total increase in bank balance sheets of nearly \$1.2 trillion. In aggregate, total assets rose nearly \$2 trillion at the banks subject to the stress tests during the first half of 2020. In addition to reserves and Treasury securities, the increase in total assets was also driven by the funding of Paycheck Protection Program (PPP)

<sup>1</sup> The reserve balances of the custodian banks will change the next second, of course, as other transactions hit their books, but the reserve balances of the banking system, which is determined exogenously by the Fed's balance sheet, are not changed by transactions between banks.

loans (a government program to support small businesses during the coronavirus event) and other lending banks made to households and businesses.

## Proposed Adjustments to Noninterest Expense Projections

To estimate the impact of the deduction of the increase in reserves from total assets on bank performance in the stress tests, we ran the model projections for noninterest expense and the CET1 ratio over the stress planning horizon for each of the 33 banks. To simulate the path of the CET1 ratio under stress of each bank, we have used BPI’s version of the CLASS model developed by Hirtle, Kovner, Vickery, and Bhanot (2016).<sup>2</sup>

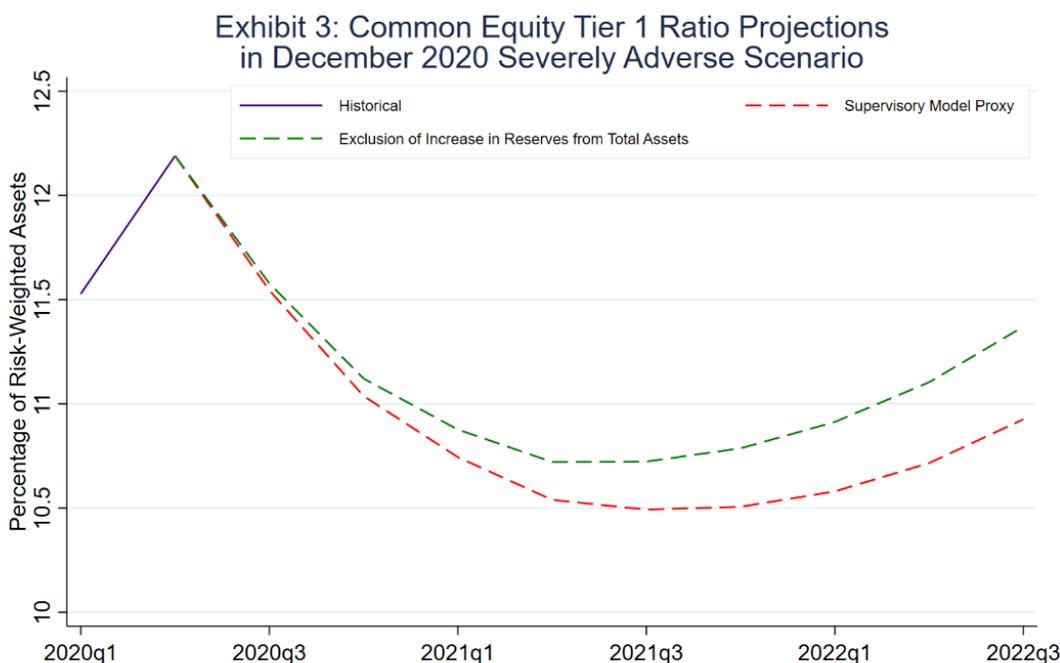


The projected path of noninterest expense over the stress planning horizon is shown in Exhibit 2. The baseline forecast using BPI’s top-down model is the dashed red line. The alternative specification that deducts reserves from total assets is plotted in green. We made a series of adjustments to the forecasts obtained under the supervisory model. First, we adjust the jump-off point for the ratio of noninterest expense to assets by deducting the change in reserves observed over the first half of 2020. We need to make an adjustment to both the first-quarter and second-quarter NIE-to-asset ratio because the

<sup>2</sup> See Hirtle, B., A. Kovner, J. Vickery, and M. Bhanot, 2016, “Assessing Financial Stability: The Capital and Loss Assessment under Stress Scenarios (CLASS) Model”, *Journal of Banking and Finance*, 69(S1), pp. S35–S55. Available at <https://www.sciencedirect.com/science/article/abs/pii/S0378426615002940>. BPI’s own version of the CLASS model uses different model specifications to generate the projections of loan losses and PPNR. For example, the projections for PPNR include bank-specific fixed effects (more specifically, a trailing multiyear fixed effect) to capture each bank’s average performance in recent years, and loan losses are modeled using quantile regressions. The percentiles of the quantile regressions are chosen to match the level of losses projected by supervisory models.

supervisory model uses the average values over the prior 4 quarters as its jump-off ratio. Then, after we have a path for the projected ratio of NIE to assets, we multiply the time-series with the adjusted series for total assets.

As a result of the deduction of the increase in reserves from total assets, under the severely adverse scenario, aggregate noninterest expense is projected to be \$1,175 billion cumulatively over the 9 quarters of the stress planning horizon. Relative to the unadjusted projections, NIE declines by \$46.1 billion for the 33 banks subject to the December stress tests. Note that we did not have to re-estimate the NIE models to perform our adjustments to the NIE forecast, only to adjust the inputs required to generate the projection of noninterest expense.



Source: Federal Reserve Board, FR Y-9C, BPI calculations.

Note: Analysis includes all the 33 banks subject to December 2020 Stress Tests.

The projected decline in the aggregate CET1 ratio in the December 2020 severely adverse scenario under the two different projections for noninterest expense is shown in Exhibit 3. We maintain the Fed’s assumptions in DFAST that both projections of share repurchases and dividends are set to zero over the planning horizon. The red line shows the path of the CET1 ratio under the supervisory projections for noninterest expense, which declined from 12.2 percent in the second quarter of 2020 to a minimum of 10.5 percent in the third quarter of 2021. Similarly, the green line is the aggregate CET1 ratio path using the adjusted assets series to generate the projections of noninterest expense. In this case, the minimum CET1 ratio was 10.7 percent (in the fourth quarter of 2021), or about 20 basis points above the projections that include the increase in reserves in total assets to project noninterest expense.

It is worth noting that we cannot perfectly replicate the minimum CET1 ratio as reported by the Federal Reserve, because the Fed’s projections of loan losses and other subcomponents of pre-provision net

revenue use confidential and much more granular supervisory data compared with BPI’s top-down models. We also have no way of estimating the size of operational risk losses based on publicly available data. For these reasons, we can only offer a best effort estimate of the impact of excluding the increase in reserves from the projections of noninterest expense. Nonetheless, the projections from BPI’s top-down model are very close to those published by the Federal Reserve in December 2020 under the severely adverse scenario.

Despite these challenges, we believe the variation in the projections of noninterest expense and the corresponding implications for the CET1 ratio of each firm give a reasonable estimate of the effect of deducting the increase in reserves and Treasury securities from total assets in the NIE projections. Table 1 shows the distribution of the change in the minimum CET1 capital ratio that results from exclusion of the increase in reserve balances from total assets in the projections of noninterest expense. The median impact on the minimum CET1 ratio is 23 basis points across the 33 banks. The 90th percentile corresponds to an increase of 60 basis points. The wide variability in the effect reflects the level of change in reserves of each bank and the quarter in which the bank reaches the trough in its CET1 capital ratio. Banks that reach the minimum CET1 ratio at the end of 9 quarters would be more affected by the expansion of bank balance sheets, since the effect of the difference in NIE projections on CET1 ratios would be growing during the stress planning horizon.

Table 1: Effect of Excluding Reserves on Minimum CET1 Capital Ratio in December 2020 Severely Adverse Scenario					
	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile
Adjustment to total assets in NIE model	0	4	23	34	60
Lower bound (net of noninterest income adjustments)	0	4	12	17	27

Note: Sample consists of the 33 firms participating in DFAST 2020. The values are in basis points.

According to the Federal Reserve’s DFAST 2020: Supervisory Stress Test Methodology, some subcomponents of noninterest income—fiduciary income and insurance/banking fees, investment banking fees, and all other noninterest income—are also normalized by total assets. The argument for adjusting these revenue components follows the same logic as for adjusting noninterest expenses. BPI’s models are not as granular as the supervisory models, and the second row of Table 1 performs the adjustment for all of noninterest income with the exception of trading revenue since the latter is scaled by trading assets. As a result, the net NIE adjustment to CET1 ratios represents more of a lower bound to the reserve balances adjustment on the minimum CET1 capital ratio. Still, after adjusting total assets in the derivation of the projections of noninterest income, the median net NIE adjustment is 12 basis points and the 90th percentile is 27 basis points. The effect of the increase in reserve balances on the minimum CET1 capital ratio will likely increase since aggregate reserve balances are expected to exceed \$5 trillion at the end of 2021.

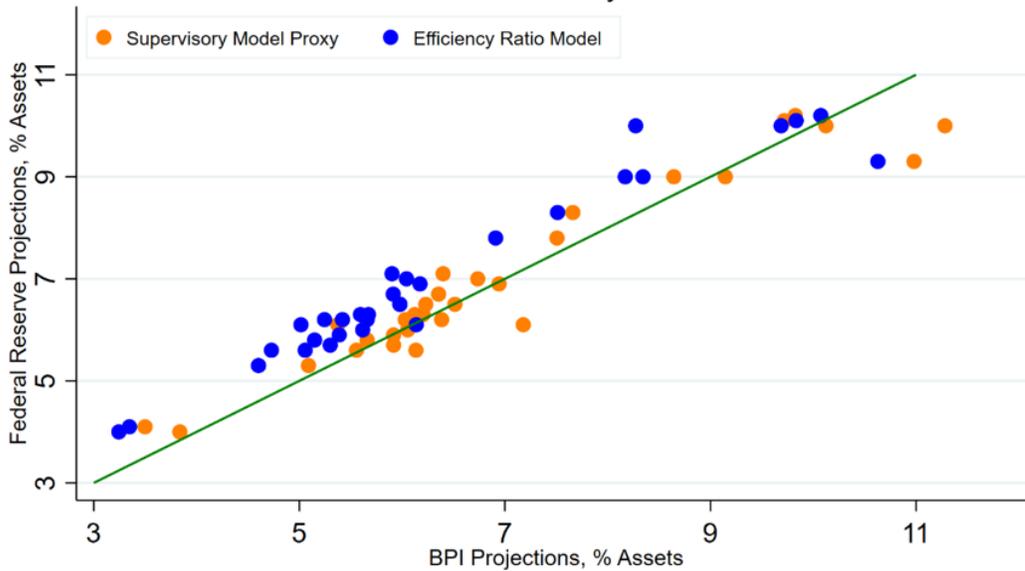
## A More Robust Solution to Address the Increase in Reserve Balances

We believe a better approach would be to avoid using total assets to transform projections of the various components of noninterest expense to dollar amounts, since reserve balances are growing rapidly and expected to remain elevated for a long time. A viable alternative that does not require using total assets and follows standard industry practice is to scale the various subcomponents of noninterest expense with operating income (i.e., the sum of net interest income and noninterest income). This change is labeled below as the efficiency ratio model. Efficiency ratio is a key measure of banks' operating performance and cost discipline. It's not uncommon for banks to manage to a publicly disclosed target efficiency ratio.

Another important feature of scaling the three subcomponents of noninterest expense by operating income is that it also captures expense controls taken during stress periods to reduce costs such as compensation, marketing expenses, consulting budgets, etc. As we will show, supervisory models assume a very slow recovery in the efficiency ratio to a normal range after the initial spike typically observed when an economy enters a recession. This occurs because supervisory models do not appropriately consider expense controls that result in the reduction of noninterest expenses during crisis periods. However, the PPNR models include fixed effects aimed at capturing individual firm characteristics and differences in business models, so it would be consistent with the other supervisory PPNR models to include more realistic features in the projections of noninterest expense.

The specification of the efficiency ratio models quite closely follows the supervisory specifications for each of the three components of noninterest expense described earlier. The only change made was to normalize each subcomponent of noninterest expense with operating income instead of total assets. All three models include an autoregressive term, an individual bank fixed effect, and a trailing multiyear fixed effect, and the autoregressive term represents an average of the dependent variable over the prior 4 quarters. The macroeconomic variables remain the same across the supervisory and efficiency ratio model specifications. To transform the projections of each noninterest projection into dollar amounts, we use the projected operating income throughout the planning horizon. Moreover, we do not deduct losses associated with the global market shock from operating income. If we were to do so, projected noninterest expense would be lower compared with the results presented next.

### Exhibit 4: Differences in NIE Projections in December 2020 Severely Adverse Scenario



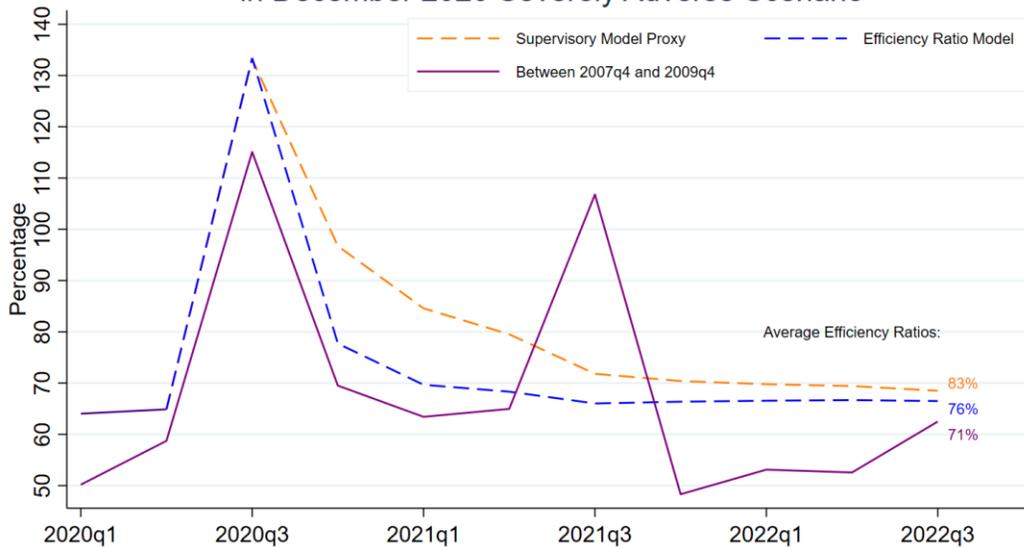
Source: Federal Reserve Board, FR Y-9C, BPI calculations.

Note: Analysis includes all the 33 banks subject to December 2020 Stress Tests. Data in the chart is restricted to banks with less than 15 percent of NIE to assets to more clearly show the fit of the two models relative to supervisory projections.

Before describing the impact of the efficiency ratio model projections on firm performance, it is useful to compare the projections obtained using the efficiency ratio model and BPI's version of the supervisory model against the projections the Federal Reserve published in December 2020. The scatterplot in Exhibit 4 shows that BPI's version of the supervisory model does a reasonable job capturing the December results the Fed published, because the large majority of the orange dots are close to the 45-degree green line. If the two projections were identical, all dots would lie on top of the 45-degree line. The projections of noninterest expense using the efficiency ratio specification are almost all above the 45-degree line and farther away from the line relative to BPI's version of the supervisory model. Thus, on average, the projections of noninterest expense derived from the efficiency ratio model are lower relative to those published by the Fed in December. The difference in noninterest expense projections across the two model specifications is about \$100 billion. Moreover, BPI's version of the supervisory model understates the Fed's December projections by approximately \$40 billion. We would not be able to perfectly match the supervisory results, because the Fed excludes losses associated with operational risk events and OREO expenses from all other noninterest expense.<sup>3</sup>

<sup>3</sup> The Federal Reserve excludes losses from operational-risk events and OREO expenses from all other noninterest expense, while we do not. For this reason, we do not include projections of losses associated with operational-risk events in our results either.

### Exhibit 5: Efficiency Ratio Projections in December 2020 Severely Adverse Scenario



Source: Federal Reserve Board, FR Y-9C, BPI calculations.

Note: Analysis includes all the 33 banks subject to December 2020 Stress Tests. The efficiency ratio is defined as noninterest expenses normalized by the sum of net interest income and noninterest income. The efficiency ratio plotted in the chart deducts GMS losses from noninterest income. The projections of noninterest expense do not deduct GMS losses from operating income. The two spikes in the historical data occur in 4Q07 and 4Q08 due to elevated mark-to-market losses associated with mortgage-related assets.

The difference in the aggregate projections of NIE across the two BPI models is \$100 billion. This difference represents the importance of expense controls in reducing expenses when operating revenues are below normal levels. As can be seen in Exhibit 5, the projected efficiency ratio calculated using the efficiency ratio model (represented by the blue dashed line) moves back faster to normal values after the initial shock relative to the efficiency ratio derived using BPI’s version of the supervisory model (dashed yellow line). The gap between the two projections is remarkable during the fourth quarter of 2020 and the third quarter of 2021 and illustrates the importance incorporating the relationship between expenses and revenues that is supported by the data.

The faster convergence to normal values during a stress event obtained using the efficiency ratio model is also consistent with the efficiency ratio observed during the 2007–2009 financial crisis. A distinctive feature of the financial crisis is that we can see two spikes in the efficiency ratio driven by elevated mark-to-market losses associated with mortgage-related assets in the fourth quarters of 2007 and 2009. That being said, the efficiency ratio in the financial crisis moved back quickly to normal values. This resulted in an average efficiency ratio of 71 percent over a 9-quarter horizon and well below the average efficiency ratio calculated using the projections of BPI’s efficiency ratio model and BPI’s supervisory model, namely 76 percent and 83 percent, respectively.

Table 2 shows the distribution of the change in the minimum CET1 capital ratio after replacing the noninterest expense projections of BPI’s supervisory model with the efficiency ratio model. The median bank in our sample would experience an 86-basis-point increase in its post-stress CET1 ratio, which represents a material improvement in performance. Banks with a high ratio of noninterest expense to risk-weighted assets would experience an even larger increase in performance because of the change in model

specification. In contrast to the reserve deduction adjustment, banks that reach the minimum CET1 capital ratio in the first year of the projection horizon would also benefit significantly from this change, because the gap in the efficiency ratio under the two model specifications occurs earlier in the stress projection horizon. Lastly, adjusting the projections of the subcomponents of noninterest income that are scaled by total assets to reflect the elevated reserve balances has very little impact on the results. This occurs because lower operating revenues would automatically result in lower noninterest expense which effectively offsets the effect of the adjustment on overall PPNR. That said, the Federal Reserve should also revisit the assumption of normalizing certain components of noninterest income with total assets. These adjustments become even more important as reserve balances are expected to grow.

**Table 2: Effect of Efficiency Ratio Model on Minimum CET1 Capital Ratio in December 2020 Severely Adverse Scenario**

	10th Percentile	25th Percentile	50 <sup>th</sup> Percentile	75th Percentile	90th Percentile
Efficiency Ratio Model	0	12	86	106	151
With Noninterest Income Adjustments	0	10	82	106	147

Note: Sample consists of the 33 firms participating in DFAST 2020. The values are in basis points.

## Conclusions

The December 2020 tests reported a 9.4-percent increase in noninterest expense projections across the 33 participating banks relative to the June results. We have shown that the increase in reserves accounted for about \$46 billion of the \$105.6 billion increase in noninterest expenses registered between the two tests in 2020. We also showed that the overstatement of expenses caused the aggregate CET1 ratio to decline another 23 basis points for the median bank. Although we cannot precisely quantify the offsetting adjustment that would result from lower noninterest income projections, we show that the overstatement of capital declines driven by higher noninterest expenses is still quite material, even if all noninterest income (excluding trading revenues) were normalized by total assets. For these reasons, we recommend making an adjustment for the increase in reserves on the projections of NIE and NII in the upcoming 2021 stress tests.

In addition, we show that a more robust solution would be scale the various subcomponents of noninterest expense with operating income and use those projections to transform the noninterest expense projections into dollar amounts. We show that this mechanism would do a better job capturing the behavior of efficiency ratios during stress periods. The slower convergence of efficiency ratios to normal values in the supervisory stress tests materially understates bank performance. In addition, this solution would neutralize unrealistic impact to noninterest expense projections from the expected continued growth of reserve balances.