OFR BRIEF SERIES
OFFICE OF FINANCIAL RESEARCH

24-02 | April 2, 2024

Liquidity Coverage Ratios of Large U.S. Banks During and After the COVID-19 Shock

by Paul Glasserman and H. Peyton Young[1]

Large U.S. bank holding companies are subject to a Liquidity Coverage Ratio (LCR) rule that is intended to enhance the short-term resilience of the banking system through better measurement and management of liquidity risk. The LCR rule was adopted by the Board of Governors of the Federal Reserve System (Federal Reserve), the Office of the Comptroller of the Currency, and the Federal Deposit Insurance Corporation in 2014.[2] Following a transition period, it took full effect in 2017. In this brief, we review the performance of components of the LCR since 2017, with particular emphasis on the effects of the market turbulence in early 2020, referred to as the COVID-19 shock. Our analysis is based on the public LCR disclosures posted on the websites of the eight U.S. bank holding companies designated as Global Systemically Important Banks (G-SIBs): JPMorgan Chase & Co., Bank of America Corporation, Citigroup Inc., Wells Fargo & Company, The Goldman Sachs Group, Inc., Morgan Stanley, The Bank of New York Mellon Corporation, and State Street Corporation.

Since 2017, the LCRs at these banks have generally declined, but they have remained above the minimum requirement, even during the COVID-19 shock. The response to the shock of some individual components of the LCR do stand out:

- The volatility of retail deposit flows increased sharply during the COVID-19 shock and has remained elevated.
- This pattern is particularly pronounced for brokered deposits. As a consequence, when compared with actual outflows, stressed outflows calculated under the LCR rules appear to be less conservative for brokered deposits than for some other funding sources.
- Flow volatility for unsecured wholesale deposits, which is generally higher than retail deposit flow volatility, also increased, but not as much.
- Outflows associated with derivatives contracts increased sharply during the COVID-19 shock, in some cases significantly outstripping levels anticipated by the LCR calculations.
- The LCR uses a 24-month lookback in measuring derivatives outflows, so the 2020 experience no longer enters into banks' LCR calculations. Stressed derivatives outflows as modeled by the LCR rules nevertheless remain elevated for several banks.

In addition to examining performance through the COVID-19 shock, this brief provides a retrospective review of six years of LCR disclosures to increase public awareness and understanding of these reports. Our analysis uses reports from Q2 2017, when public disclosures began, through the Q1 2023.

Background on the LCR

The LCR rule adopted by the U.S. banking agencies is based on an international standard developed by the Basel Committee on Banking Supervision.[3] In formulating the standard, the Basel Committee noted that, in the financial crisis of 2007-09, even some adequately capitalized banks faced difficulties because of poor liquidity management.

The LCR rule seeks to ensure that banks have sufficient high-quality liquid assets (HQLA) to meet their cash needs over a 30-day period of stress.[4] The rule can be expressed as a requirement that the ratio of HQLA to net cash outflows exceeds 100%:

$$LCR = \frac{HQLA}{net\ cash\ outflow\ over\ 30\ days} \geq 100\%.$$

The LCR rule prescribes detailed steps for the calculation of the numerator and the denominator. The denominator is calculated from specific categories of flows, to which we turn shortly.

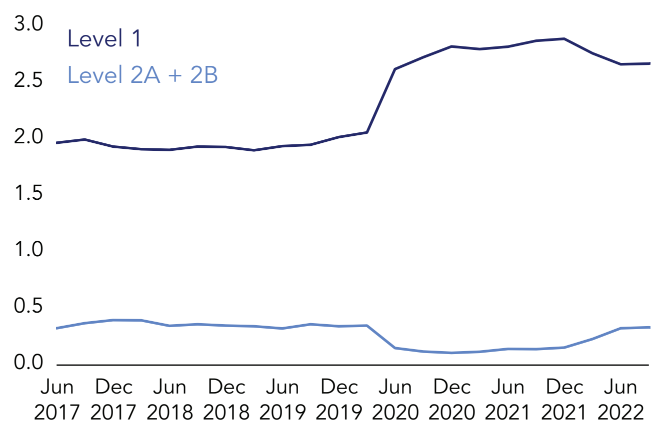
In the numerator, HQLA include Federal Reserve bank balances, Treasury securities, and certain other government issued or guaranteed securities. These are examples of Level 1 liquid assets. The LCR rule also allows the inclusion of certain other sovereign obligations and obligations of government-sponsored enterprises as Level 2A HQLA and certain publicly traded securities as Level 2B HQLA. Level 2A and 2B assets are subject to quantity limits and haircuts.

Figure 1 plots HQLA totals for the U.S. G-SIBs over time. Level 2B assets make up a negligible fraction of the total. Level 2A assets have averaged around 10% of total HQLA. At least two factors related to the COVID-19 shock contributed to the evident increase in HQLA in Q2 2020: retail customers moved money into bank deposits and several banks issued long-term debt as the Federal Reserve launched a bond-buying program. These sources of additional cash allowed banks to increase their liquidity levels.

The requirement that the LCR be at least 100% applies to U.S. banking organizations designated G-SIBs (Category I) and other banks (Category II) with more than $700 billion in assets or $75 billion in cross-jurisdictional activity. For banks in Category III or IV (generally banks with more than $100 billion but less than $700 billion in assets), a lower ratio of 85% or 70% may apply, depending on the bank's dependence on wholesale funding.[5] As this brief considers only the G-SIBs, the 100% minimum applies.

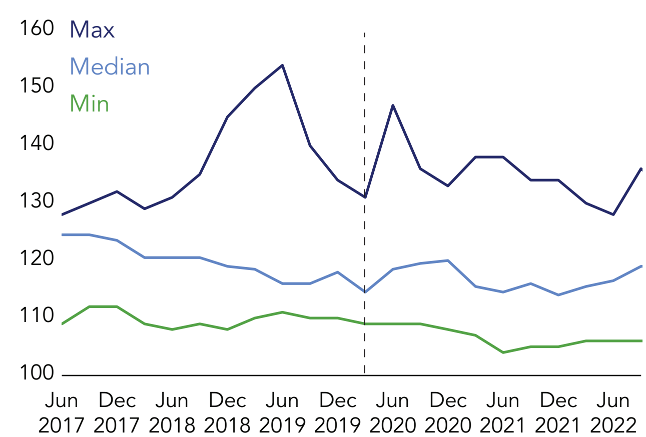
Figure 2 plots the minimum, median, and maximum LCR for the U.S. G-SIBs by quarter, based on the banks' public disclosures. The median shows a decreasing trend since the LCR rule took full effect in 2017, perhaps because the banks have gained experience in managing the LCR requirements. Despite the

Figure 1. Total HQLA for U.S. G-SIBs ($ trillions)



Sources: LCR disclosures, authors' analysis

Figure 2. Liquidity Coverage Ratio for U.S. GSIBs (percent)



Sources: LCR disclosures, authors' analysis

Figure 3. Federal Reserve's Template for Banks' Public LCR Disclosures

		Average Unweighted Amount	Average Weighted Amount
HIGH-QUALITY LIQUID ASSETS			
1	Total eligible high-quality liquid assets (HQLA), of which:		
2	Eligible level 1 liquid assets		
3	Eligible level 2A liquid assets		
4	Eligible level 2B liquid assets		
CASH OUTFLOW AMOUNTS			
5	Deposit outflow from retail customers and counterparties, of which:		
6	Stable retail deposit outflow		
7	Other retail funding outflow		
8	Brokered deposit outflow		
9	Unsecured wholesale funding outflow, of which:		
10	Operational deposit outflow		
11	Non-operational funding outflow		
12	Unsecured debt outflow		
13	Secured wholesale funding and asset exchange outflow		
14	Additional outflow requirements, of which:		
15	Outflow related to derivative exposures and other collateral requirements		
16	Outflow related to credit and liquidity facilities including unconsolidated structured transactions and mortgage commitments		
17	Other contractual funding obligation outflow		
18	Other contingent funding obligations outflow		
19	**TOTAL CASH OUTFLOW**		
CASH INFLOW AMOUNTS			
20	Secured lending and asset exchange cash inflow		
21	Retail cash inflow		
22	Unsecured wholesale cash inflow		
23	Other cash inflows, of which:		
24	Net derivative cash inflow		
25	Securities cash inflow		
26	Broker-dealer segregated account inflow		
27	Other cash inflow		
28	**TOTAL CASH INFLOW**		
			Average Amount
29	**HQLA AMOUNT**		
30	**TOTAL NET CASH OUTFLOW AMOUNT EXCLUDING THE MATURITY MISMATCH ADD-ON**		
31	**MATURITY MISMATCH ADD-ON**		
32	**TOTAL NET CASH OUTFLOW AMOUNT**		
33	**LIQUIDITY COVERAGE RATIO (%)**		

Source: 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.

general decline, the minimum has remained above the 100% requirement.

The vertical dotted line in the figure marks the COVID-19 shock in Q1 2020. Financial markets experienced exceptionally high volatility in March 2020, and many market participants found their liquidity resources strained in what has been called a "dash for cash." This period thus provides a test period for the LCR's cash outflow assumptions. In **Figure 2** we see that the median LCR for the U.S. G-SIBs dipped in Q1 2020. But our focus is on what can be learned from changes in individual components of the LCR's cash outflow calculations.

The banks are required to calculate their LCRs each day to cover liquidity needs under stress conditions over the next 30 days. In their quarterly public disclosures, banks report averages over these daily values, and **Figure 2** is based on these quarterly averages. A bank's minimum daily LCR within a quarter is almost certainly lower than its quarterly average. Thus, **Figure 2** does not rule out the possibility that some banks may have experienced liquidity strains within the most turbulent days of the quarter.[6]

Net Cash Outflows: The LCR Denominator

The denominator of the LCR measures net cash outflows over a 30-day period of stress. The net cash outflow is the difference between outflows and inflows. These inflows and outflows are summed over various categories of sources and needs for cash. Under the LCR rule, inflows are capped at 75% of the outflows, and the net calculation includes a maturity mismatch add-on to reflect differences in timing of anticipated inflows and outflows.

Figure 3 shows the template adopted by the Federal Reserve[7] in 2016 for banks' required public LCR disclosures, which began in Q2 2017. The top four lines report a bank's HQLA amount, broken down into Levels 1, 2A, and 2B. Lines 5-19 report cash outflow amounts, and lines 20-28 report cash inflow amounts. These outflow and inflow amounts are intended to model potential flows over the next 30 days under stress conditions; they do not measure observed flows retrospectively. We will examine the LCR's assumptions by comparing its stressed outflows with actual flows calculated from changes in banks' LCR disclosures.

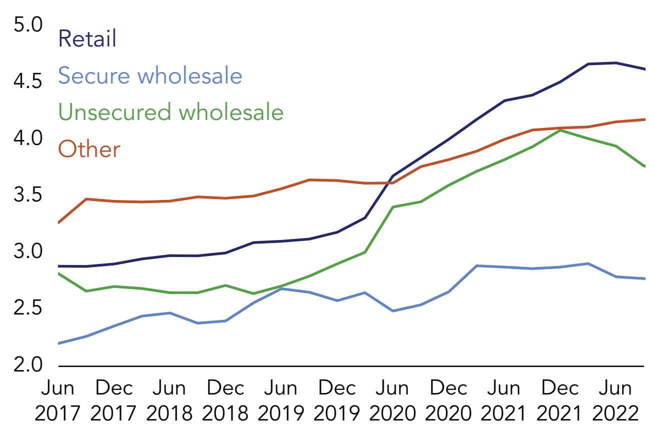
The main categories of outflows are retail deposits, unsecured wholesale funding, secured wholesale funding, and additional outflows, including outflows related to derivatives exposures and other collateral requirements. Some of these categories are broken down into subcategories. Inflows are organized into similar categories. Our analysis focused on outflows.

Unweighted Amounts

For each of the line items that go into the calculation of outflows, the template requires reporting of weighted and unweighted amounts, each of which is averaged over the quarter. We discuss the unweighted amounts first.

Figure 4 plots the total, by quarter, for the U.S. G-SIBs of the unweighted amounts for retail deposits (line 5), unsecured wholesale funding (line 9), and secured wholesale funding (line 13); "other" shows the difference between the total in line 19 and the three other lines. Examples of unsecured wholesale funding include non-retail deposits, federal funds purchased, and unsecured debt issued by the bank. Secured wholesale funding includes repurchase agreements and other forms of collateralized borrowing.

Figure 4. Unweighted Amounts for U.S. GSIBs ($ trillions)



Sources: LCR disclosures, authors' analysis

The levels for retail, unsecured wholesale, and secured wholesale measure the banks' total level of short-term funding in each of these categories, as measured by the LCR's unweighted amounts. The retail category shows an increasing trend over most of the quarters; its sharpest increase was in Q2 2020, following the COVID-19 shock, as many retail customers moved holdings from risky assets to bank deposits and increased precautionary saving. Perhaps surprisingly, unsecured wholesale funding shows a similar trend and a similar inflection in 2020. More recently, the figure shows that both retail and unsecured wholesale deposits have decreased, likely in response to higher interest rates available through alternatives to bank deposits, with unsecured wholesale customers moving sooner and faster. Despite inflows of wholesale deposits from regional banks to some of the largest G-SIBs, the total for line 9 decreased in Q1 2023.

Weighted Amounts

The weights used in the calculation of the weighted amounts in the LCR template are intended to reflect the risk of a cash outflow, with a higher weight reflecting a greater risk. The weighted amounts are used in the calculation of the denominator of the LCR. With all else equal, a larger weighted amount of cash outflows yields a larger denominator and thus a larger HQLA requirement in the numerator to meet the LCR threshold of 100%.

The role of the weights can be illustrated through the case of retail funding in lines 5-8 of the template. The unweighted amount for line 6 is a bank's amount of retail deposits categorized as stable. The main requirement for retail deposits to be designated stable is that they be fully insured. The quantity of stable retail deposits is a "stock" amount rather than a flow. Under the LCR rule, stable retail deposits are assigned a weight of 3%. Thus, every $100 million of stable retail deposits (an unweighted amount) adds $3 million (the weighted amount) to the stressed outflows attributable to this source of funding.

The low weight of 3% for stable retail deposits reflects the relatively low risk that these deposits would be withdrawn, even under stress conditions. In contrast, the LCR rule assigns a weight of 40% to many brokered deposits, reflecting experience that these deposits are much less "sticky." A weight of 100% on a funding source would mean that a bank would need to provision sufficient liquid assets to cover the complete loss of the funding source in a period of stress.

Figure 5 shows the average weight by outflow category and bank, calculated from the banks' public disclosures.[8] The average weights vary across banks because banks differ in their mixes of funding sources. Within the retail category, for example, a bank with a higher proportion of brokered deposits and a lower proportion of stable retail deposits will have a higher average weight for its retail outflows under the LCR rule.

The pooled results in **Figure 5** compare the average level of riskiness of the four categories, according to the LCR rule. Retail deposits appear least risky, with an average weight of 10%, and unsecured wholesale funding appears most at risk of withdrawal in a period of stress, with an average weight of 40%. But the table also shows substantial variation across banks, with some banks choosing riskier (higher weight)

Figure 5. Average LCR Weight by Category (percent)

	JPM	BAC	C	WFC	GS	MS	BNY	SST	Pooled
Retail	7	9	11	8	20	21	23	19	10
Unsecured Wholesale	37	38	40	35	72	61	50	41	40
Secured Wholesale	26	25	22	28	43	45	33	23	31
Other	21	19	18	14	20	19	39	52	19

Note: Average weight by category and bank. JPM (JP Morgan Chase), BAC (Bank of America), C (Citibank), WFC (Wells Fargo), GS (Goldman Sachs), MS (Morgan Stanley), BNY (Bank of New York Mellon), SST (State Street).

Sources: LCR disclosures, authors' analysis

mixes of funding within individual categories. Under the LCR rule, higher weights lead to higher HQLA requirements.

The unweighted outflow amounts in the LCR calculation are largely accounting values reflecting a bank's current balance sheet and commitments. The weights in the LCR convert the unweighted amounts into potential flows under stress. To evaluate the performance of the LCR, we need to compare the stressed flows projected by the LCR's weights with the actual flows experienced in a period of stress. We will use the COVID-19 shock for such a comparison.

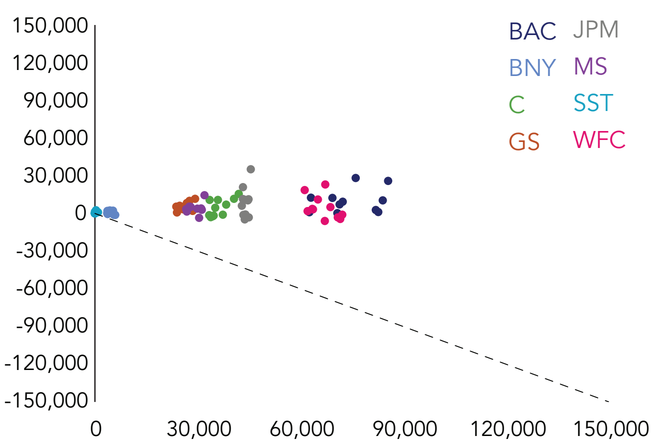
Retail Funding Outflows

We noted in the previous section that an additional \$100 million in stable retail deposits adds \$3 million to the cash outflow amount for this source of funding. Through the requirement that the LCR exceed 100%, this increases the required HQLA by \$3 million. This additional HQLA thus acts as a provision[9] for stressed outflows from the additional \$100 million in stable retail deposits.

We can compare these provisions for stressed outflows with actual outflows. **Figure 6** illustrates the comparison. The left panel shows the pre-COVID-19 period Q2 2017 - Q4 2019, and the right panel shows Q1 2020 - Q4 2022. The figures are for all sources of retail funding, corresponding to line 5 of the disclosure template. The horizontal axis shows the weighted amount for line 5 reported by each bank in each quarter; we interpret these as the provisions for stressed retail outflows. The vertical axis shows the change in the unweighted amounts from one quarter to the next. A change of -25,000 means that a bank's level of retail funding (the unweighted amount for line 5) decreased by \$25 billion from one quarter to the next.

In each panel of **Figure 6** the dotted line, which has a slope of -1, shows where the decrease in the unweighted amount exceeds the weighted amount. A point below the line would indicate that the actual outflow (the drop along the vertical axis) from one quarter to the next exceeded the provisioned amount (the level along the horizontal axis). The provisioned amount is simply the weighted amount calculated under the LCR rule. Virtually all the points in the figure are above the dotted line, indicating that the actual outflows did not exceed the provisioned amounts. This comparison is based on the quarterly averages in the LCR disclosures and thus may not reflect flows over shorter periods of stress. With that caveat, the LCR requirements look conservative.

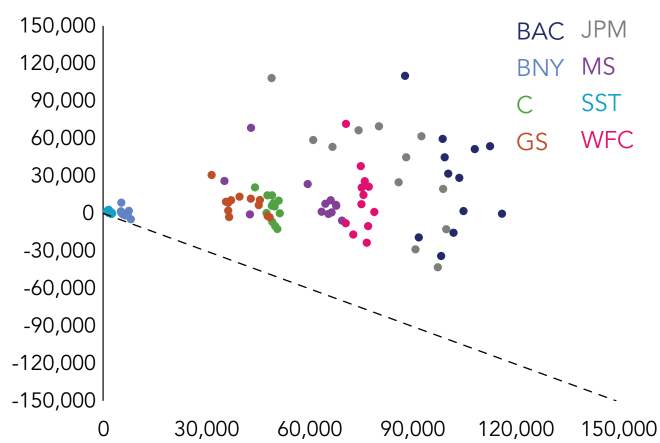
Figure 6a. Q2 2017 - Q4 2019 Retail Outflows, Change in Unweighted (y-axis, \$ millions), Weighted (x-axis, \$ millions)



Note: Dashed line has a slope = -1.

Sources: LCR disclosures, authors' analysis

Figure 6b. Q1 2020 - Q4 2022 Retail Outflows, Change in Unweighted (y-axis, \$ millions), Weighted (x-axis, \$ millions)



Note: Dashed line has a slope = -1.

Sources: LCR disclosures, authors' analysis

A comparison of the two panels reveals a more complex picture. In the pre-COVID-19 period on the left, there is very little vertical dispersion among the points, indicating that there is very little volatility in retail funding. The picture changes markedly on the right, where we see much greater vertical dispersion, reflecting elevated volatility in actual retail funding flows. For five of the eight banks, the largest flow was from Q1 2020 to Q2 2020. In particular, the two values over $100 billion at the top of the right panel (for JPMorgan Chase & Co. and Bank of America Corporation) are changes between these two quarters.

We can quantify the increase in flow volatility by calculating the standard deviation of flows in the two periods. For this calculation, we exclude The Bank of New York Mellon Corporation and State Street Corporation, because their levels of retail funding are close to zero. To put the remaining banks on a consistent scale, we take the standard deviation of the percentage changes in unweighted amounts, rather than the dollar changes in unweighted amounts. We pool these percentage changes across the remaining banks.

Figure 7 shows the results. The first two rows of numbers show the volatilities of the unweighted amounts for retail outflow (line 5), by bank and by period. The pooled volatility increased by a factor of 2.5 during and after the COVID-19 shock.[10] For some individual banks, the volatility more than tripled. In contrast, the average weighted amount across the banks – the average provision – increased by a factor of 1.5.[11]

This pattern can also be seen in **Figures 8** and **9**. The two figures contrast the same two time periods as before. Each figure shows the distribution of the flow/provision ratio in the indicated time period, where the flow is the increase in the unweighted amount for line 5 and the provision is the weighted amount for line 5. (Thus, a ratio below -1 would correspond to an outflow exceeding the provision, which would also correspond to a point in **Figure 6** below the dotted line.) The distributions pool ratios across the G-SIBs, excluding The Bank of New York Mellon Corporation and State Street Corporation. The increased flow volatility relative to provisions is evident in the greater spread of the distribution in **Figure 9**.

In the immediate aftermath of the COVID-19 shock, most of the increased volatility was to the upside, with the G-SIBs experiencing inflows in retail funding. This is evident in **Figure 9**, which shows a longer tail to the right than to the left of the distribution when compared to **Figure 8**. However, as these flows reverse (see **Figure 4**), we could potentially see similar volatility to the downside. With greater downside volatility, we could see bank-quarters falling below the dotted

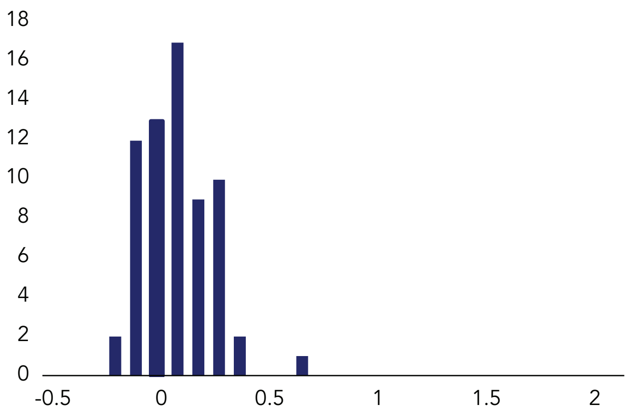
Figure 7. Retail Funding Amounts Before and After the COVID Shock

	JPM	BAC	C	WFC	GS	MS	Pooled
Volatility Unweighted							
Q2 2017 - Q4 2019 (percent)	1.6	1.1	1.9	1.2	2.3	2.7	2.3
Q1 2020 - Q4 2022 (percent)	4.7	4.0	2.5	3.0	5.3	10.1	5.6
Ratio	3.0	3.7	1.3	2.5	2.3	3.8	2.5
Mean Weighted ($ millions)							
Q2 2017 - Q4 2019	44,038	74,550	36,296	66,685	26,353	29,309	46,205
Q1 2020 - Q4 2022	82,556	102,533	49,443	75,531	40,572	59,702	68,390
Ratio	1.9	1.4	1.4	1.1	1.5	2.0	1.5

Note: Ratios are calculated prior to rounding. BNY and SST excluded because their retail funding amounts are small. Top: Volatility of unweighted retail outflows by period. Bottom: Mean weighted amounts, in USD millions. Volatility is calculated by the standard deviation.

Sources: LCR disclosures, authors' analysis

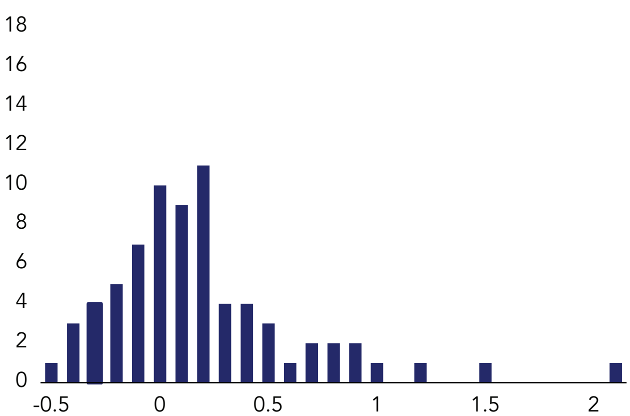
Figure 8. Flow/Provision Ratio, Q2 2017 - Q4 2019



Note: Flow/provision binned in increments of 0.1. X-axis represents lower bound of bin. Y-axis represents number of reported bank quarters.

Sources: LCR disclosures, authors' analysis

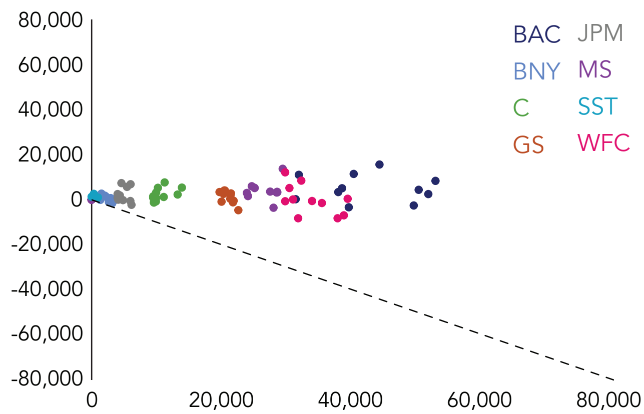
Figure 9. Flow/Provision Ratio, Q1 2020 - Q4 2022



Note: Flow/provision binned in increments of 0.1. X-axis represents lower bound of bin. Y-axis represents number of reported bank quarters.

Sources: LCR disclosures, authors' analysis

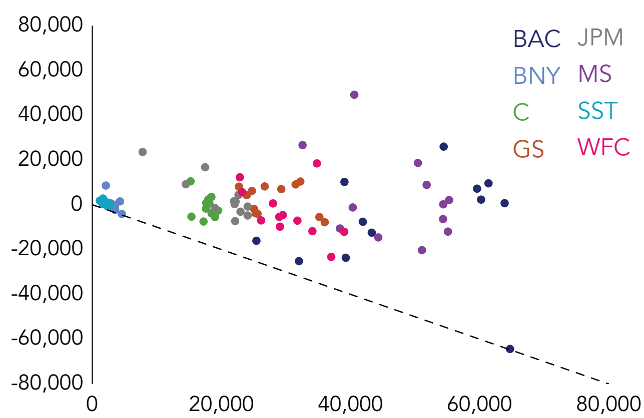
Figure 10a. Q2 2017 - Q4 2019 Brokered Deposit Outflows, Change in Unweighted (y-axis, $ millions), Weighted (x-axis, $ millions)



Note: Dashed line has a slope = -1.

Sources: LCR disclosures, authors' analysis

Figure 10b. Q1 2020 - Q4 2022 Brokered Deposit Outflows, Change in Unweighted (y-axis, $ millions), Weighted (x-axis, $ millions)



Note: Dashed line has a slope = -1.

Sources: LCR disclosures, authors' analysis

line in **Figure 6**, meaning that actual retail outflows exceed the stressed flows provisioned for by the LCR.

This possibility is particularly evident in **Figure 10**, which restricts **Figure 6** to brokered deposits. The greater vertical dispersion in the right panel shows the increased outflow volatility for these deposits. Although the LCR weight on brokered deposits is much higher than on stable retail deposits – making the provisioned amount much higher for each dollar of deposits – we see that the points in **Figure 10** get much closer to the dotted line than the points in **Figure 6**. Thus, relative to actual flow volatility, the LCR is less conservative for brokered deposits than for stable retail deposits.[12]

Wholesale Funding

The rapid withdrawal of wholesale funding featured prominently in the failures of large financial firms in

Figure 11. Unsecured Wholesale Funding Amounts Before and After the COVID Shock

	JPM	BAC	C	WFC	GS	MS	BNY	SST	Pooled
Volatility Unweighted									
Q2 2017 - Q4 2019 (percent)	1.9	2.8	2.5	3.5	6.9	5.2	5.2	4.0	4.2
Q1 2020 - Q4 2022 (percent)	5.8	7.3	4.2	2.5	6.7	7.7	4.7	5.8	6.2
Ratio	3.0	2.6	1.7	0.7	1.0	1.5	0.9	1.4	1.5
Mean Weighted ($ millions)									
Q2 2017 - Q4 2019	264,372	172,002	249,444	156,265	36,951	34,385	109,648	65,152	136,027
Q1 2020 - Q4 2022	403,936	241,365	345,905	142,030	68,768	47,156	142,950	86,667	184,847
Ratio	1.5	1.4	1.4	0.9	1.9	1.4	1.3	1.3	1.4

Note: Ratios are calculated prior to rounding. Volatility is calculated by the standard deviation.

Sources: LCR disclosures, authors' analysis

2008, and the failures of several large regional banks in 2023 were driven by the withdrawal of uninsured wholesale deposits. The LCR is intended to ensure the resilience of large banks to these types of funding outflows.

As we saw in **Figure 4**, the LCR disclosure template (**Figure 3**) separates secured wholesale funding (line 13) and unsecured wholesale funding (line 9). Both refer to funding that matures within 30 days.

The weight applied to secured wholesale funding is determined primarily by the type of collateral used to secure the funding. Collateral is classified using the same categories of assets that are used for the numerator of the LCR: for example, funding backed by assets that would qualify as Level 1 HQLA gets a weight of zero, whereas funding backed by assets that do not qualify as HQLA gets a weight of 100%. Other cases result in weights ranging from 15% to 50%, depending on the liquidity of the collateral. (**Figure 11** shows the average weight by bank.) The volatility of secured wholesale funding outflow (as measured by the standard deviation of percentage changes in the unweighted amount for line 13) remained essentially unchanged from the pre-COVID-19 to post-COVID-19 period. The same holds for the average provision (as measured by the average level of the weighted amount for line 13).

The weight attached to unsecured wholesale funding ranges from 5% to 100%, depending on the type of transaction and counterparty. Within unsecured wholesale funding, operational deposits are deposits associated with specific services provided to the customer by the bank; these are generally "stickier" deposits and thus get lower weights in the LCR rule. Among non-operational deposits, those that are fully insured get a weight of 20%, and deposits that are not fully insured get a weight of 40%. Funding from financial counterparties gets a higher weight than funding from non-financial counterparties. Debt instruments issued by the bank get a risk weight of 100%. A weight of 100% means that the LCR calculation assumes that the bank would not be able to roll over any of this debt under conditions of stress. (**Figure 5** shows the average weight by bank.)

The volatility of changes in the unweighted levels of unsecured wholesale funding (line 9 of the template) is greater than the volatility for retail funding. As shown in **Figure 11** the standard deviation grew from 4.2% in the pre-COVID-19 period to 6.2% in the subsequent period, an increase by a factor of 1.5.[13] In some cases, the growth in volatility is greater—as much as three times greater—even though the average weighted amount (for line 9) increased much less, causing outflow volatility to grow by a larger factor than the amount provisioned against this volatility. This is similar to the pattern we observed for retail funding, but the impact of the COVID-19 shock is somewhat smaller for unsecured wholesale funding than for retail funding, with 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.

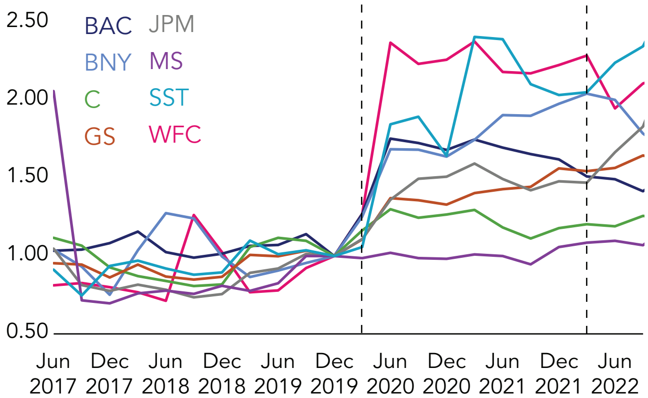
By combining these points, we see that the COVID-19 shock would have a limited impact on derivative disclosures from Q1 2020: the shock was late in the quarter, so its effect is diminished by averaging over the quarter. In contrast, we would expect to see a larger effect in Q2 2020: any large derivative 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



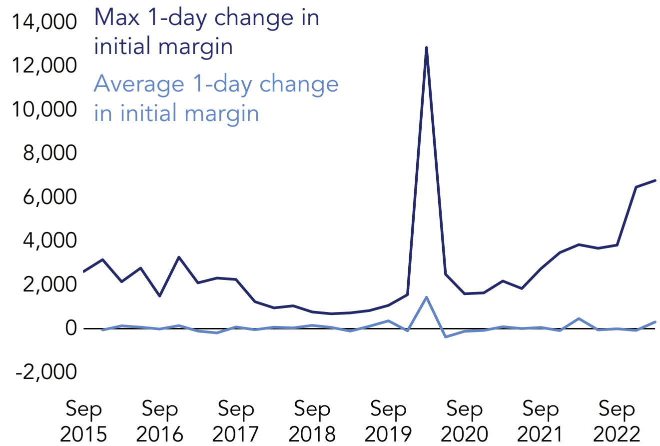
Sources: LCR disclosures, authors' analysis

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.

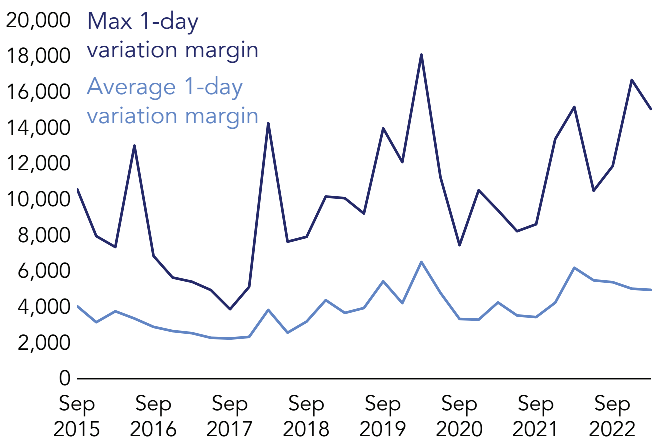
To illustrate, we use data from the CME Group, one of the largest derivatives clearinghouses. We combine their disclosures for over-the-counter interest rate swaps and listed futures and options.

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