A Better Way to Combine Stress Results

11.20.18

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The heavy reliance of the Fed's stress tests on projections from a single model, in turn based on a single economic scenario, causes the stress tests to suffer from two key failings. First, they create incentives for banks to homogenize their portfolios thus making banks sensitive to the same shocks and possibly increasing systemic risk. In a recent speech, Kevin Stiroh, head of bank supervision at the Federal Reserve Bank of New York, observed that the business models of large US banks are in fact becoming more similar, with banks gravitating toward the universal bank model. Second, for reasons we explain, projections under a single scenario do not accurately measure bank risk. Randal Quarles, Vice Chairman of the Federal Reserve Board, expressed in a recent speech a similar concern about the global market shock component of stress tests (which are not further addressed here), stating that "a single market shock does not adequately capture risks in firms' trading book."

This research note presents a straightforward and intuitive way to combine projections of bank performance under multiple scenarios to determine the capital required to pass the stress test. The approach would both provide a more accurate measurement of bank risk and reduce the unintended and unwanted incentives that lead to increased correlation risk.

The Fed currently projects bank losses under two scenarios—the "severely adverse" scenario and the "adverse" scenario—and requires banks to have enough capital to pass the test that generates the maximum peak-to-trough decline in regulatory capital ratios. The Fed sets the severely adverse scenario to resemble conditions in a severe postwar recession (conditions associated with sharply rising unemployment). Because the adverse scenario would serve no purpose if it were just an easier version of the severely adverse scenario, the Fed uses it to test banks for secondary but still important sources of risk (most frequently rising interest rates). Nevertheless, the projection under the severely adverse scenario almost always generates the maximum decline in peak-to-trough regulatory capital ratios and so determines banks' capital requirements. Indeed, the Economic Growth, Regulatory Relief, and Consumer Protection Act removed the requirement that the Fed include a second scenario and it is unknown if one will be included in future stress tests.

Our results suggest that, by setting capital based on the projection under the severely adverse scenario alone, the Fed is both throwing away useful information and establishing unwanted and unintended incentives. For example, as explained in a previous BPI blog post, the current design could incentivize banks to take on greater interest rate risk.

In this research note, we describe a way that two projections can be combined to deliver a near-optimal measure of bank risk under simplifying assumptions. When there are two independent sources of bank risk, a bank's stress capital buffer should be set equal to the sum of 1) the projected decline in capital ratios under the more important source of risk and 2) a fraction between zero and 40 percent of the projected decline under the less important source.

Such an approach would raise capital requirements if no other adjustments were made. If the Fed wishes to follow this procedure but keep the overall stringency about the same as it is now, it should reduce the severity of the severely adverse scenario. Viewed another way, because the Fed is currently ignoring important sources of risk, it is probably calibrating the one source of risk it measures—the risk of a severe recession—too high. This interpretation is consistent with separate BPI research (see here, here, here, here, and here) that finds that the conditions in the severely adverse scenario are much worse than those in the great recession.

NEAR-OPTIMAL STRESS TEST

Consider a bank, *i*, whose return on risk-weighted assets, Z_i, evolves over the stress-test horizon according to

$$Z_i = b_{1i}f_1 + b_{2i}f_2 \qquad (1)$$

where f_1 and f_2 are independent common factors with mean 0 and variance 1. Coefficients b_{1i} and b_{2i} represent bank i's sensitivity to changes in each factor. In this simple example, the bank faces no idiosyncratic risk, and investors are assumed to be risk neutral with a required return of zero.

The objective is to design a stress test framework that establishes a capital buffer for each bank such that the bank has, at most, a specific probability of failure, where failure occurs if capital falls below some minimum requirement. While the precise failure rate will depend on the statistical distribution of the factors, we will simply focus on standard deviations to keep the discussion general. Specifically, bank i would be required to maintain a stress capital buffer (C_i) over its minimum requirement that will ensure the bank has capital that is N standard deviations (σ_{Z_i}) from the minimum, where

$$\sigma_{Z_i} = \sqrt{(b_{1i}^2 + b_{2i}^2)}. \qquad (2)$$

In this simple case, therefore, the optimal stress capital buffer would be

$$C_i = N\sqrt{(b_{1i}^2 + b_{2i}^2)} \qquad (3)$$

The inverted cone in exhibit 1 illustrates the optimal stress capital buffer required by each possible factor loading. The stress capital buffer is represented by the height of the surface. By contrast, the inverted pyramid (exhibit 2) illustrates the capital requirement prescribed by the max rule. In both cases, the optimal stress capital buffer rises as the factor loadings get further from the origin.

Exhibit 1

Optimal Rule

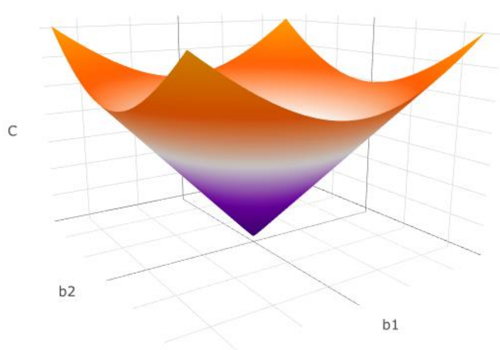
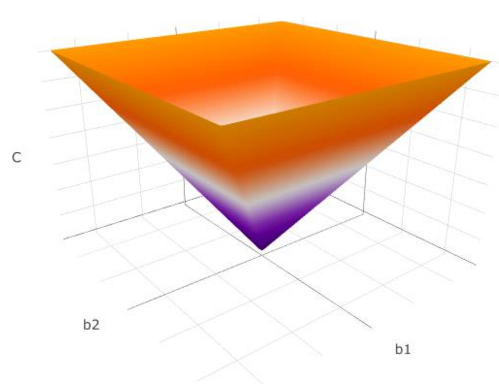


Exhibit 2

Max Rule



Assuming the Fed designs the stress scenarios conservatively, all capital requirements prescribed by the max rule are greater than or equal to those prescribed by the optimal rule. When we compare the surfaces generated by the two rules (exhibit 3), we can see that the stress capital buffer prescribed by the max rule is equal to the optimal stress capital buffer along the corners where $b_{1i} = b_{2i}$, i.e. — where the bank is exposed to both sources of risk equally. Everywhere else, the max rule is too stringent. Exhibit 4 illustrates this by showing a slice of exhibit 3 in which b_{2i} is held constant where the purple line represents the optimal rule and the orange line represents the max rule.

Exhibit 3

Max vs. Optimal Rule

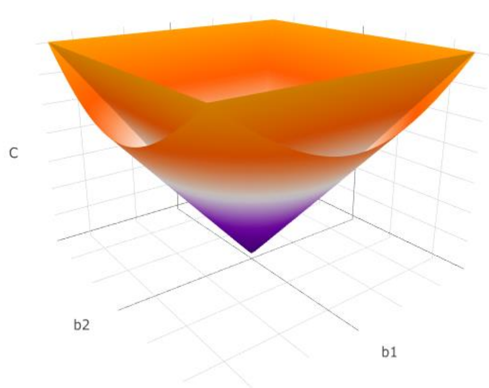
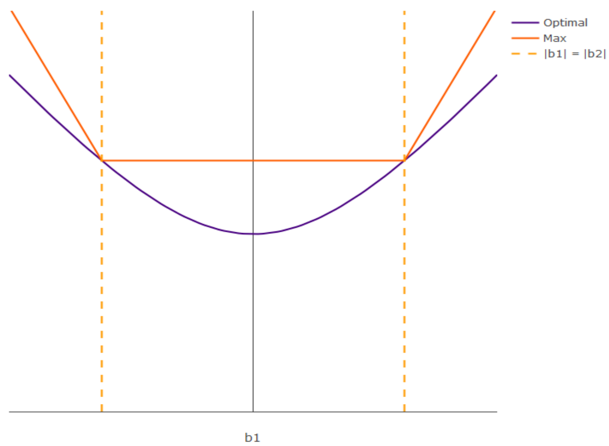


Exhibit 4

Max vs. Optimal Rule, Holding b2 Constant



To address this problem, we construct a rule using a standard approach for approximating a curve, polynomial interpolation, applied to the two projections. This near-optimal rule is as follows: (1) set the capital buffer equal to the projection that yields the maximum decline and (2) add a fraction of the second projection determined by weight w_i, defined below.

Specifically, set the two stress test scenarios to:

$$(f_1, f_2) = \ (-N, 0) \quad (4)$$

and

$$(f_1, f_2) = (0, -N). \quad (5)$$

That is, each scenario is as unlikely as the desired rarity of a bank failure. Plugging these two scenarios into equation (1), we get the following projected losses:

$$p_{1i} = |-N\ b_{1i}| \qquad (6)$$

and

$$p_{2i} = |-N\ b_{2i}| \qquad (7)$$

Note that

$$C_i = N\sqrt{(b_{1i}^2 + \ b_{2i}^2)} = \sqrt{p_{1i}^2 + p_{2i}^2} \qquad (8)$$

We will interpolate $C_i(p_{1i}, p_{2i})$ using the polynomial,

$$P(p_{1i}, p_{2i}) = p_{1i} + w_i p_{2i}^2, \qquad p_{2i} < p_{1i} \qquad (9)$$

Interpolating at points (p_{1i}, p_{1i}) and $(p_{1i}, 0)$—where $p_{1i} = p_{2i}$ and $p_{2i} = 0$—we get the following weight,

$$w_i = \frac{(\sqrt{2} - 1)}{p_{1i}} \qquad (10)$$

This leaves us with a near-optimal rule that gives precisely the same capital requirement as the optimal rule when $b_{2i} = 0$ and when $b_{1i} = b_{2i}$ and closely approximates the surface of the optimal rule everywhere else:

$$C_i = p_{1i} + \frac{(\sqrt{2} - 1)}{p_{1i}} p_{2i}^2 = p_{1i} + (\sqrt{2} - 1)\frac{p_{2i}}{p_{1i}} p_{2i} \qquad (11)$$

When we plot the stress capital buffer of the near-optimal rule along with the optimal stress capital buffer, they are virtually indistinguishable (exhibit 5). Exhibit 6 shows a slice of exhibit 5, holding b_{2i} constant.

Exhibit 5

Near Optimal vs. Optimal Rule

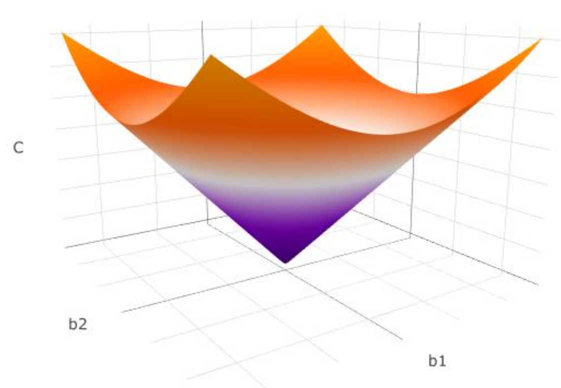
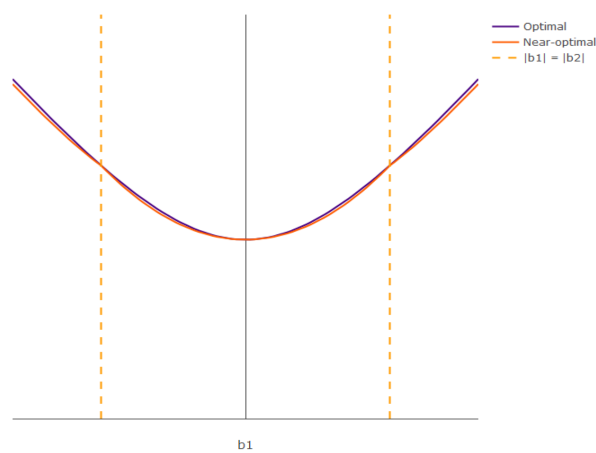


Exhibit 6

Near-optimal vs. Optimal Rule, Holding b2 Constant



UNDESIRABLE PROPERTIES OF THE "MAX" RULE

When capital buffers are established by picking the worst of the two projections, a bank receives no penalty for increasing its exposure to the secondary sources of risk. If banks choose their portfolio to minimize capital for a given level of risk, then they will reduce their exposure to the scenario that generates the greater losses and increase their exposure to the secondary risk until the two exposures are about equal.

Such a process is likely underway in the United States where, as shown by Covas (2017), Acharya et al (2017), Bordo and Duca (2018), and Cortés et al (2018), banks subject to stress tests are shifting away from exposures, such as small business lending and lending to middle-class households, that do poorly in a severe recession. The process may have been accelerated by the Fed increasing the severity of the severely adverse scenario to compensate, on average, for the fact that the resulting capital buffer requirements were not taking into account important secondary sources of risk.

IMPLEMENTATION

As noted in the introduction, the Fed already projects losses under two scenarios intended to capture different sources of risk – the severely adverse scenario and the adverse scenario. Our analysis suggests that instead of only using the results from the severely adverse scenario, the Fed should also be adding a fraction of the losses projected under the adverse scenario to the losses under the severely adverse scenario as in equation (11). Of course, any such implementation would require adjusting for the simplifying assumptions that we made to generate the result.

The scenarios should be chosen to each be exactly as stringent as the desired stringency of the overall test. In the analysis above, the two factors are each set to $-N$, which is N standard deviations below the expected outcome. Suppose, for example, the first factor is intended to capture a positive unemployment shock while the second is meant to capture a positive interest rate shock. Suppose also that the test is intended to ensure that, for each bank, there is a 1 percent chance of failure. Then the first scenario should resemble an unemployment shock with a 1 percent chance of being exceeded and the second scenario should resemble an interest rate shock with a 1 percent chance of being exceeded.

In the U.S. case, such an approach may call for an easing of the severely adverse scenario. If the Fed is satisfied with the capital buffers currently being required by the stress tests on average, then it has likely amplified the stringency of the severely adverse scenario to make up for the fact that the buffers do not account for other sources of risk. In the above analysis, for example, if banks' exposures to the two factors are typically about equal, and the Fed seeks capital buffers that seem about right using its "max" rule, then it will calibrate the test to resemble the inverted pyramids in exhibits 2 and 3. In that case, the severely adverse scenario would need to be set to $\sqrt{2}N$, or about 40 percent more stringent than the desired stringency of the overall test. More realistically, banks are likely exposed to the risk of a severe recession more than other sources of risk, so the severity amplification may be less. A recent BPI research note found, for example, that aggregate net losses projected using the 2018 severely adverse scenario were $200 billion greater than net losses projected using the macroeconomic conditions that prevailed during the Great Recession.