volatility increasing by a factor of 1.5 rather than the 2.5 we saw for retail funding.

Derivative Exposures and Other Collateral Requirements

Line 15 of the template in **Figure 3** reports outflow related to derivative exposures and other collateral requirements, which we refer to simply as derivative exposures for brevity.

As discussed in Section 3, the unweighted amount for retail deposit outflows measures the stock of qualifying deposits and is therefore relatively straightforward to calculate. The unweighted amount for derivative exposure outflows (line 15) is more complex. This item includes, among other items, known contractual payments due under existing commitments; collateral received from counterparties that may be substituted or withdrawn; and additional collateral that may need to be posted by the bank to counterparties because of a deterioration in the bank's financial condition.

Most notably, this item includes potential derivative valuation changes, measured as "the absolute value of the largest 30-consecutive calendar day cumulative net mark-to-market collateral outflow or inflow realized during the preceding 24 months resulting from derivative transaction valuation changes."[14] To the best of our knowledge, this component is the only item in the LCR calculation that explicitly uses a bank's historical experience as an input to the calculation. This potential derivative valuation change gets a weight of 20% in the calculation of the weighted amount for line 15 of the template.

To understand the impact of the COVID-19 shock on derivative exposure outflows, we highlight three points:

The amounts reported by banks in their quarterly LCR disclosures are quarterly averages of daily calculations, in which each daily calculation applies to the next 30 days.

The potential derivative valuation change is calculated as the peak 30-day change over the preceding 24 months, as of the day of the LCR calculation.

The greatest market disruptions from the COVID-19 shock took place in March 2020.

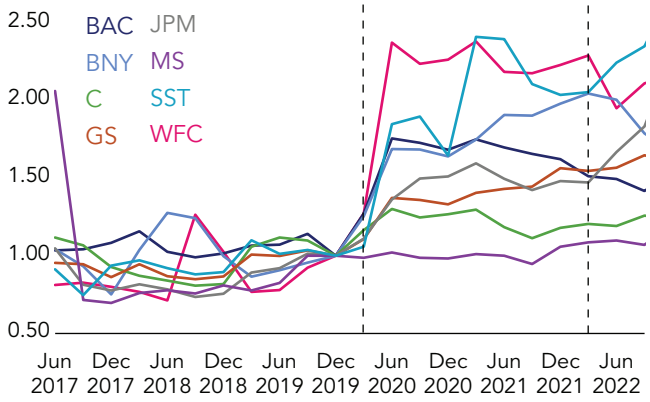
By combining these points, we see that the COVID-19 shock would have a limited impact on derivative disclosures from Q1 2020: the shock was late in the quarter, so its effect is diminished by averaging over the quarter. In contrast, we would expect to see a larger effect in Q2 2020: any large derivative valuation changes in March 2020 would impact the LCR calculation on every day of Q2 because of the 24-month lookback period. This feature is unique to derivative exposures because, as already noted, this is the only item that uses historical data explicitly as an input to the LCR calculation.

With this understanding, we plot the ratio of the weighted amount for derivative exposures (line 15) for each quarter relative to Q4 2019, the last quarter before the COVID-19 shock. We plot this ratio separately for each G-SIB. By construction, all ratios are 1 in Q4 2019. The first vertical dotted line marks Q1 2020. As expected, the ratios increase (except for one bank) in Q1 2020. But the largest increases are in Q2 2020, where the impact of the COVID-19 shock is fully reflected in the quarterly average.

For several of the banks, the increase is greater than 50% – a dramatic increase over previous amounts. The largest percentage increases are for Wells Fargo and Company and State Street Corporation, which have relatively smaller levels of derivatives exposures. But we also see large percentage increases for Bank of America Corporation and The Goldman Sachs Group, Inc., both of which have large derivatives businesses. Their percentage increases are much larger than the corresponding percentage increases for other outflow items in the LCR disclosures. The sharp increases in **Figure 12** suggest that the derivative outflows in March 2020 were larger than anticipated by the provision – the weighted amount – set by the LCR rules. The precise drivers of the sharp increase cannot be determined from the LCR disclosures because the weighted derivative outflows combine several sources of stressed outflows under the LCR rules.

Because of the 24-month lookback window for valuation changes, the experience of the COVID-19 shock ceased to enter banks' LCR calculations in Q1 2022.

Figure 12. Weighted Derivatives Outflow Relative to Q4 2019



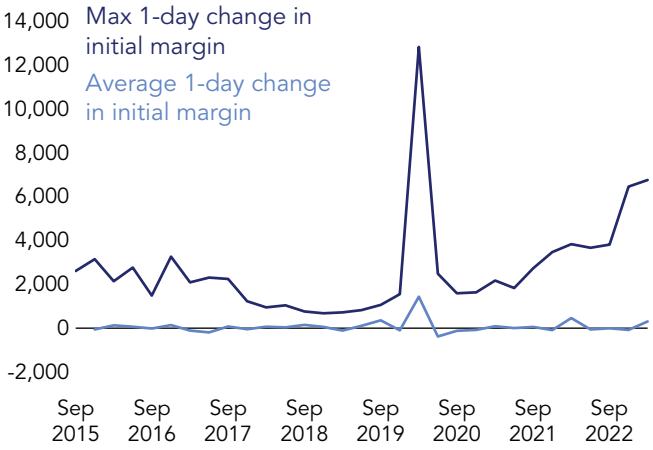
Sources: LCR disclosures, authors' analysis

This quarter is marked by the second vertical dotted line in **Figure 12**. With all else equal, we would expect to see a drop in the weighted amount (and therefore in the ratio plotted in the figure) as the peak change in value over the previous 24 months drops. The results in the figure are mixed. The ratios drop for some banks and increase for others; in no case does the ratio return to 1. We return to this point shortly.

There are two further aspects of derivatives liquidity risk that remain opaque from the LCR disclosures: changes in initial margin and daily coverage of liquidity needs. The 24-month lookback calculation measures mark-to-market changes in value and thus reflects variation margin payments. Derivatives cleared through central counterparties (CCPs) or bilateral contracts subject to margin requirements also entail posting of initial margin as collateral. In periods of elevated market volatility, initial margin typically increases, and the resulting collateral requirements impose liquidity demands separate from the mark-to-market payments covered through variation margin.

We can get indirect information on both issues – initial margin and daily strains on liquidity – through disclosures from CCPs, rather than the banks. Central counterparties make quarterly public disclosures through the CPMI-IOSCO (2015) framework[15], and these include information on margin requirements. The amounts disclosed by the CCPs are aggregated over all counterparties; the amounts are not associated with specific counterparties or the U.S. G-SIBs.

Figure 13. CME Average and Maximum Change in One-Day Initial Margin ($ millions)



Note: Calculation combines Chicago Mercantile Exchange (CME) base and interest-rate swap clearing.

Sources: Clarus Financial Technologies, authors' analysis

But the relative changes around the COVID-19 shock should nevertheless be informative about the liquidity demands faced more broadly by participants in derivatives markets.

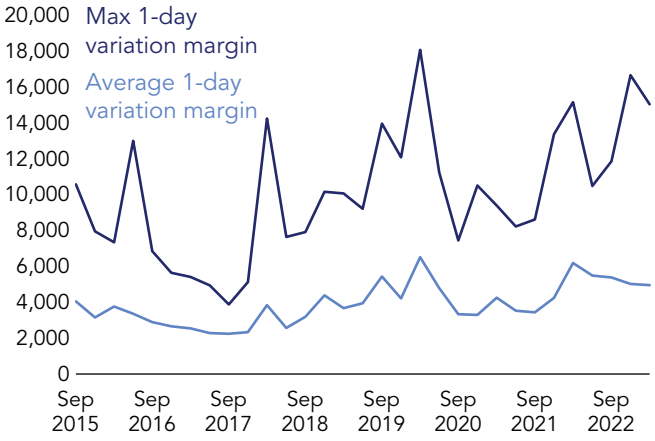
To illustrate, we use data from the CME Group, one of the largest derivatives clearinghouses. We combine their disclosures for over-the-counter interest rate swaps and listed futures and options.

Figure 13 plots the average one-day change in initial margin (IM) and the maximum one-day change in each quarter. In Q1 2020 (the time of the COVID-19 shock) we see a dramatic increase in the maximum one-day change in IM, far greater than the average change in that quarter and far greater than the maximum in other quarters.

Figure 14 shows corresponding plots for one-day changes in variation margin (VM). We again see that the maximum one-day change at the COVID-19 shock is much greater than the average one-day change in the quarter.

The CME data is based on a large number of market participants. It is not specific to the U.S. G-SIBs or to banks, but it should reflect market conditions generally. With that caveat, the figures suggest that the quarterly averages for derivatives outflows reported in the LCR

Figure 14. CME Average and Maximum One-Day Variation Margin ($ millions)



Note: Calculation combines Chicago Mercantile Exchange (CME) base and interest-rate swap clearing.

Sources: Clarus Financial Technologies, authors' analysis

disclosures may not fully reflect the potential daily stress on liquidity. Also, the liquidity demands from peak IM changes appear to be of similar magnitude to peak VM changes, but past IM changes are excluded from the LCR's 24-month lookback. Finally, the relatively large maximum one-day changes in VM in 2022 may help explain why we do not see a broad reduction of the ratios plotted in **Figure 12** at the end of the 24-month window following the COVID-19 shock.

Conclusion

In requiring disclosure of LCR data, the Federal Reserve's stated purpose was to "promote market discipline by providing the public with comparable liquidity information about covered companies."[16] In requiring the template of **Figure 3,** the Federal Reserve noted that a "more granular disclosure would provide market participants a more accurate view of the covered company's liquidity risk profile."[17] Despite these objectives, there has been little public work studying the performance of individual components of the LCR calculation across time and across institutions. This brief is a step toward filling that gap.

The market turbulence of March 2020–the COVID-19 shock–provides a stress test through which to examine individual components of the LCR framework. Our main findings based on the public disclosures of the U.S. G-SIBs are as follows:

The volatility of retail deposit outflows more than doubled during and after the COVID-19 shock, whereas the corresponding provisions to buffer these outflows increased by only 50%.

Flow volatility for unsecured wholesale deposits, which is generally higher than retail deposit flow volatility, increased by as much as three times.

Weighted outflows associated with derivatives contracts increased sharply during the COVID-19 shock, more than doubling in the case of one bank.

The LCR uses a 24-month lookback in measuring derivatives outflows, so the 2020 experience no longer enters into LCR calculations. Weighted derivatives outflows nevertheless remain elevated for several banks.

These observations are based on the quarterly averages reported in public LCR disclosures. Quarterly averages may not fully reflect the liquidity demands faced by banks in shorter but severe periods of stress. Public disclosures from derivatives central counterparties point to large one-day spikes in both initial margin and variation margin during the COVID-19 shock.

Endnotes

1 Paul Glasserman, Contractor, Office of Financial Research (paul.glasserman@ofr.treasury.gov) and H. Peyton Young, Research Principal, Office of Financial Research (hobart.young@ofr.treasury.gov).

2 See Department of Treasury (2014) "Liquidity Coverage Ratio: Liquidity Risk Measurement Standards," Final Rule, Federal Register, Vol. 79, No. 197, October 10, 2014, pp. 61440-61541. See also Board of Governors of the Federal Reserve (2019) "Changes to Applicability Thresholds for Regulatory Capital and Liquidity Requirements," Final Rule, Federal Register, Vol. 84, No. 212, November 1, 2019, pp. 59230-59283.

3 Basel Committee on Banking Supervision (2013) "The Liquidity Coverage Ratio and Liquidity Risk Monitoring Tools," Bank for International Settlements, https://www.bis.org/publ/bcbs238.pdf. For a comparison of the U.S. rules and the Basel standard, see Cetina and Gleason (2015) "The Difficult Business of Measuring Banks' Liquidity: Understanding the Liquidity Coverage Ratio," OFR Working Paper 15-20.

4 A separate Basel Committee standard, the Net Stable Funding Ratio, considers liquidity over a one-year horizon.

5 These categories are defined in "Changes to Applicability Thresholds for Regulatory Capital and Liquidity Requirements," Final Rule, Federal Register, Vol. 84, No. 212, November 1, 2019, pp.59230—59283.

6 Ihrig, Jane, Cindy M. Vojtech, Gretchen C. Weinbach, and Maureen Cowhey (2021). "How Dynamic is Bank Liquidity, Including when the COVID-19 Pandemic First Set In?," FEDS Notes. Washington: Board of Governors of the Federal Reserve System, August 30, 2021, https://doi.org/10.17016/2380-7172.2969 use confidential supervisory data to compare daily LCRs with quarterly averages. They find that the daily LCR averaged over the G-SIBs (or subsets of the G-SIBs) are generally close to the quarterly averages. For reasons of confidentiality, they do not report the largest deviations for individual banks. Our analysis is limited to public disclosures and thus to quarterly averages, which may mask large changes on individual days for individual banks. Confidential daily data underpinning the LCR is collected by banking regulators through the FR 2052a Complex Institution Liquidity Monitoring Report.

7 Board of Governors of the Federal Reserve System, "Liquidity Coverage Ratio: Public Disclosure Requirements," Final Rule, Federal Register Vol. 81, No. 248, December 27, 2016, p.94930.

8 For each bank, each quarter, and each outflow category, we calculate the average weight as the ratio of the weighted amount to the unweighted amount for the corresponding line in the LCR template. For each bank, we average this ratio across quarters Q2 2017 through Q1 2023. These are the average weights reported in the table. For the pooled values, we sum weighted and unweighted amounts across banks in each quarter before calculating the ratios.

9 We use the term "provision" to refer to the HQLA requirement attributable to a specific LCR line item, as measured by the weighted amount for that line item. The actual HQLA requirement is determined by the overall net outflows and is calculated from all the line items.

10 This calculation assigns the change from Q4 2019 – Q1 2020 to the pre-COVID-19 period. Counting it instead as part of the post-COVID-19 period further increases the growth in volatility across the two periods.

11 In a value-at-risk model, one would expect the provision or stressed buffer to be proportional to the flow volatility.

12 For the banks with large retail operations, brokered deposits make up 15% of total retail funding, on average. For some of the other banks, the average is 60-90%.

13 This calculation excludes an anomalous 25% drop in Citigroup Inc.'s unsecured wholesale funding from its first to its second LCR disclosure in 2017.

14 Federal Register Vol. 79, No. 197, p.61533.

15 CPMI-IOSCO (2015) "Public Quantitative Disclosure Standards for Central Counterparties (CCPs)," https://www.bis.org/cpmi/publ/d125.htm.

16 Federal Register Vol. 81, No. 248, December 27, 2016, p.94923

17 Federal Register Vol. 81, No. 248, December 27, 2016, p.94925