The Clearing House®

At the Center of Banking Since 1853®

Estimating How Basel III Liquidity Requirements Should Affect a GSIB Surcharge

June 2018

Francisco Covas
+1.202.649.4605
francisco.covas@theclearinghouse.org

Robert Lindgren
+1.202.777.7690
robert.lindgren@theclearinghouse.org

Estimating How Basel III Liquidity Requirements Should Affect a GSIB Surcharge

As a result of the introduction of Basel III liquidity requirements, large banks hold a sizable stock of liquid assets that can be easily liquidated if a financial crisis (and resulting run of liabilities) were to occur. These large stockpiles of highly liquid assets make fire sales of illiquid assets much less likely to occur, thereby decreasing the potential magnitude of a large bank's losses during a crisis and the probability of the bank's failure.

This note proposes a recalibration of the global systemically important bank holding company (GSIB) capital surcharge that takes into account the impact of the liquidity coverage ratio (LCR) – one of the post-crisis liquidity requirements – on a GSIB's probability of failure. Our findings indicate that the favorable impact of liquidity requirements on bank losses should lead to approximately a 25 percent haircut on the GSIB surcharge. As a result, the LCR haircut yields a reduction in the GSIB surcharge between 50 to 100 basis points, depending on each bank's method 2 surcharge. These results are obtained under the assumption that banks are subject to a 100 percent LCR requirement, and thus understate the impact, as all GSIBs have an LCR over 100 percent in practice.

BACKGROUND

The Basel III Liquidity Coverage Ratio focuses on short-term liquidity over a hypothetical 30-day window. Large and internationally active U.S. banks began compliance with the *full* LCR in January 2015. The U.S. final rule also included a less strict version of the LCR, the so called *modified* LCR, which applies to banks with consolidated assets between $50 billion and $250 billion.[1]

The GSIB surcharge is an additional capital buffer that each U.S. GSIB is required to hold, over and above its risk-based capital requirements and other capital buffers. The calibration of the GSIB surcharge uses an expected impact framework, whereby each GSIB surcharge is chosen such that it equalizes the expected loss from a GSIB's failure to the expected loss from the failure of a non-GSIB reference BHC. To estimate the GSIB capital surcharge, the U.S. methodology requires three inputs: (i) the relationship between capital and the probability of failure; (ii) the GSIB's systemic score; and (iii) the reference non-GSIB's systemic score. This note studies the impact of the U.S. implementation of the Basel III liquidity coverage ratio on the relationship between *capital and the probability of failure.*[2]

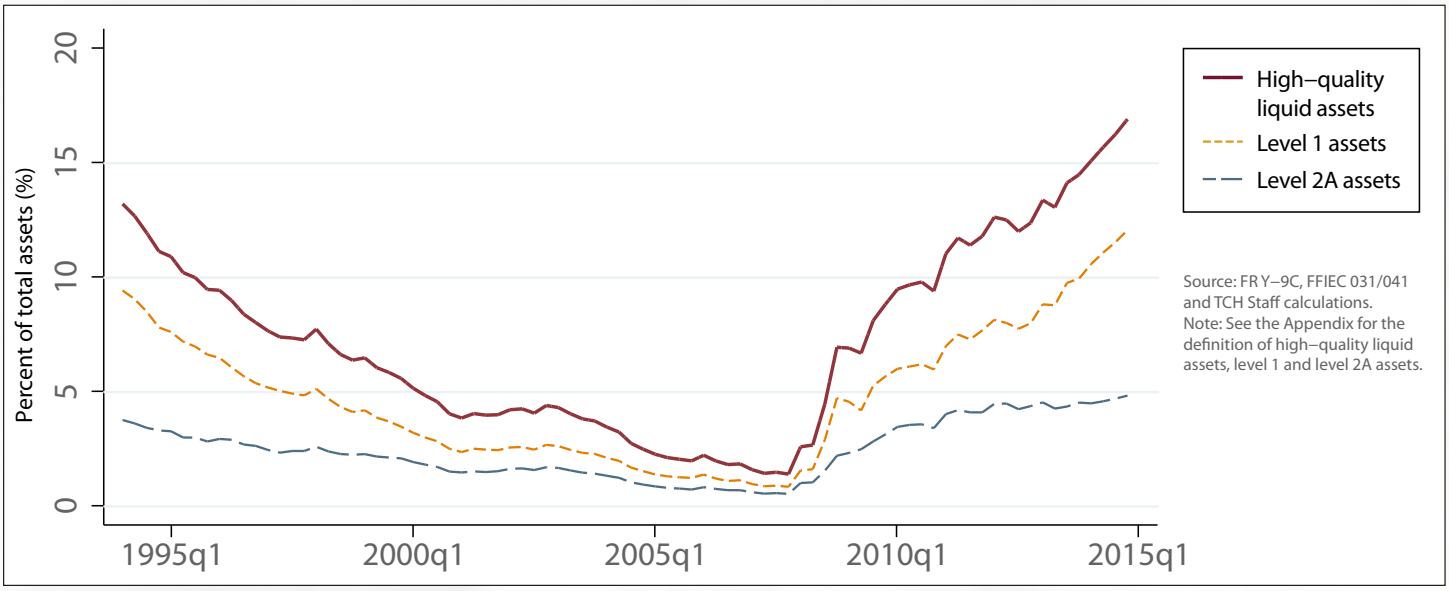
To account for how liquidity affects the relationship between capital and the probability of default, this note first replicates the analysis described in the GSIB calibration white paper and makes a simple adjustment to the measure used to capture bank losses. Specifically, this note adjusts the historical data on the return on risk-weighted assets (RORWA) depending on banks' holdings of liquid assets at that time.[3] Intuitively, had banks been subject to liquidity requirements during past financial crises, they would have entered those crises with larger buffers of highly liquid assets. Thus, banks would have been able to liquidate those liquid assets during the stress period, thereby reducing the likelihood of fire sales of less liquid assets and the size of their resulting losses. Thus, higher liquidity *ex ante* lowers the probability of bank failure for a given level of capital by a measurable amount. As a result, the introduction of liquidity requirements should lower each bank's GSIB surcharge. We cover in the remainder of this note

1 In addition, the Basel III liquidity requirements also include a longer-term requirement, the so called net stable funding ratio (NSFR). The NSFR was finalized as an international standard by the BCBS in 2014 and the U.S. agencies issued the NSFR for public comment in mid-2016; however, the final rule has not yet been published by the agencies. This note does not consider potential effects of the NSFR.

2 Of note, there are several important post-crisis reforms that reduce the systemic impact of a GSIB's failure and are not quantified in this note, such as the more stringent credit limits for inter-GSIB exposures, single point of entry resolution strategies, greater reliance on longer-term debt under the total loss absorbing capacity standard and living wills.

3 Return-on-risk weighted assets is defined as after tax net income divided by risk-weighted assets.

FIGURE 1: High-quality liquid assets



Source: FR Y–9C, FFIEC 031/041 and TCH Staff calculations.
Note: See the Appendix for the definition of high–quality liquid assets, level 1 and level 2A assets.

the amount by which the GSIB surcharge is reduced due to the introduction of liquidity requirements under Basel III.

HISTORICAL PROXY FOR LIQUIDITY REQUIREMENTS

As a first step, we need to find a proxy for current liquidity requirements on U.S. banks that can be employed on a historical basis. For this purpose, we chose an approximation for banks' holdings of high-quality liquid assets (HQLA) proposed by Weinbach et al (2017), which can be constructed using banks' regulatory reports. The HQLA proxy is defined as the sum of level 1 and level 2A assets. Level 1 assets include reserve balances, Treasury securities, mortgage-backed securities (MBS) guaranteed by Ginnie Mae, and agency debt that is explicitly guaranteed by the full faith and credit of the U.S. government. Level 2A assets comprise government-sponsored enterprise (GSE) debt, GSE MBS and GSE commercial MBS. Under the LCR, level 2A assets receive a 15 percent haircut, and those amounts must be less than two-thirds of Level 1 assets for each bank.[4]

The figure above plots the ratio of HQLA, and its two major subcomponents, to total assets between the first-quarter of 1994 (the variables used to construct the HQLA-proxy are only available from 1994 onwards) and the fourth quarter of 2014 (the end of the GSIB white paper calibration sample). As depicted in the chart, the bulk of HQLA is composed of Level 1 assets, owing in large part to the high level of reserve balances in the later part of the sample. Earlier in the sample period, the bulk of Level of 1 assets included mostly U.S. Treasuries. Mortgage-backed securities issued by government-sponsored enterprises comprise the majority of level 2A assets. As shown by the red line in the chart, the ratio of HQLA-to-assets declined at a relatively steady pace between the start of our sample in the first quarter of 1994 and the second quarter of 2008, just prior to Lehman's bankruptcy. Post-Lehman's bankruptcy, banks' holdings of HQLA rose sharply because of the Federal Reserve's massive lending programs, followed by the Federal Reserve's large scale asset purchase programs conducted between 2009 and 2014. The Federal Reserve's actions increased the amount of reserve balances in the banking system, as shown by the rise of the dashed yellow line in the post-crisis period. In addition, holdings of U.S. Treasuries also increased a significant amount during the post-crisis period.

RELATIONSHIP BETWEEN LIQUID ASSETS AND LOSSES

This section shows that, historically, banks with more liquid balance sheets experienced lower losses in past crises. We use the GSIB calibration white paper sample to estimate the relationship between the magnitude of banks' losses and the ratio of HQLA-to-assets. Table 1 presents the estimates of a linear regression of the natural logarithm of losses (i.e., -RORWA) on the natural logarithm of HQLA-to-assets. Because we are taking the logarithm of losses, we exclude from the

4 We assume level 2B assets – which includes investment-grade corporate debt securities – are zero since those amounts are quite small based on banks' liquidity coverage ratio disclosures.

TABLE 1: Regression of HQLA-to-assets on the magnitude of losses

The sample period includes data from the first quarter of 1994 until the fourth quarter of 2014 for all top-holder bank holding companies from the Consolidated Financial Statements for Holding Companies (FR Y9C) and commercial banks from FFIEC 031/041 reports that are not part of a bank holding company. Furthermore the sample includes only the largest banks in terms of total assets in each quarter. The dependent variable is RORWA, defined as net income on a four-quarter rolling basis divided by risk-weighted assets. The independent variable is the ratio of HQLA-to-total assets lagged four quarters so that the observation period does not overlap with the dependent variable. The model is estimated using ordinary least squares and robust standard errors are reported in parenthesis. * p-value < 0.10; ** p-value < 0.05; and *** p-value < 0.01.

DEPENDENT VARIABLE: LN (-$RORWA_{I,T}$)	
Explanatory variable:	(1)
1. ln(HQLA-to-$assets_{i,t-4}$), top 50 banks	-0.1314*** (0.0199)
# of observations	208
R-squared	15.0%

sample banks that reported positive net income during the sample period.

As shown by the results reported in Table 1, the estimated regression coefficient is negative, which indicates that banks with a higher ratio of HQLA-to-assets experience lower losses. For example, an increase in a bank's HQLA-to-assets ratio from 5 percent to 15 percent is associated with a 14.4 percent reduction in the size of losses.[5] As described in more detail in the appendix, we use this result to make an adjustment to banks' reported RORWA during past crises.

LCR ADJUSTMENT TO THE RETURN ON RISK-WEIGHTED ASSETS

Next, we adjust banks' reported RORWA in each quarter of our sample based on their holdings of high-quality liquid assets one year earlier and estimate the probability of default that is associated with a given capital level. The RORWA adjustment is only performed if a bank was non-compliant with liquidity requirements had they been in place at the time. The appendix outlines the procedure used to determine the minimum level of HQLA-to-assets that satisfies a liquidity coverage ratio of 100 percent. Moreover, the mapping between the minimum level of HQLA-to-assets that satisfies a LCR of 100 percent varies according to banks' business models. This occurs because the regulatory data is not sufficiently rich to allow for an estimation of total net cash outflows, the denominator of the LCR. As a result, two banks with a different composition of assets and liabilities have in reality different minimum levels of HQLA-to-assets needed to satisfy a LCR of 100 percent. For this reason, we use the statistical procedure outlined in the appendix to estimate a relationship between capital and a bank's probability of default that is robust to differences in the composition of banks' balances sheets. If anything, our proposed approach provides a lower bound estimate of the impact of liquidity requirements on banks' probability of default. Our approach is also similar to the method employed by Firestone et al (2017).

Figure 2 shown in the next page, displays the percentiles of returns on risk-weighted assets for the bottom five percentiles before the LCR adjustment (red dots) and post-LCR adjustment (blue dots).[6] Because all observations for RORWA are negative for the bottom five percentiles, more than 5 percent of the time banks experience a loss. Also, more than 50 percent of the losses are less than 3 percent of risk-weighted assets.

The solid lines that pass through the dots represent the regression function that relates the return on risk-weighted assets to the natural logarithm of the associated percentile. The specification of each of the two regression models is included in the figure for one of the 500 simulations of the statistical procedure. As shown, all coefficients in the regression are statistically different from zero.

As described earlier, one of the three key inputs in the calculation of the GSIB surcharge is the relationship

5 The marginal effect is calculated as -0.1315 x [ln(15)-ln(5)] =-0.1445.

6 As noted above, the LCR adjustment requires a bootstrap procedure and the chart illustrates just one replication of the bootstrap method. The analysis uses 500 bootstrap replications.

FIGURE 2: Returns on risk-weighted assets

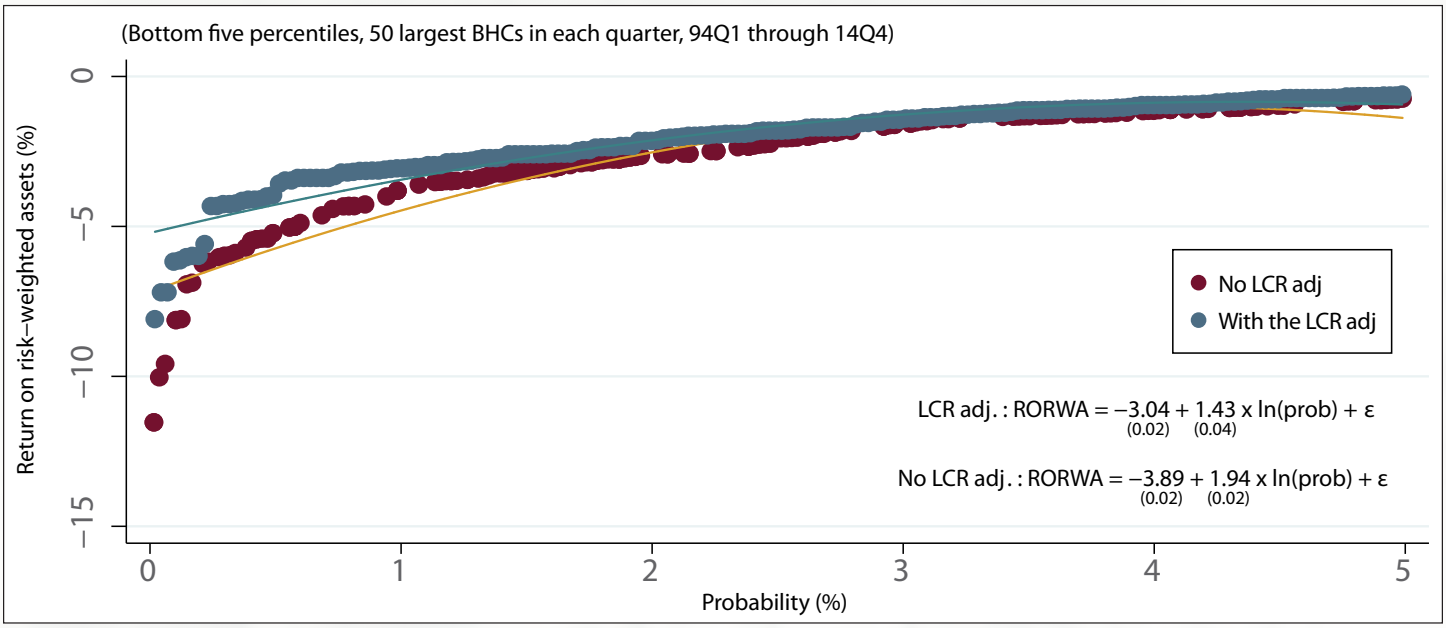


TABLE 2: Distribution of the LCR Haircut

The table shows the distribution of the LCR haircut across 500 simulations. A bootstrap procedure is needed because the mapping between the minimum required level of HQLA-to-assets that corresponds to a liquidity coverage ratio of 100 percent varies by bank (see appendix for more details).

	LCR Haircut (%)
Average	27.8
Median	27.6
25th percentile	23.7
75th percentile	31.9

between capital and the probability of failure, and, as shown in the appendix, that relationship is captured by the estimated slope coefficient of the regression displayed in the chart above. Thus, a natural way of calculating the LCR haircut on the GSIB surcharge is to define it as 1 minus the ratio of the slope coefficients of the regression that estimates the quantiles of RORWA. For the simulation shown in the chart above, the LCR haircut equals 26.2 percent or 1 - 1.43/1.94. As noted earlier, the mapping between the minimum level of HQLA-to-assets that is LCR compliant is not unique, thus we repeat the experiment shown in the figure above a large number of times. The distribution of the LCR haircut across all simulations is shown in Table 2. The table shows some moments of the distribution of the LCR haircut. In particular, the average LCR haircut is 28 percent and the first and third quantiles range between 24 percent and 32 percent, respectively.

To estimate the impact of the LCR haircut on the GSIB surcharge we use a value of 25 percent.

IMPLICATIONS FOR THE GSIB SURCHARGE

Table 3 presents the estimated impact of the LCR haircut on the method 2 GSIB surcharge. Since the mapping between each bank systemic indicator score and its GSIB surcharge is done in increments of 50 basis points for each 100-point fixed-width band of the GSIB systemic indicator score, the LCR haircut is applied directly to the GSIB surcharge under method 2 as shown in the leftmost column of Table 3.

In the implementation of the GSIB assessment framework in the U.S., the banking agencies required U.S. banks to calculate their systemic indicator score under both method 1 as well as the U.S.'s own method (method 2), with

TABLE 3: LCR Haircut Impact on the Method 2 GSIB Surcharge

GSIBs	LCR adjustment h = 0.25 (p.p.)	Current Method 2 surcharge (%)	Method 2 GSIB surcharge with LCR Adj. (%)	Method 1 GSIB surcharge (%)
JPM	1.1	3.5	2.5	2.5
MS	0.9	3.0	2.0	1.0
C	1.0	3.0	2.0	2.0
GS	0.9	2.5	1.5	2.0
BAC	0.9	2.5	1.5	2.0
WFC	0.7	2.0	1.5	1.5
BK	0.5	1.5	1.0	1.0
STT	0.5	1.5	1.0	1.0

Note: The LCR adjustment is calculated as follows:

$$LCR\ Adj. = h \times \beta \ln\left(\frac{SLGD_{GSIB}}{SLGD_r}\right),$$

where h is the LCR haircut, β is the slope coefficient of the GSIB regression and equals 2.18 (see GSIB calibration white paper), $SLGD_{GSIB}$ is the GSIB's systemic loss given default score and $SLGD_r$ is the reference bank's non-GSIB score (equal to 100).

whichever method results in a higher capital surcharge being binding.[7]

In particular, five of the eight U.S. GSIBs report an LCR adjusted method 2 GSIB surcharge equal to the method 1 GSIB surcharge. One GSIB has a higher LCR-adjusted method 2 GSIB surcharge relative to method 1 and the remaining two GSIBs have a GSIB surcharge that is higher under method 1.

SUMMARY

Our findings indicate that the introduction of Basel III liquidity requirements leads to approximately a 25 percent LCR haircut on the GSIB surcharge by lowering the probability of bank failure. This assumes that the bank is operating at 100 percent LCR compliance, and thus understates the impact, as all GSIBs have LCRs over 100 percent in practice. Overall, a 25 percent LCR haircut translates into a reduction in the GSIB surcharge between 50 to 100 basis points, depending on each bank's method 2 score. It is important to note that the GSIB calibration white paper (2015), acknowledges the importance of several post-crisis reforms on the calibration of the GSIB surcharge. However, the paper does not attempt to quantify these effects under the premise that the impact of post-crisis reforms cannot be rigorously quantified and that the effect would be reversed by the omission of losses that some of the largest banks would have incurred had the government not intervened in the last financial crisis. As shown by our work, Firestone et al (2017) and Brooke et al (2105), it is important to quantify the impact of post-crisis regulations on bank behavior in order to inform the debate on a potential review of the GSIB surcharge framework and other regulatory requirements imposed on the largest banks.

As for future research, it would be important to investigate the impact of the introduction of total loss absorbing capacity standard in reducing moral hazard and therefore the relationship between capital and the probability of default. Second, there is no empirical justification for the indicators used to calculate a bank's cost of failure and its empirical validity needs to be reassessed. Finally, other regulatory changes designed specifically to reduce failure costs, such as living wills, greater reliance on longer-term debt under the total loss absorbing capacity standard, and the elimination of cross-default clauses need to be reflected in the calculation of a GSIB's systemic score.

7 Method 2 replaces the substitutability category with a measure of a bank's reliance on short-term wholesale funding (STWF) and also doubles the systemic indicator scores from the other categories. In contrast to the substitutability score under method 1, the STWF indicator is divided by each bank's risk-weighted assets. This approach allows for aggregate reduction of the G-SIB surcharge if all U.S. G-SIBs reduce their reliance on short-term wholesale funding. More generally, method 2 in its entirety has fixed coefficients, so a bank can change its own method 2 score regardless of the actions by other firms. That said, the G-SIB capital surcharge obtained under method 2 is currently higher than the capital surcharge obtained under the Basel Committee's methodology for all eight U.S. G-SIBs.

REFERENCES

Board of Governors of the Federal Reserve System, "Calibrating the GSIB Surcharge," July 20, 2015.

Brook, Martin, Oliver Bush, Robert Edwards, Jas Ellis, Bill Francis, Rashmi Harimohan, Katharine Neiss and Caspar Siegert, "Measuring the macroeconomic costs and benefits of higher UK bank capital requirements," Financial Stability Paper No. 35 – December 2015, Bank of England.

Firestone, Simon, Amy Lorenc and Ben Ranish, "An Empirical Economic Assessment of the Costs and Benefits of Bank Capital in the US," Finance and Economics Discussion Series 2017-034. Washington: Board of Governors of the Federal Reserve System.

Ihrig, Jane, Edward Kim, Ashish Kumbhat, Cindy Vojtech, and Gretchen C. Weinbach, "How have banks been managing the composition of high-quality liquid assets?," Finance and Economics Discussion Series 2017-092. Washington: Board of Governors of the Federal Reserve System.

Technical Appendix

BACKGROUND ON THE GSIB SURCHARGE

The expected impact framework requires an estimate of the relationship between each GSIB's and the reference non-GSIB's capital level and its probability of default. To obtain this mapping of capital levels to probabilities of default, the Federal Reserve estimates a specific functional form to the actual percentiles of the annual return on risk-weighted assets (RORWA), using as its sample set (i) the historical loss experience of top 50 U.S. bank holding companies (ii) over a time period beginning in 1986 and ending in 2014. Specifically, the regression is defined as follows:

$$\mathrm{RORWA_i} = \alpha + \beta \ln[\mathrm{P}(x \leq \mathrm{RORWA_i})] \quad (1)$$

where $P(x \leq RORW_i)$ is the probability that a particular realization of $RORWA_i$, x, will be less than or equal to a specified level over a given year. This expression can be inverted to obtain a closed-form expression for this probability:

$$\mathrm{P}(x \leq \mathrm{RORWA_i}) = \mathrm{P}(\mathrm{RORWA_i}) = e^{\frac{\mathrm{RORWA_i}-\alpha}{\beta}}. \quad (2)$$

The Federal Reserve assumes a bank fails if its capital ratio falls below a failure point, f. Under those assumptions, a bank that begins a period with capital k_i fails if its four-quarter return on risk-weighted assets is low enough such that $k_i + RORWA_i < f$ or $RORWA_i < f - k_i$. Using equation (2), the probability of default as function of the capital ratio is:

$$\mathrm{P}(k_i) = e^{\frac{(f-k_i-\alpha)}{\beta}}. \quad (3)$$

Under the expected impact framework, the GSIB surcharge is chosen such that it equalizes the expected loss from a GSIB's failure to the expected loss from the failure of a non-GSIB reference BHC:

$$\mathrm{EL_{GSIB}} = \mathrm{EL_r}, \quad (4)$$

and plugging in the definition of EL = PD ×SLGD yields

$$\mathrm{SLGD_{GSIB}} \times \mathrm{P}(k_{GSIB} + k_r) = \mathrm{SLGD_r} \times \mathrm{P}(k_r). \quad (5)$$

Solving the capital surcharge of a GSIB, k_{GSIB}, gives:

$$k_{GSIB} = \beta \ln\left(\frac{\mathrm{SLGD_{GSIB}}}{\mathrm{SLGD_r}}\right). \quad (6)$$

Thus, to estimate the GSIB capital surcharge, this formula requires (i) the slope coefficient of the regression; (ii) the GSIB's SLGD score; and (iii) the reference non-GSIB's SLGD score. This note studies the impact of the Basel III liquidity requirements on the estimated coefficient, $\hat{\beta}$.

MINIMUM HQLA LEVEL THAT IS LCR COMPLIANT

The next step is to determine the minimum level of HQLA that would be LCR compliant for each of the RORWA observations included in our sample. First, we estimate the relationship between our proxy of HQLA-to-assets and the LCR as reported in each GSIB's Pillar III disclosures between the second quarter and fourth quarter of 2017 (most recent quarter available). Namely, we estimate the following regression:

$$LCR = \alpha \frac{HQLA}{Assets}, \quad (7)$$

and the parameter alpha is estimated to be equal to 5.4. Next, we calculate the minimum level of HQLA-to-assets that would be equivalent to a LCR of 100 percent. Subtracting 1 from each side of equation (1) we get:

$$LCR - 1 = \alpha\left(\frac{HQLA}{Assets} - \frac{HQLA}{Assets}\Big|_{min}\right) \quad (8)$$

Solving for the minimum level of HQLA-to-assets that is LCR compliant we obtain:

$$\frac{HQLA}{Assets}\Big|_{min} = \frac{HQLA}{Assets} - \left(\frac{LCR-1}{\alpha}\right). \quad (9)$$

Note that the minimum level of HQLA-to-assets that satisfies a LCR of 100 percent varies by bank, thus the need to use a bootstrap method outlined in the next section. Also, as noted earlier this minimum-level can only be calculated for the eight U.S. GSIBs between the second quarter of 2017 and the first quarter of 2018.

BOOTSTRAP PROCEDURE

Since each bank has only available a proxy of the liquidity coverage ratio historically, and the correspondence between the minimum level of HQLA-to-assets that is LCR compliant is bank-specific, we use a resampling approach to avoid biasing the results due to an arbitrary choice of such minimum level of HQLA. In practice, this amounts to sample randomly the observations of RORWA and HQLA-to-assets of the same bank and to also sample randomly the minimum required level of HQLA-to-assets that satisfies the LCR of 100 percent. This procedure is repeated until we have the same number of observations as in the GSIB white paper regression. Generally, this bootstrap procedure is very similar to the approach pursued in the Firestone et al (2017) paper. The main difference is that we use a proxy for liquid assets that is much closer to the definition of HQLA.

It is easier to explain the bootstrap procedure via an example. First, assume we draw a bank randomly from our sample with a RORWA of -5% and ratio of HQLA-to-assets of 5%. Second, we draw another random observation from the sample containing the minimum-level of HQLA-to-assets, and let's assume that 30% is the minimum level of HQLA-to-assets that is LCR compliant for this bank. Since RORWA is negative and the bank is not LCR compliant (because the ratio of HQLA-to-assets of 5% is less than the 30% requirement), the RORWA adjustment performed is as follows:

$$\widetilde{RORWA} = \left(\frac{30\%}{5\%}\right)^{-0.1315} \times (-5\%) = 0.79 \times (-5\%) = -3.95\%$$

Note that if the ratio of HQLA-to-assets of the randomly sampled bank was greater than 30 percent in the example above, or RORWA is non-negative, there is no LCR adjustment. Third, we repeat this procedure a large number of times (with replacement) until the number of observations in our simulated sample is equal to the number of observations in the original GSIB calibration white paper sample. Fourth, we estimate the relationship between a bank's capital level and its probability of default as proposed in the GSIB calibration white paper. Next, we repeat steps 1 through 4 a large number of times. We chose the number of bootstrap replications to be equal to 500.

HQLA DEFINITION

This section contains the details concerning the construction of the high-quality liquid asset series proxy for banks in our sample. All bank-level data are obtained from the FR-Y9C reports published by the Federal Reserve Board for bank holding companies and the FFIEC 031/041 reports published by the Federal Deposit Insurance Corporation for commercial banks. The data covers the period from 1994:Q1 to 2014:Q4. The table below contains the source of each of the seven components of HQLA following the paper by Weinbach et al (2017). The amount of level 2A assets are subject to a 15 percent haircut and are capped at no more than 40 percent of each bank's total HQLA. In addition, the HQLA proxy assumes level 2B assets are zero.

HQLA Item	Series
Reserves (level 1)	FFIEC 031/041 RC-A item 4
Treasury securities (level 1)	FR Y-9C HC-B item 1 (column B) + item 1 (column D) + HC-D item 1 (A)
GNMA MBS (level 1)	FR Y-9C HC-B item 4.a.(1) (B) + item 4.a.(1) (D)
Agency debt with full U.S. government guarantee (level 1)	FR Y-9C HC-B item 2.a. (B) + item 2.a. (D)
GSE debt (level 2A)	FR Y-9C HC-B item 2.b. (B) + item 2.b. (D) +HC-D item 2 (A)
GSE MBS (level 2A)	FR Y-9C HC-B item 4.a.(2) (B) + item 4.a.(2)(D)+item 4.b.(1)(D) +HC-D item 4.a (A) + item 4.b (A)
Agency CMBS (level 2A)	FR Y-9C HC-B item 4.c.(1)(a) (B) + item 4.c.(1)(a) (D) + item 4.c.(2)(a) (B) + item 4.c.(2)(a) (D) + HC-D item 4.d (A)