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Overview and Assessment
of the Methodology Used by the
Federal Reserve to Calibrate the
Single-Counterparty Credit Limit

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SUMMARY

In March 2016, the Federal Reserve issued a notice of proposed rulemaking (NPR) implementing single-counterparty credit limits (“SCCL”) for domestic and foreign bank holding companies (BHCs) with total consolidated assets of \$50 billion or more. Under the proposal, the stringency and composition of the applicable SCCL would vary based on the size and type of BHC, with U.S. globally systemically important bank holding companies (GSIBs) subject to the most stringent SCCL. For GSIBs, the proposal would generally limit credit exposures to any counterparty to no more than 25 percent of its tier 1 capital, but in the case of a GSIB credit exposure to another GSIB, a more stringent limit of 15 percent would apply. Concurrent with its NPR, the Federal Reserve also published a white paper describing the methodology it used to determine whether the more stringent credit limit for inter-GSIB exposures was appropriate. This note reviews the methodology advanced in the white paper and identifies two important shortcomings in the calibration of the more stringent inter-GSIB credit limit:

- » The model used to calibrate the more stringent inter-GSIB credit limit has twice as many parameters as features in the data it is trying to replicate, that is half of the credit risk model parameters are not pinned down. The standard practice in calibration is to use features of the data in as many dimensions as there are unknown parameters. Thus, the lack of empirical basis for half of the parameters of the credit risk model implies that the ***proposed more stringent 15 percent limit for inter-GSIB exposures is not appropriately calibrated.***

- » The model and assumptions presented in the SCCL white paper are inconsistent with the model and assumptions presented in a similar calibration white paper the Federal Reserve published in 2015 in connection with finalizing its capital surcharges for GSIBs. In particular, the SCCL white paper assumes all GSIBs have the same probability of default which is inconsistent with the GSIB surcharge framework, in which the probability of default varies inversely with the systemic cost of a GSIB’s failure. ***In order to achieve conceptual and intellectual consistency across the two frameworks, either the 15 percent inter-GSIB credit limit would have to be increased substantially or the GSIB surcharges would have to be cut roughly in half for the majority of GSIBs.***

ABOUT THE QUANTITATIVE CREDIT RISK MODEL

The white paper uses a stylized quantitative credit risk model to calibrate the credit limit for exposures between GSIBs. The model takes as a given the 25 percent limit established by the Dodd-Frank Act for credit exposures between a GSIB and any counterparty. The rationale provided in the white paper for a more stringent inter-GSIB limit is that the failure of a GSIB causes far greater negative externalities than the failure of a less systemically important financial institution.

The credit risk model assumes a GSIB has a pre-existing portfolio of assets and extends a loan to a counterparty that is or is not a GSIB. To estimate the appropriate limit on loans

from GSIBs to GSIBs, the model needs to assign numerical values for the following parameters:

- » The expected return of the loan.
- » The expected return of the portfolio.
- » The volatility of the value of the loan.
- » The volatility of the value of the portfolio.
- » The initial capital ratio of the lending bank.
- » The capital level below which the lending bank would be non-viable.
- » The exposure limit on the loan to a non-GSIB counterparty.
- » The correlation between the value of a loan to a non-GSIB counterparty and the portfolio value.
- » The correlation between the value of a loan to another GSIB counterparty and the portfolio value.
- » The exposure limit on the loan to a GSIB counterparty.

The white paper simply assumes numerical values for half of the model's parameters (i.e., the first five of 10). The return on the existing portfolio of assets is assumed to be 1 percent, and the return on a loan is also assumed to be 1 percent. The volatility of the value of the portfolio is assumed to be 3 percent, and the volatility of the value of the loan is assumed to be 9 percent. The initial capital ratio is assumed to be 10 percent.

Two values are taken from existing regulations: The level of capital of the GSIB deemed to be non-viable and effectively in default is assumed

to be 4.5 percent, the minimum capital requirement under Basel III; and the amount of the loan to a non-GSIB is assumed to equal 25 percent of capital, the limit established by Dodd-Frank. The two correlations are estimated using data on credit default swaps (CDS). The correlation between the portfolio of a typical GSIB and value of the loan to the non-GSIB is set using the correlations between CDS spreads of GSIBs and the CDS spreads of 256 other firms with outstanding CDS. Finally, the correlation between the portfolio of a GSIB and the loan to a GSIB is set using the correlations between GSIBs' CDS spreads.

Finally, the white paper uses the model to set the inter-GSIB credit limit. It does so by targeting a default probability of about 1.3 percent, which is "broadly consistent with observed data on the likelihood of large negative losses experienced by large BHCs."¹ First, the paper simulates the probability that the GSIB would default because of a credit loss to a non-GSIB counterparty when the single-counterparty credit limit is set at 25 percent of the GSIB's capital. Next, it solves the model when a GSIB extends a loan to another GSIB and finds that the credit limit needs to be lowered to 15 percent of the GSIB's capital in order to reach the same 1.3 percent probability of default. The GSIB-to-GSIB credit limit is lower because the GSIB to GSIB correlation is higher than the GSIB to non-GSIB correlation, and as a result there is a greater likelihood that the loan to a GSIB would perform poorly precisely when the lending GSIB's portfolio would experience heightened credit losses, increasing the odds of failure of a GSIB.

¹ "Calibrating the Single-Counterparty Credit Limit between Systemically Important Financial Institutions," p.9, footnote 8.

KEY OBSERVATIONS

The proposed more stringent 15 percent limit for inter-GSIB exposures is not appropriately calibrated...

Calibration has a long tradition in economics and is a strategy for finding numerical values for the parameters of models. This process involves setting parameter values so that the behavior of the model matches features of the data in as many dimensions as there are unknown parameters.² As described above, the quantitative credit risk model described in the SCCL white paper has ten parameters. Thus, the model should be calibrated using ten features of the measured data. However, the SCCL white paper only uses five data features, such that only a subset of the parameters used in the analysis are actually calibrated, with the remaining five parameters instead set at arbitrary assigned values (noted above).

The lack of an empirical basis for the numerical values assigned to the capital ratio of a GSIB, the rate of return of GSIBs' assets, and the two parameters governing the volatility of GSIBs' assets to the data introduces degrees of freedom in the analysis that substantially undermines the SCCL white paper's "calibration" of a more stringent inter-GSIB credit limit. Different choices for the initial capital ratio of a GSIB, rate of return of the assets, or volatility of the GSIBs' assets would yield completely different inter-GSIB credit limits. The next section provides an example of how a modest variation in just one of those parameters – the initial capital ratio of a

GSIB – has a material impact on the calibration of the inter-GSIB credit limit.

Moreover, the SCCL white paper appears to suggest that the rate of return of GSIBs' assets and its volatilities were chosen to target the odds of failure of a GSIB. If so, the procedure violates a key principle of the calibration of economic models which is to use features of the data in as many dimensions as there are unknown parameters. In this instance we have four parameters – the return on the loan, the return on the portfolio, the volatility of the loan, and the volatility of the portfolio – matched to the same feature of the data, namely the likelihood of large negative losses experienced by large BHCs. Indeed, the white paper refers to its analysis as "an exercise," which seems a more apt description than a calibration.³

The SCCL calibration is inconsistent with the GSIB surcharge rationale. Either the inter-GSIB credit limit is too stringent or the GSIB surcharge is too high.

The calibration in the SCCL white paper assumes that all GSIBs have the same starting level of capital and so the same probability of default. Indeed, the SCCL white paper states "...Model parameters... have been calibrated so that the resulting default probability is broadly consistent with observed data on the likelihood of large negative losses experienced by large BHCs."⁴ However, more systemically important

² See Cooley, Thomas F. (1997) "Calibrated Models," Oxford Review of Economic Policy, 13 (3) pp. 55-69.

³ "Calibrating the Single-Counterparty Credit Limit between Systemically Important Financial Institutions," p.8.

⁴ "Calibrating the Single-Counterparty Credit Limit between Systemically Important Financial Institutions," p.9, footnote 8.

GSIBs are required to hold additional capital in amounts equal to their GSIB surcharge. As described in a recent TCH research note assessing the GSIB surcharge methodology, the surcharges are chosen so the expected probability of a GSIB's failure declines in direct proportion to the systemic cost of its failure as measured by its "systemic loss given default score."⁵ For example, the failure of JPMorgan Chase (JPM) is assumed to pose greater systemic costs than the failure of a hypothetical reference bank since JPM has a higher systemic loss given default (SLGD) score than that reference bank. As a result, the framework laid out in the GSIB surcharge white paper increases the capital requirements of JPM relative to that reference bank. In particular, the capital surcharge of JPM is set to 4.5 percent while the surcharge of the reference bank is set to zero.

However, in the calibration of the more stringent credit limit between GSIBs presented in the SCCL white paper, the differences in capital levels required under the GSIB surcharge framework – and the impact of those differences on a GSIB's probability of default – are not taken into account. As a result, the inter-GSIB credit limit is lower than it would otherwise be if the calibration explicitly incorporated the capital surcharge of each GSIB.

Table 1 illustrates the inconsistencies between the SCCL white paper and the GSIB surcharge for JPM, the bank with the highest SLGD score under the Federal Reserve's GSIB surcharge framework. The first column reports the

TABLE 1: ILLUSTRATION OF CALIBRATION INCONSISTENCIES

	REFERENCE BHC	JP MORGAN CHASE	
Credit limit	25%	15%	178%
Capital ratio 10%	10%	10% + GSIB Surcharge	10% + GSIB Surcharge
Probability of Default	1.33%	0.01%	0.16%
Systemic LGD Score (Method 2)	100	857	857
PD ^r /PD ^{JPM}		122.4	8.6
SLGD ^{JPM} /SLGD ^r		8.6	8.6

assumptions for a reference bank holding company, a large, non-GSIB banking firm whose failure would not pose an outsized risk to the financial system. In particular, we assume the reference bank has a capital ratio of 10 percent, a probability of default of 1.3 percent and its SLGD score is 100.⁶

The SCCL white paper reports that if a GSIB with 10 percent capital makes a loan to another GSIB in an amount equal to 15 percent of its equity, its probability of default would also be about 1.3 percent. However, using an approach for SCCL purposes that is consistent with that taken for GSIB surcharge purposes, the appropriate starting point for JPM's capital would be 14.5 percent, the capital of the reference bank plus JPM's GSIB surcharge.⁷ The second column of Table 1 reports the results using the SCCL model when the bank begins with 14.5 percent capital ratio; that is, when the bank is subject to the same GSIB surcharge as JPM. When the single-counterparty credit limit is 15 percent, the probability of default of a bank with an initial capital ratio of 14.5 percent is 0.01

6 Alternatively, we could also have assumed the reference bank to be the smallest GSIB with a credit limit to another GSIB of 15 percent and a probability of default of 1.3 percent. The important point is just that it is a reference bank and we assume its SLGD is 100 following the GSIB calibration white paper.

7 This example is meant to be illustrative and underscore the importance that banks' capital ratios in the calibration of the more stringent inter-GSIB limit. As of the first quarter of 2016, JPM's tier 1 capital ratio was 13.5 percent.

5 See "TCH Research Note: Overview and Assessment of the Methodology Used to Calibrate the U.S. GSIB Capital Surcharge" (May 2016), available at <https://www.theclearinghouse.org/issues/articles/2016/05/20160510-tch-research-note-on-us-gsib-capital-surcharge-methodology>.

percent, more than 100 times lower than the probability of default of the reference bank. However, that limit is clearly too low – as the GSIB surcharge white paper’s formula for estimating the probability of default sets that bank’s probability of default at about only one-ninth the probability of default of the reference bank – that is, 0.16 percent rather than 0.01 percent.

The third column of Table 1 reports the results when the SCCL model is used to set an inter-GSIB credit limit for GSIBs that uses the GSIB surcharge formula for estimating a GSIB’s probability of default. As shown, the limit would have to be about 180 percent of JPM’s tier 1 capital to be consistent with the capital surcharge set in the GSIB white paper. Indeed, relatively higher limits would be required for all other U.S. GSIBs.

Table 2 extends the analysis outlined above to the remaining seven GSIBs. The table reports the capital ratio including the capital surcharge of each GSIB, the probability of default implied by the GSIB surcharge calibration white paper and the associated credit limit obtained using the quantitative credit risk model presented in the SCCL white paper. For all GSIBs, the inter-GSIB credit limit consistent with the GSIB calibration white paper is above 15 percent of tier 1 capital. Indeed, for 5 of the 8 GSIBs the credit limit is more than 100 percent of tier 1 capital.

However, the lower 15 percent inter-GSIB limit is based on the standard in the Basel Large Exposure Framework, which has already been agreed to and implemented in some jurisdictions, which may pose practical

TABLE 2: GSIB SURCHARGE CONSISTENT CREDIT LIMITS

	CAPITAL RATIO	PROBABILITY OF DEFAULT	CREDIT LIMIT
Reference BHC	10.0%	1.33%	25%
JP Morgan Chase	14.5%	0.16%	178%
Citigroup	13.5%	0.19%	125%
Goldman Sachs	13.0%	0.23%	105%
Bank of America	13.0%	0.24%	108%
Morgan Stanley	13.0%	0.24%	110%
Wells Fargo	12.0%	0.38%	70%
State Street	11.5%	0.48%	51%
Bank of New York Mellon	11.0%	0.63%	32%

NOTE: The probability of default of the reference BHC is assumed to be about 1.3 percent (see SCCL white paper) and the probabilities of default of all GSIBs are obtained using the Expected Impact framework described in the GSIB surcharge white paper.

obstacles to an inter-GSIB credit limit set above 15 percent. Another, perhaps more feasible, way to achieve consistency across these two regulations would be to use the model presented in the SCCL white paper to calculate the GSIB surcharges, holding constant the 15 percent limit and incorporating its implied probabilities of default obtained using the GSIB surcharge white paper.

Recall that the GSIB white paper calls for the GSIB surcharge to be set so that the probability of default of the GSIB declines in proportion to the GSIB’s SLGD score. The model and assumptions used in the SCCL paper generate probabilities of default that depend on the starting capital ratios of the GSIBs. Given the reference bank, which has a SLGD score of 100 and a probability of default of 1.3 percent, the SCCL model can be used to pin down starting capital ratios for each GSIB that are inversely proportional to the GSIBs’ SLGD score. The GSIB surcharges, which are reported in Table 3, are then simply those capital ratios minus the 10 percent ratio of the reference bank. As can be seen by comparing column 1 with column 2 of Table 3, the GSIB surcharges

derived using the SCCL-model are about half as large as the surcharges derived using the methodology presented in the GSIB surcharge white paper for 5 of the 8 GSIBs. Moreover, as shown in the last column of Table 3, the GSIB surcharges obtained under the so called “Method 1” – based on the international Basel Committee framework for identifying GSIBs – are considerably similar to the SCCL-consistent GSIB surcharges. In other words, this analysis suggests that the higher GSIB surcharge obtained under Method 2 and the more stringent 15 percent inter-GSIB credit limit duplicate each other.

CONCLUSION

Taking a step back, in this research note we demonstrate that the analysis presented in the SCCL white paper is not a calibration of the more stringent inter-GSIB credit limit. Instead, it illustrates the potential impact of a higher degree of correlation in the financial performance across counterparties on credit

TABLE 3: HYPOTHETICAL GSIB SURCHARGE CONSISTENT WITH INTER-GSIB LIMIT OF 15%

	CURRENT GSIB SURCHARGE (METHOD 2)	SCCL-CONSISTENT GSIB SURCHARGE	CREDIT LIMIT	MEMO: METHOD 1 GSIB SURCHARGE
JP Morgan Chase	4.5%	2.2%	15%	2.5%
Citigroup	3.5%	2.0%	15%	2.0%
Goldman Sachs	3.0%	1.8%	15%	1.5%
Bank of America	3.0%	1.8%	15%	1.5%
Morgan Stanley	3.0%	1.7%	15%	1.0%
Wells Fargo	2.0%	1.3%	15%	1.0%
State Street	1.5%	1.1%	15%	1.0%
Bank of New York Mellon	1.0%	0.8%	15%	1.0%

limits between such counterparties. Thus, the analysis presented in the SCCL white paper provides a rationale for an additional factor to take into account in the decision to impose a more stringent credit limit between systemically important banking organizations. However, GSIBs are already subject to a host of new regulatory initiatives aimed at reducing the likelihood and costs of their failure, therefore omitting these other regulatory measures from the calibration of a more stringent inter-GSIB limit leads to biased results and casts doubts on the benefits of this particular regulation in reducing the odds of a GSIB’s failure. ■