Level 3 Assets as Regulatory Arbitrage:
An Analysis of Capital Requirements & Level 3 Assets at U.S. G-SIB Banking Institutions

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ABSTRACT

The objective of this report is to analyze whether the introduction of the Supplementary Leverage Ratio incentivizes banks to hold riskier assets on the balance sheet. The Supplementary Leverage Ratio (SLR) was introduced in 2016 following the aftermath of the 2007-2008 financial crisis as a stop-gap measure to existing capital ratio requirements, including the Tier 1 capital ratio. Unlike the Tier 1 capital ratio, however, the SLR is non-risk-weighted, which introduces an incentive problem for banks– banks are less willing to hold safer assets in search of more returns by holding riskier assets. Risky assets, particularly those that are categorized as Level 3 due to a lack of significantly observable inputs and require a level of subjectivity to determine its value, may provide banks with the ideal vehicle to bypass strict regulatory requirements. While evidence in this study suggests that Level 3 assets have been decreasing over time and that the SLR has been more binding than the Tier 1 capital ratio since 2016, only the SLR shows a negative relationship between changes in SLR and changes in Level 3 assets. As the bank's SLR gets closer to its required minimum, it is associated with an increase in Level 3 assets.

I. INTRODUCTION

After the financial crisis in 2007-2008, bank regulatory bodies faced the reality that previous risk management measures had been insufficient to predict the level of stress that banks were under. These regulatory bodies were now tasked with re-evaluating existing measures in an attempt to prevent similar economic shutdowns from occuring again.

Common in the evaluation of capital is a risk-weighted measure called the Tier 1 capital ratio. This ratio is calculated based on the relative riskiness of certain assets, so riskier assets are weighted more heavily than non-risky assets. As a result, holding riskier assets is disincentivized because it increases the amount of risk-weighted assets (RWAs) on the balance sheet. Banks are required to maintain above a specific minimum in order to be considered "sufficiently capitalized" by the bank's regulatory bodies. However, because the Tier 1 Capital Ratio had insufficiently prevented the risky behavior contributory to the 2007-2008 financial crisis, a new, non-risk-weighted measure called the Supplementary Leverage Ratio (SLR) was introduced as a potential "stop gap" to the existing methodology. Thus, current regulation specifies minimums for both the Tier 1 capital ratio and the SLR– banks that do not meet the requirements for both face prompt corrective action or other penalties.

Pursuant to the discussion of capital measurements and riskiness of certain assets, my discussion will focus specifically on Level 3 assets. Level 3 assets are a particular type of Fair Value Asset (FVA), and they are typically the most illiquid and most difficult to value as compared to Level 1 or Level 2 assets. Level 1 assets are defined as having readily observable market prices, and Level 2 assets do not have readily observable market prices, but their fair value can be determined using related assets or other data sources. Level 3 assets are considered

the most difficult to value because they require the use of proprietary firm models and subjective assumptions. Common examples of Level 3 assets include mortgage-backed securities (MBS), complex derivative products and distressed debt.

Level 3 assets are particularly interesting not just because of the inherent subjectivity in its categorization. In the period leading up to the financial crisis of 2007-2008, major financial institutions began to reduce their balance sheets. Acharya and Tuckman contend that "the existence of lender of last resort (LOLR) facilities allows firms to put off sales of risky assets", and indeed, the evidence shows that banks who put off the sale of their illiquid (Level 2 and 3) assets, such as Lehman Brothers and Bear Stearns, paid the price (2014).

The role of Level 2 and 3 assets was significant in the last financial crisis, but will new regulatory measures be sufficient to limit banks' incentives and behavior? The objective of this report is to analyze whether the introduction of the Supplementary Leverage Ratio, a non-risk-weighted metric, incentivizes banks to hold riskier assets on the balance sheet. Additionally, because of the subjective nature of categorizing fair value assets, and in particular Level 3 assets, it is possible that banks may be manipulating their holdings of such Level 3 assets in order to reward the moral hazard incentive the SLR creates.

The outline of the paper is as follows: Section 2 will discuss relevant background on capital ratio requirements as well as a detailed analysis of the Tier 1 capital ratio and SLR. Section 3 highlights the incentive problem the SLR introduces, and Section 4 presents data and results. Section 5 concludes the paper.

II. BACKGROUND

In the United States, financial institutions are subject to a multi-faceted regulatory regime, where institutions must comply with both international and domestic banking regulation and supervision. At the international level, the Basel Committee on Banking Supervision (BCBS) determines the appropriate risk-based capital ratios and leverage ratios, which vary depending on a number of factors, including but not limited to whether the institution is a holding company or a depository institution and the number of assets on the institution's balance sheet. Domestically, the Federal Reserve as of July 2013 formally adopts the BCBS Basel III capital framework for US banking institutions. For regulated US financial institutions, most capital ratios are reported on SEC filed annual reports and/or on Federal Financial Institutions Examination Council (FFIEC) bank call reports, with the largest financial institutions required to submit stressed scenarios under "adverse economic conditions" for the Federal Reserve's Comprehensive Capital Analysis and Review (CCAR) and Dodd-Frank Act stress-testing (DFAST).

I will discuss an overview of the two primary ratios of interest for this paper. The first is the Tier 1 capital ratio, which is Tier 1 capital divided by total risk-weighted assets. Tier 1 capital is a broad term which encompasses assets including common stock, retained earnings, related surplus and accumulated other than comprehensive income, among others (Hill, 2015). To be "risk-weighted" refers to the weighting of a particular asset to a specific risk level. Traditionally safe assets such as U.S Treasuries receive lower risk-weights than assets which are riskier and more volatile, such as corporate bonds or equities. At an extremely simplified level, to calculate the Tier 1 capital ratio, banks must calculate the weighted average of all the assets

held at the institution by summing the products of the assigned risk-weight and the asset together and dividing this amount by the total amount of Tier 1 capital.

The Tier 1 capital requirement can be determined as follows. All subject financial institutions are subject to a 6.0% minimum Tier 1 capital ratio. If a bank is defined as a Global Systemically Important Bank (G-SIB) by BCBS, regardless of whether it is the holding company entity or the insured depository institution (IDI), 1) a G-SIB buffer, 2) a capital conservation buffer and 3) a countercyclical capital buffer will apply. No buffers are added to the 6.0% minimum if the institution is not defined as a G-SIB, and the G-SIB buffer (1) is only added to the minimum requirement for bank holding companies (BHCs). The countercyclical capital buffer has remained at 0% since inception, but may change as needed in the future as determined by BCBS.

The capital conservation buffer was introduced in 2016, alongside the countercyclical capital buffer and has followed a predetermined schedule, increasing in regular increments to 2.50% by 2019. This incremental buffer schedule can be found in Table 1.

The G-SIB buffer depends on the G-SIB score that a particular institution receives from BCBS. The G-SIB scores separate G-SIB banks into five main "buckets", where the higher the score, the higher the buffer requirement. Higher scores are associated with larger balance sheets, though a variety of different metrics are reported and considered when BCBS makes its annual determination[1]. This same G-SIB buffer is also used to calculate the minimum Common Equity Tier 1 (CET1) requirement. Finally, as with the capital conservation buffer, the G-SIB buffer was not expected to be fully implemented until 2019. Between 2016 and 2019, financial institutions were required to abide by a certain percentage of the final buffer requirement, known

[1] Further information about the BCBS G-SIB determination methodology can be found publicly on their website at this link: https://www.bis.org/bcbs/gsib/index.htm.

as the “transitional requirement”, but were considered in compliance as long as they remained above this percentage. The actual Tier 1 capital minimum requirements used by each of the 8 U.S. G-SIB institutions are listed in Table 1, which, along with the capital conservation buffer was used to calculate what G-SIB buffer each bank would have used for that annual period would be.

The second ratio is the supplementary leverage ratio (SLR). Unlike the Tier 1 capital ratio, the SLR is not risk-weighted– all assets are counted equally based on the amount held on the balance sheet. The SLR is calculated by dividing Tier 1 capital by total leverage exposure, where total leverage exposure is defined as assets both on-balance sheet and assets that are off-balance sheet, including OTC derivatives, cleared derivatives, repo-style transactions and other off-balance sheet exposures (Davis Polk, 2014). The introduction of the SLR in 2014 was intended to act as an additional stop gap against risk-weighted ratios, because during the financial crisis of 2007-2008 it was shown that the risk-weighted capital ratios were not sufficient at determining the level of duress bank balance sheets were under (Haldane and Maduros, 2012; as cited in Greenwood, et. al., 2017). The SLR was also introduced as a complement to the existing U.S. leverage ratio, which differs from the SLR in that the U.S. leverage ratio does not take into account any off-balance sheet assets. Banks with significant off-balance sheet assets will have a lower SLR than U.S. leverage ratio.

Table 1

Tier 1 Capital Minimums as reported, Capital Conservation buffer and calculated G-SIB buffer

Tier 1 Capital Actual (BHC)								
	2021	**2020**	**2019**	**2018**	**2017**	**2016**	**2015**	**2014**
Bank of America	11.00%	11.00%	11.00%	9.75%	8.75%	7.38%	6.00%	6.00%
BNY Mellon	8.50%	8.50%	8.50%	7.875%	7.25%	6.625%	6.00%	5.50%
Citigroup	12.00%	11.50%	11.50%	10.125%	8.75%	7.50%	6.00%	5.50%
Goldman Sachs	11.00%	11.00%	11.00%	9.80%	8.50%	7.375%	6.00%	5.50%
JP Morgan Chase	12.00%	12.00%	12.00%	10.50%	9.00%	7.75%	6.00%	5.50%
Morgan Stanley	11.50%	11.50%	11.50%	10.10%	8.80%	7.40%	6.00%	6.00%
State Street	9.50%	9.50%	10.00%	9.00%	8.00%	7.00%	6.00%	5.50%
Wells Fargo	10.50%	10.50%	10.50%	9.375%	8.25%	7.125%	6.00%	6.00%

Capital Conservation Buffer								
	2021	**2020**	**2019**	**2018**	**2017**	**2016**	**2015**	**2014**
	2.50%	2.50%	2.50%	1.875%	1.25%	0.625%	0.00%	0.00%

G-SIB Buffer Table Calculated (BHC)								
	2021	**2020**	**2019**	**2018**	**2017**	**2016**	**2015**	**2014[2]**
Bank of America	2.50%	2.50%	2.50%	1.875%	1.50%	0.75%	0.00%	0.00%
BNY Mellon	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-0.50%
Citigroup	3.50%	3.00%	3.00%	2.25%	1.50%	0.875%	0.00%	-0.50%
Goldman Sachs	2.50%	2.50%	2.50%	1.925%	1.25%	0.75%	0.00%	-0.50%
JP Morgan Chase	3.50%	3.50%	3.50%	2.625%	1.75%	1.125%	0.00%	-0.50%
Morgan Stanley	3.00%	3.00%	3.00%	2.225%	1.55%	0.775%	0.00%	0.00%
State Street	1.00%	1.00%	1.50%	1.125%	0.75%	0.375%	0.00%	-0.50%
Wells Fargo	2.00%	2.00%	2.00%	1.50%	1.00%	0.50%	0.00%	0.00%

Determining the minimum SLR follows a similar, formulaic approach to the calculation of the Tier 1 capital ratio requirement. Only G-SIBs and other top-tier U.S institutions[3] along

[2] In most annual filings for fiscal year 2014, banks reported only the Tier 1 capital requirement and did not disclose an explicit G-SIB buffer amount. These calculated amounts are assuming a 6.0% minimum, and the negative buffer amounts could be as a result of a transitory "ramp-up" before the regulation was required to be adopted.

[3] The SLR reporting requirement currently applies to any U.S. BHC with at least $700 billion in total consolidated assets or at least $10 trillion in assets under custody and its IDI subsidiaries. All 8 G-SIB banks are captured in this requirement, and the scope of my research focuses on the G-SIBs, so I will be referring to these populations interchangeably herein. Other large, top-tier institutions have recently become subject to the SLR and therefore the reporting requirement, and thus were not included in the scope of my research.

with their IDI subsidiaries are currently required to report their supplementary leverage ratios. However, the absolute minimum for all advanced approach banks[4] is set at 3.0%. G-SIB BHCs have a surcharge of 2.0% to avoid any corrective action and IDI subsidiaries have a 3.0% surcharge to be considered "well capitalized", totalling 5.0% for G-SIB BHCs and 6.0% for IDI subsidiaries.

In addition to the regulatory capital requirements at an international and federal level, banks must also comply with Generally Accepted Accounting Principles (GAAP), overseen by the United States Financial Accounting Standards Board (FASB). All public companies, including banks and other financial institutions, must report quarterly and annually to the SEC, detailing the company's financial performance. Per FASB guidelines, all financial institutions must report the amount of Level 3 assets held on the balance sheet, as well as changes between Level 2 and Level 3 assets.

Figure 1 includes a sample selection of the types of assets categorized as Level 1, 2 and 3 per JP Morgan's 2020 10-K, released on February 23, 2021. From this figure, we can see, for example, that under interest rate derivative receivables, there was about $481.1 billion categorized as Level 1, $1,373.6 billion categorized as Level 2 and $16.4 billion categorized as Level 3 assets. Looking further to the right of the chart, the fair value assets are adjusted based on "derivative receivables and derivative payables and the related cash collateral… when a legally enforceable master netting agreement exists" based on the guidance allowed by the

[4] Advanced approach banks are defined as a banking organization with greater than or equal to $250 billion in total consolidated assets or greater than or equal to $10 billion of on-balance sheet foreign exposures. It also includes a foreign banking organization's US intermediate holding company with the same criteria, regardless of whether the intermediate holding company is a BHC. (Davis Polk, 2014).

FASB[5]. The final column in the chart shows the sum of fair value assets, net of any derivative adjustments that were made, totaling about $1,243.2 billion.

Figure 2 details the FASB reporting requirement which outlines transfers into and out of Level 3 Assets. From left to right, the table shows the fair value of assets at the beginning of the year, followed by any gains or losses incurred for the item, any purchases or sales that were made over the course of that year that would add or subtract to the total fair value amount, any assets that had reached maturity or settled, and any transfers into and out of Level 3 categorization. The term "transfers" is used in reference to any changes to the categorization of the asset– either from Level 2 to 3 ("transferred into" Level 3), or in the reverse from Level 3 to 2 ("transferred out of" Level 3). These assets are evaluated by the bank and determined to be more closely aligned with Level 2 or 3 categorization due to changes in observability of inputs[6]. Reasons for reclassification of specific assets are not discussed in the footnotes unless significant.

U.S financial institutions must comply with all of its capital ratio requirements. A financial institution is in violation of its capital requirements if at least one of the ratios is not "sufficiently held", and a ratio is said to be "binding" if it is the most strict requirement that the bank must comply with. As a result of these requirements, a binding regulatory requirement could therefore influence bank decision making, including funding, lending and allocation of assets (Campbell, 2021).

[5] From footnote (g), page 178 of JP Morgan Chase & Co. 2020 Form 10-K: "As permitted under U.S. GAAP, the Firm has elected to net derivative receivables and derivative payables and the related cash collateral received and paid when a legally enforceable master netting agreement exists. The level 3 balances would be reduced if netting were applied, including the netting benefit associated with cash collateral."

[6] From footnote (i), page 185 of JP Morgan Chase & Co. 2020 Form 10-K: "All transfers into and/or out of level 3 are based on changes in the observability and/or significance of the valuation inputs and are assumed to occur at the beginning of the quarterly reporting period in which they occur."

Figure 1

Categorization of Level 1, 2, and 3 Fair Value Assets per JP Morgan 2020 Annual Filing

Assets and liabilities measured at fair value on a recurring basis

December 31, 2020 (in millions)	Fair value hierarchy			Derivative netting adjustments[g]	Total fair value
	Level 1	Level 2	Level 3		
Federal funds sold and securities purchased under resale agreements	$ —	$ 238,015	$ —	$ —	$ 238,015
Securities borrowed	—	52,983	—	—	52,983
Trading assets:					
Debt instruments:					
Mortgage-backed securities:					
U.S. GSEs and government agencies[a]	—	68,395	449	—	68,844
Residential – nonagency	—	2,138	28	—	2,166
Commercial – nonagency	—	1,327	3	—	1,330
Total mortgage-backed securities	—	71,860	480	—	72,340
U.S. Treasury, GSEs and government agencies[a]	104,263	10,996	—	—	115,259
Obligations of U.S. states and municipalities	—	7,184	8	—	7,192
Certificates of deposit, bankers' acceptances and commercial paper	—	1,230	—	—	1,230
Non-U.S. government debt securities	26,772	40,671	182	—	67,625
Corporate debt securities	—	21,017	507	—	21,524
Loans[b]	—	6,101	893	—	6,994
Asset-backed securities	—	2,304	28	—	2,332
Total debt instruments	131,035	161,363	2,098	—	294,496
Equity securities	97,035	2,652	179	—	99,866
Physical commodities[c]	6,382	5,189	—	—	11,571
Other	—	17,165	346	—	17,511
Total debt and equity instruments[d]	234,452	186,369	2,623	—	423,444
Derivative receivables:					
Interest rate	2,318	386,865	2,307	(355,765)	35,725
Credit	—	12,879	624	(12,823)	680
Foreign exchange	146	205,127	987	(190,479)	15,781
Equity	—	71,279	3,519	(54,125)	20,673
Commodity	—	21,272	231	(14,732)	6,771
Total derivative receivables	2,464	697,422	7,668	(627,924)	79,630
Total trading assets[e]	236,916	883,791	10,291	(627,924)	503,074
Available-for-sale securities:					
Mortgage-backed securities:					
U.S. GSEs and government agencies[a]	21,018	92,283	—	—	113,301
Residential – nonagency	—	10,233	—	—	10,233
Commercial – nonagency	—	2,856	—	—	2,856
Total mortgage-backed securities	21,018	105,372	—	—	126,390
U.S. Treasury and government agencies	201,951	—	—	—	201,951
Obligations of U.S. states and municipalities	—	20,396	—	—	20,396
Certificates of deposit	—	—	—	—	—
Non-U.S. government debt securities	13,135	9,793	—	—	22,928
Corporate debt securities	—	216	—	—	216
Asset-backed securities:					
Collateralized loan obligations	—	10,048	—	—	10,048
Other	—	6,249	—	—	6,249
Total available-for-sale securities	236,104	152,074	—	—	388,178
Loans[b][f]	—	42,169	2,305	—	44,474
Mortgage servicing rights	—	—	3,276	—	3,276
Other assets[b][e]	8,110	4,561	538	—	13,209
Total assets measured at fair value on a recurring basis	$ 481,130	$ 1,373,593	$ 16,410	$ (627,924)	$ 1,243,209

Figure 2
Transfers into and out of Level 3 Fair Value Assets per JP Morgan 2020 Annual Filing

	Fair value measurements using significant unobservable inputs								
Year ended December 31, 2020 (in millions)	Fair value at January 1, 2020	Total realized/unrealized gains/(losses)	Purchases[g]	Sales	Settlements[h]	Transfers into level 3[i]	Transfers (out of) level 3[i]	Fair value at Dec. 31, 2020	Change in unrealized gains/(losses) related to financial instruments held at Dec. 31, 2020
Assets:[a]									
Trading assets:									
Debt instruments:									
Mortgage-backed securities:									
U.S. GSEs and government agencies	$ 797	$ (172)	$ 134	$ (149)	$ (161)	$ —	$ —	$ 449	$ (150)
Residential – nonagency	23	2	15	(5)	(4)	—	(3)	28	(1)
Commercial – nonagency	4	—	1	—	(1)	2	(3)	3	—
Total mortgage-backed securities	824	(170)	150	(154)	(166)	2	(6)	480	(151)
U.S. Treasury, GSEs and government agencies	—	—	—	—	—	—	—	—	—
Obligations of U.S. states and municipalities	10	—	—	(1)	(1)	—	—	8	—
Non-U.S. government debt securities	155	21	281	(245)	(7)	—	(23)	182	11
Corporate debt securities	558	(23)	582	(205)	(236)	411	(580)	507	(25)
Loans[b]	673	(73)	1,112	(484)	(182)	791	(944)	893	(40)
Asset-backed securities	37	(3)	44	(40)	(9)	9	(10)	28	(4)
Total debt instruments	2,257	(248)	2,169	(1,129)	(601)	1,213	(1,563)	2,098	(209)
Equity securities	196	(75)	53	(376)	(1)	535	(153)	179	(20)
Other	232	271	245	(9)	(154)	6	(245)	346	206
Total trading assets – debt and equity instruments	2,685	(52) [d]	2,467	(1,514)	(756)	1,754	(1,961)	2,623	(23) [d]
Net derivative receivables:[c]									
Interest rate	(332)	2,682	308	(148)	(2,228)	(332)	308	258	325
Credit	(139)	(212)	73	(154)	181	59	(32)	(224)	(110)
Foreign exchange	(607)	49	49	(24)	83	13	3	(434)	116
Equity	(3,395)	(65)	1,664	(2,317)	1,162	(935)	24	(3,862)	(556)
Commodity	(16)	(546)	27	(241)	356	(310)	(1)	(731)	267
Total net derivative receivables	(4,489)	1,908 [d]	2,121	(2,884)	(446)	(1,505)	302	(4,993)	42 [d]
Available-for-sale securities:									
Mortgage-backed securities	1	—	—	—	(1)	—	—	—	—
Asset-backed securities	—	—	—	—	—	—	—	—	—
Total available-for-sale securities	1	—	—	—	(1)	—	—	—	—
Loans[b]	516	(243) [d]	962	(84)	(733)	2,571	(684)	2,305	(18) [d]
Mortgage servicing rights	4,699	(1,540) [e]	1,192	(176)	(899)	—	—	3,276	(1,540) [e]
Other assets[b]	917	(63) [d]	75	(104)	(320)	40	(7)	538	(3) [d]

III. PROBLEM & HYPOTHESIS

The introduction of the SLR highlights an incentive problem for banks: if all assets are held equally, banks have less incentive to hold safer assets given the traditional risk-reward tradeoff. In other words, banks may decide to hold riskier assets in order to achieve higher returns, subject to its regulatory minimum requirements. Several papers and articles in existing literature have observed and highlighted the incentive problem for banks, showing that the SLR has become increasingly binding (Covas, 2021), (Greenwood, et. al, 2017), (Ita, 2017). However, my paper will seek to add to the existing literature by attempting to show whether banks are

manipulating their holdings of specifically Level 3 assets in order to skirt the required minimum capital ratios.

IV. DATA & RESULTS

I begin my analysis with a replication of analysis done by Greenwood, et. al– finding the distance from the actual Tier 1 capital ratio and SLR and subtracting required minimum, resulting in a percentage difference. Greenwood, et. al use fourth quarter data from 2016, in which, of the 8 G-SIB banks, the SLR was more binding for 7 banks. For my replication, I used fourth quarter data from 2020, exactly four years after Greenwood et. al's data, which showed that 6 of the same 8 banks were more bound by the SLR than the Tier 1 capital ratio. This replication was only a simple exercise– it observes only capital requirement distance measurements for bank holding companies and not IDI subsidiaries and does not observe how the distance from requirements may have changed in between periods.

Using data from the S&P Capital IQ Pro database, I was able to collect quarterly Tier 1 capital ratios dating back to Q12010 and SLR data beginning in Q32016. For a true comparison and given that Basel III rules were first implemented in 2016, data after Q32016 was most relevant to the scope of my research. For G-SIB BHCs, I compared the Tier 1 capital ratio against the actual minimum requirements pulled from each institution's annual report, as summarized in Table 1. Given that the G-SIB buffer does not apply for G-SIB IDI subsidiaries, I determined Tier 1 capital requirements for banks by adding the 6.0% minimum to the capital conservation buffer, which are also summarized in Table 1. For SLR calculations, I applied the formula as described in the previous section, in which G-SIB BHCs are subject to a minimum SLR of 5% and G-SIB IDI subsidiaries are subject to a minimum of 6%. From this, I was able to determine a quarterly time series of the distance from Tier 1 capital and SLR requirements.

Table 2
Distance from Requirement: Tier 1 Capital Ratio and SLR, Q42016 and Q42020

	Requirements		Actual 2016 Q4 Ratings		Actual 2020 Q4 Ratings		Distance from Requirement 2016[7]		Distance from Requirement 2020[8]	
Company	Tier 1 Capital Ratio	SLR	Tier 1 Capital Ratio	SLR	Tier 1 Capital Ratio	SLR	Tier 1 Capital Ratio	SLR	Tier 1 Capital Ratio	SLR
JP Morgan Chase	12	5	14.2	6.5	15	6.9	2.2	***1.5***	3.0	***1.9***
Bank of America	11.5	5	13.6	7	13.5	7.2	2.1	***2***	***2.0***	2.2
Citigroup	11.5	5	15.8	7.6	13.7	7	4.3	***2.6***	2.2	***2.0***
Morgan Stanley	11.5	5	20	6.4	19.4	7.4	8.5	***1.4***	7.9	***2.4***
Goldman Sachs	11	5	16.6	6.5	16.7	7	5.6	***1.5***	5.7	***2.0***
Wells Fargo	10.5	5	12.8	7.6	13.3	8.1	***2.3***	2.6	***2.8***	3.1
BNY Mellon	10	5	14.5	6	16.1	8.6	4.5	***1.0***	6.1	***3.6***
State Street	10	5	14.7	5.9	14.4	8.1	4.7	***0.9***	4.4	***3.1***

Table 3 summarizes the number of instances by institution in which the SLR was more binding than the Tier 1 capital ratio. For example, of the BHCs, JP Morgan Chase & Co. was bound by the SLR for all 21 quarters, whereas Wells Fargo & Company, Citigroup Inc. and State Street Corporation were bound by the SLR in 17 of those quarters. The numbers at the bank[8] level are even more dramatic. Of the 12 total bank subsidiaries of G-SIB institutions, 9 saw a more binding SLR, with Goldman Sachs Bank USA bound by the SLR in 19 of 21 quarters and BNY Mellon, National Association bound by 17 of 21.

[7] Binding requirements are in bold.
[8] At all eight G-SIB banks, all IDIs refer to specific bank entities. I use IDI and bank synonymously herein.

Table 3
Number of Quarters for Binding Capital Requirements by G-SIB BHC and Bank

Type	Company Name	SLR < Tier 1 (SLR Binding)	Tier 1 < SLR (Tier 1 Binding)
BHC	JPMorgan Chase & Co.	21	0
BHC	Bank of America Corporation	19	2
BHC	Wells Fargo & Company	17	4
BHC	Citigroup Inc.	17	4
BHC	The Goldman Sachs Group, Inc.	21	0
BHC	The Bank of New York Mellon Corporation	21	0
BHC	State Street Corporation	17	4
BHC	Morgan Stanley	21	0
Bank	JPMorgan Chase Bank, National Association	21	0
Bank	Bank of America, National Association	21	0
Bank	Bank of America California, National Association	21	0
Bank	Wells Fargo Bank, National Association	21	0
Bank	Wells Fargo National Bank West	20	1
Bank	Citibank, N.A.	21	0
Bank	Goldman Sachs Bank USA	19	2
Bank	BNY Mellon, National Association	17	4
Bank	The Bank of New York Mellon	21	0
Bank	State Street Bank and Trust Company	21	0
Bank	Morgan Stanley Bank, N.A.	21	0
Bank	Morgan Stanley Private Bank, National Association	21	0

The decision to include bank and bank holding company data was twofold. The first is that the requirements for banks and BHCs are different, and thus separate analysis and calculation of the two is necessary. A secondary reason is that due to the nature of the type of assets that are typically categorized as Level 3, it follows that Level 3 assets would be more likely to be on the same balance sheet as where the broker dealer sits within the institution. Therefore, if the broker dealer sits within the IDI subsidiary, analysis should focus on banks; if

the broker dealer is in the BHC, analysis should also be focused there. However, my research found that the location of the broker dealer was not definitively located in either, and as a result, the scope of my research includes both types of institutions. Further details may be found in the Appendix.

From Tables 2 and 3, it is possible to conclude that since the introduction of the SLR, G-SIB banks have been more bound by it than the Tier 1 capital ratio. The results suggested that with no change in the regulatory environment, the supplementary leverage ratio remained the more binding requirement that banks must comply with, and indicated that the incentive problem as discussed previously could still remain a factor in banks' decision-making activity.

My research now turns to what banks have been doing with Level 3 assets over time, as shown in Figure 3. After retrieving data from S&P Capital IQ Pro, Level 3 assets (gross) as a percentage of the BHC's total assets and Level 3 as a percentage of total fair value assets were determined. Fair value assets are calculated from the gross sums of Level 1, 2, and 3 assets at the specific bank entity. From Figure 3 we see how the percentage of Level 3 assets with the Tier 1 capital and SLR distance measures have changed over time. Overall, the amount of Level 3 assets has largely decreased since 2014 at each of the G-SIB BHCs[9] and banks[10], both as a percentage of total assets and as a percentage of FVA. Bank of America, Goldman Sachs and Morgan Stanley's bank entities and Morgan Stanley BHC have flat to slightly increased levels of Level 3 assets as compared to other BHCs and banks. From these charts, it is also interesting to note that in general, the Tier 1 capital distance from requirement has largely narrowed since

[9] Note that BNY Mellon was removed from the sample set because the institution's holdings of Level 3 assets were largely entirely phased out by the start of the observation period in Q12014. 7 G-SIBs BHCs and banks are represented.

[10] Bank of America California, National Association; Wells Fargo National Bank West and Morgan Stanley Private Bank, National Association were removed from the sample set as they are secondary, smaller bank subsidiaries and have very small holdings of Level 3 assets.

2014, with exceptions at JP Morgan, Wells Fargo and Morgan Stanley's bank entities, with Morgan Stanley's Tier 1 distance measure coming in at just above 12% by Q32021.

Figure 3

Time Series of % of Level 3 Assets / Total Assets, % of Level 3 Assets / Total FVA, Distance from Tier 1 capital requirement, Distance from SLR requirement, Q12014 - Q32021

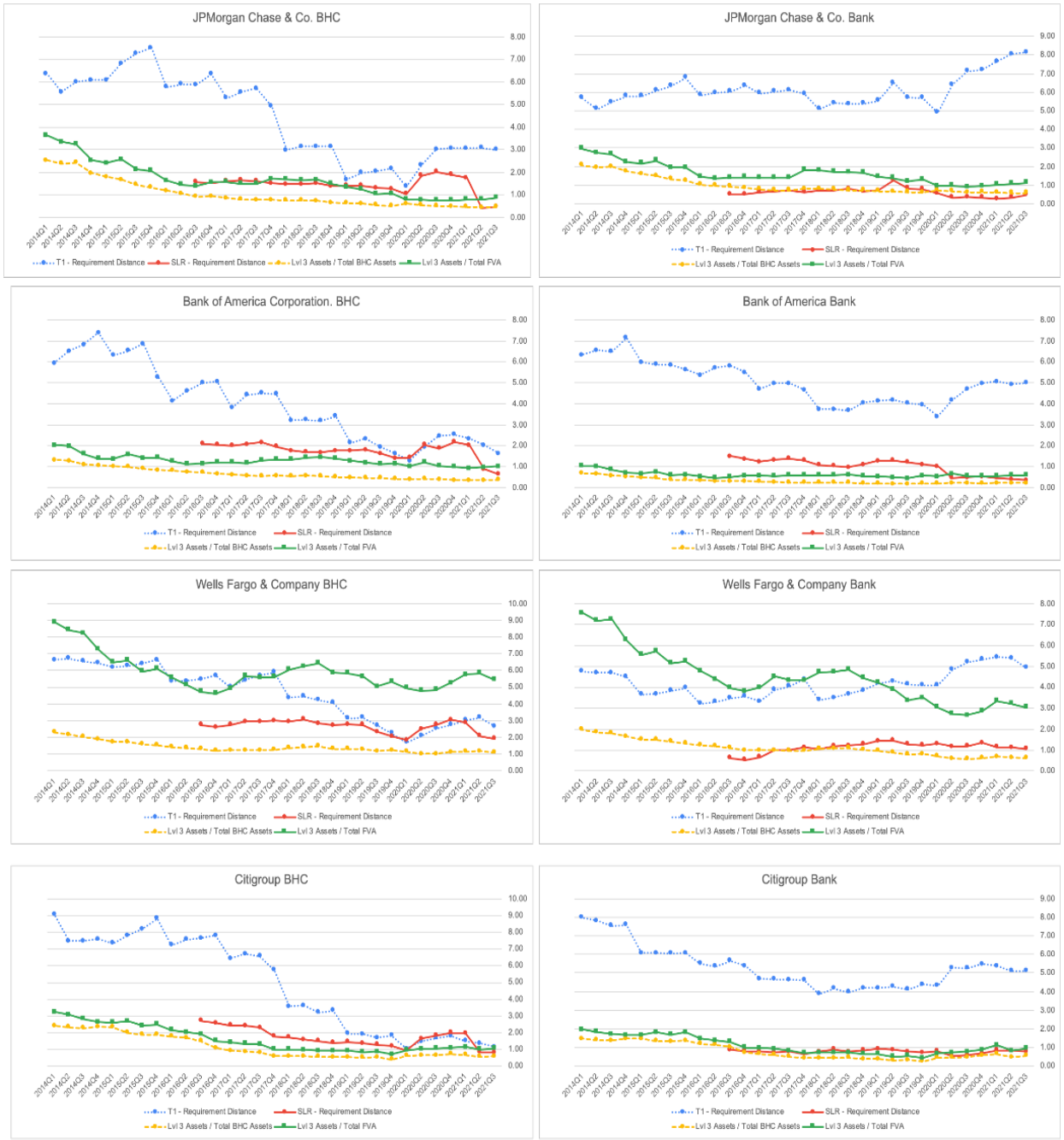
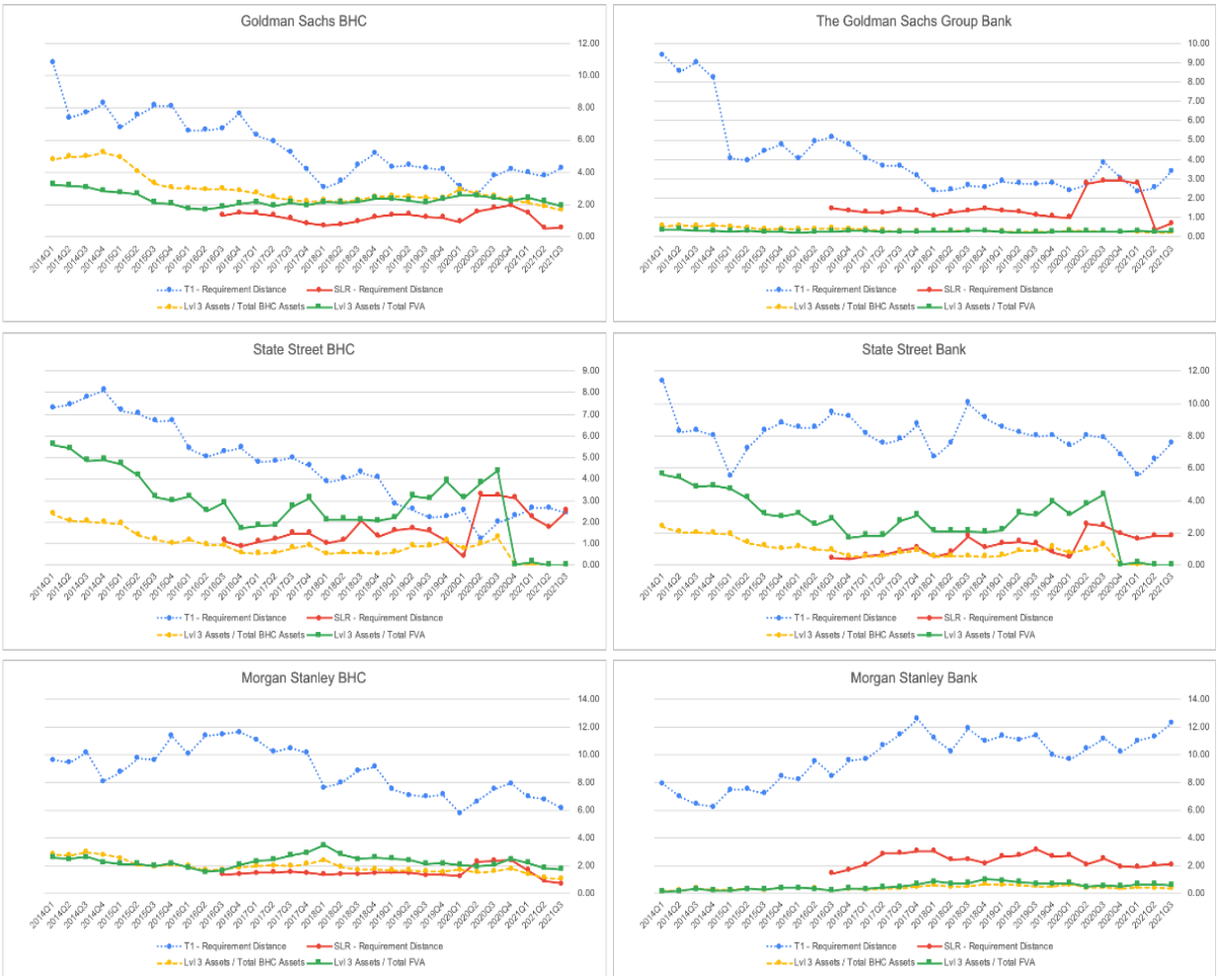


Figure 3 (cont'd)



At the SLR level, the distance from requirement remained relatively unchanged, but many banks experienced a widening of the distance from requirement in early 2020, which subsequently narrowed again by the beginning of 2021, as seen at the BHC level for all 7 G-SIBs and at the bank level for Goldman Sachs and State Street. This behavior is likely a direct result of the Federal Reserve's actions during the COVID-19 pandemic– beginning in April of 2020, the SLR requirements were eased, in which "the change would exclude U.S. Treasury securities and deposits at Federal Reserve Banks from the calculation of the rule for holding companies" (Federal Reserve, 2020). The provision was approved in an effort to promote liquidity in the

Treasury market and to encourage banks to lend to small businesses and households, and the change was reversed as planned in March of 2021. The effectiveness of such an acquiescence has been hotly debated, with critics arguing that the proposal did not achieve what Fed hoped to accomplish, particularly in the context of the Fed's repurchasing activities during the pandemic (Ip, 2021).

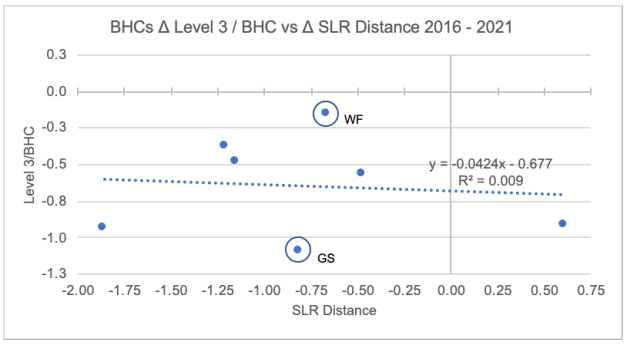
Understanding that Level 3 assets have generally decreased in the last several years and that the SLR has been more binding than the Tier 1 capital ratio, the final portion of my analysis will attempt to demonstrate whether there is a relationship between Level 3 assets and these capital ratio requirements.

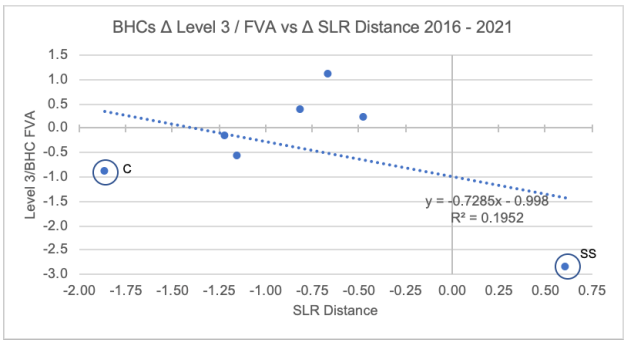
Figure 4 shows scatterplots for both BHCs and banks with the dependent variable as the change in Level 3 over Total BHC assets or the change in Level 3 over Total FVA assets between Q32016 and Q22021 and the independent variable as the change in SLR distance or Tier 1 capital distance over the same period. The top four charts show plots for BHCs and the bottom four show the plots for banks. Within each quartet, the top two charts show the change in SLR distance from 2016 to 2021 and the bottom two show the change in the Tier 1 distance from requirement.

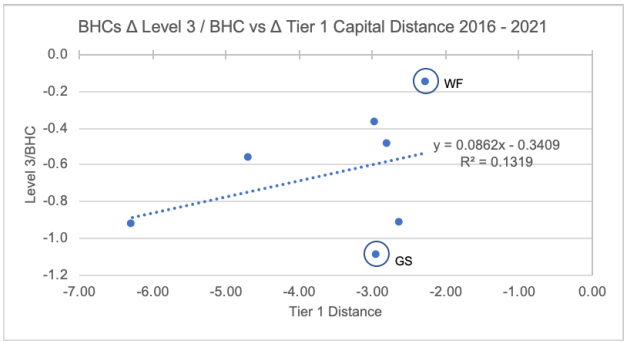
The scatter plots measuring the change in distance from SLR requirement appear to suggest a negative relationship with the percentage of Level 3 asset holdings, both at the bank holding company level and at the depository subsidiary levels. This finding is not inconsistent with the suggestion that as Level 3 assets at the firm decrease, the distance from the SLR requirement increases. A few outliers in these plots are highlighted– while there is no consistent outlier among BHCs comparing Level 3 assets as a portion of total BHC assets versus total FVA, Morgan Stanley and State Street banks emerge as outliers in both plots.

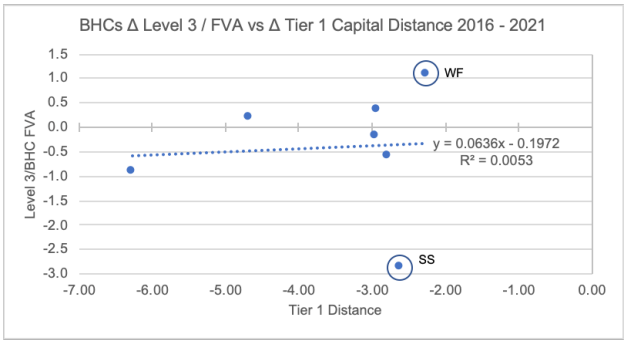
Figure 4

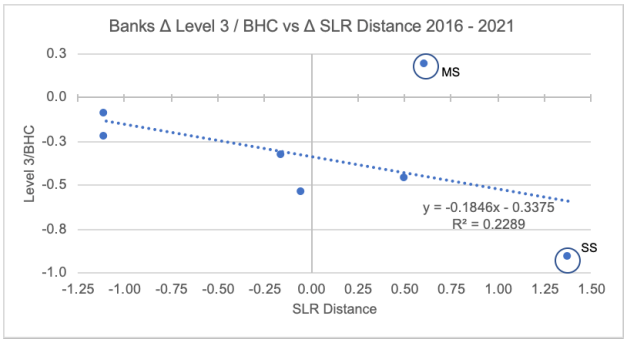
Relationship between Changes in Level 3 / Total BHC or Fair Value Assets and Changes in Distance from Tier 1 or SLR Requirement for BHCs and Banks

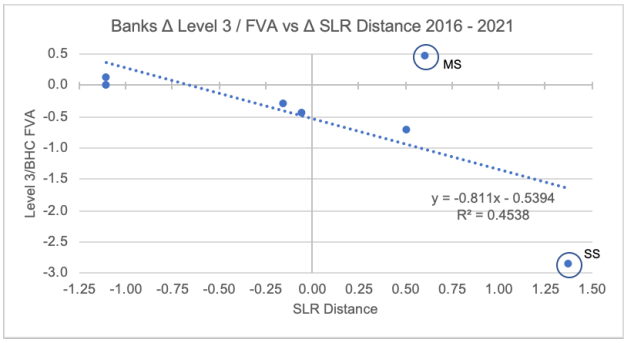


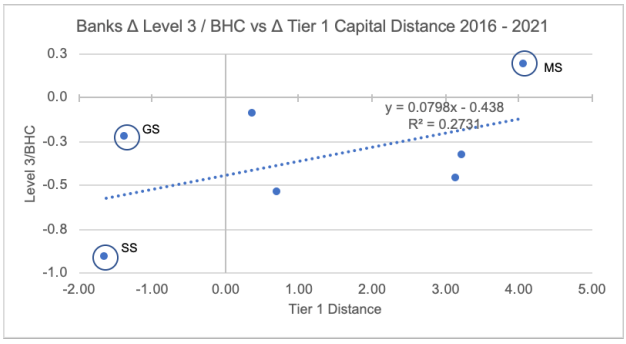


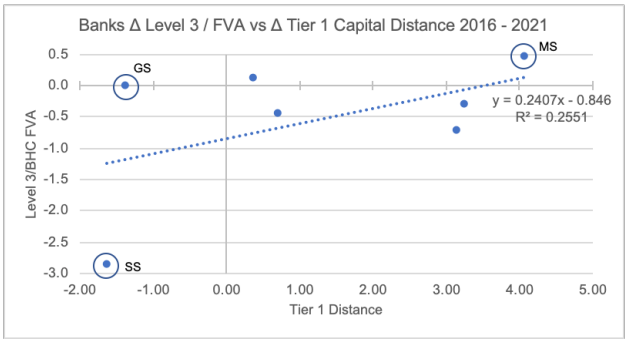












Looking at the plots measuring distance from Tier 1 capital requirement against Level 3 divided by Total BHC assets and Total FVA assets, the relationship indicates a positive trend. Unlike the SLR, this suggests a somewhat counterintuitive relationship between Level 3 assets and the Tier 1 capital ratio: as Level 3 assets decrease, the distance between the actual Tier 1 capital ratio and its minimum requirement also decreases. Additionally, at the bank holding company level, among all 7 of the observed G-SIBs, the change in distance of the Tier 1 capital ratio were all negative. Therefore, from 2016 to 2021, at each of the G-SIB BHCs, as the level of Level 3 assets decreased as a proportion of fair value or total assets, the distance to the Tier 1 capital requirement decreased at each institution– in Citigroup's instance, as much as -6.28%. Considering how the Tier 1 capital ratio has decreased over time from fairly high levels at the start of 2014, it could be that the Tier 1 capital ratio has "more to decrease from" as compared to the SLR, which banks had been fairly close to the requirement since its introduction in 2016. Ultimately, a more comprehensive time series regression comparing the change-on-change measures across all quarters in the dataset will be necessary.

V. CONCLUSION

My research affirms two primary observations: Level 3 assets have been falling over the last several years, and the SLR has been generally the more binding capital requirement compared to the Tier 1 capital ratio. In addition, my research suggests that while there is evidence to suggest a negative correlation between the change in distance from SLR against the change in Level 3 assets between 2016 and 2021, further, more detailed regression analysis controlling for both bank-specific and time-specific idiosyncrasies will be needed in order to confirm the significance of this relationship.

Similar analysis will need to be conducted for the Tier 1 capital ratio, as preliminary indications between the change in distance from requirement against Level 3 assets showed a positive relationship across the 2016 to 2021 period. This positive relationship could be significant, or it may also be affected by variables which are currently unaccounted for. It may also be particularly tricky to attribute any significant relationship with the Tier 1 capital ratio because financial institutions are only required to maintain a specific ratio, not a minimum amount of Tier 1 capital or amount of risk-weighted assets. The bank's ability to control the amount of risk-weighted assets on its balance introduces another complexity which may make it difficult to observe the relationship between capital requirements and Level 3 asset holdings.

Of course, the Tier 1 capital ratio and SLR do not exist in a vacuum. The U.S. leverage ratio as well as the CET1 ratio, among others, could have also been observed in addition to the Tier 1 capital ratio to verify whether the SLR is the most binding capital requirement since 2016.

Overall, while my research was unable to demonstrate whether banks were manipulating their holdings of Level 3 assets in order to circumvent its capital requirements, my work hopefully provides a starting point for further research and analysis.

VI. APPENDIX

In addition to data collected specific to the 8 G-SIB institutions, preliminary analysis was done on approximately the first hundred banks by aggregate assets. For this analysis, I used the Federal Reserve's published list of insured, U.S. Chartered Commercial Banks of $300 million or more in assets[11]. From this list, I selected the top 100 ranked banks and top 93 bank holding companies, removing any banks that had large portions of missing historical information from the S&P Capital IQ Pro database[12]. The remaining subset consisted of a total of 97 banks and 91 bank holding companies. Data collected from this full dataset are summarized in Table 4, which shows the proportion of Level 3 assets as a percentage of total BHC assets in Q32010 and ten years later in Q32021. At a glance, it is clear that Level 3 assets have decreased dramatically over time at all financial institutions, not only at G-SIBs. The names that have held these types of assets have also changed quite dramatically as well.

Rank correlation is another type of analysis used to check both the significance of Level 3 assets at the bank versus the bank holding level as well as observe how Level 3 assets may have changed over time at the firm level. Again, using the available datasets for banks and bank holding companies with 97 banks and 91 bank holding companies, after determining the Level 3 assets as a percentage of total BHC assets and as a percentage of total FVA, the companies were ranked in order largest to smallest, i.e. institutions with larger Level 3 asset allocations received higher ranks than financial institutions with lower percentages. Once the rankings are determined, a correlation can be calculated between rankings of two time periods– the more correlated two rankings are between one another, the closer to 100% they are.

[11] Accessible publicly through the Federal Reserve's website. Direct link to September 30, 2021 publication: https://www.federalreserve.gov/releases/lbr/current/lrg_bnk_lst.pdf.

[12] BBVA USA, TD Bank USA and BancorpSouth were excluded from the list of banks and Cadence BC and BancorpSouth were excluded from the list of BHCs.

Table 4
Ranked Level 3 Holdings as a Percent of Total Assets: Q32021 & Q32010

Company Name	Level 3 / Total Assets
	2021Q3
Morgan Stanley Bank, N.A.	2.39%
Huntington Bancshares Incorporated	2.31%
Wells Fargo & Company	1.12%
The PNC Financial Services Group, Inc.	1.06%
Goldman Sachs Bank USA	0.89%
U.S. Bank National Association	0.82%
MUFG Americas Holdings Corporation	0.80%
Citibank, N.A.	0.76%
Citizens Financial Group, Inc.	0.55%
Fifth Third Bancorp	0.54%
Truist Bank	0.51%
JPMorgan Chase & Co.	0.46%
Bank of America Corporation	0.37%
Regions Bank	0.28%
HSBC Bank USA, National Association	0.20%
Morgan Stanley Private Bank, National Association	0.16%
Capital One Financial Corporation	0.12%
Zions Bancorporation, National Association	0.10%
Bank of the West	0.09%
Santander Bank, National Association	0.09%
Silicon Valley Bank	0.08%
First Horizon Bank	0.05%
Average	**0.51%**
Std. Deviation	**0.63%**

Company Name	Level 3 / Total Assets
	2010Q3
Goldman Sachs Bank USA	8.38%
JPMorgan Chase & Co.	5.54%
Zions Bancorporation, National Association	4.95%
The PNC Financial Services Group, Inc.	4.91%
KeyCorp	4.70%
State Street Bank and Trust Company	4.04%
Wells Fargo & Company	3.98%
Bank of America Corporation	3.60%
Morgan Stanley Bank, N.A.	3.26%
TD Bank, N.A.	3.08%
HSBC Bank USA, National Association	2.96%
Citibank, N.A.	2.58%
Manufacturers and Traders Trust Company	2.45%
Santander Bank, National Association	2.26%
First Horizon Bank	2.13%
Huntington Bancshares Incorporated	1.92%
Ally Bank	1.82%
U.S. Bank National Association	1.69%
Truist Bank	1.23%
Comerica Bank	1.13%
Average	**2.49%**
Std. Deviation	**2.00%**

Table 5 shows the mean, median and standard deviation of correlations of rankings one year apart for the four observed ratios over the Q32010 to Q32021 period. The high rank correlation as well as low standard deviation across four axes of observation indicate little change in rank correlations over the 11-quarter observation period. In cases where banks had any change in levels of Level 3 assets, this analysis suggests that the change was very gradual and over an extended period of time. In other cases, such as when banks reported little to no Level 3 assets to begin with or small percentages of Level 3 assets, there was no significant change to their allocations generally despite the change in regulatory capital ratio requirements during the observed period.

Table 5

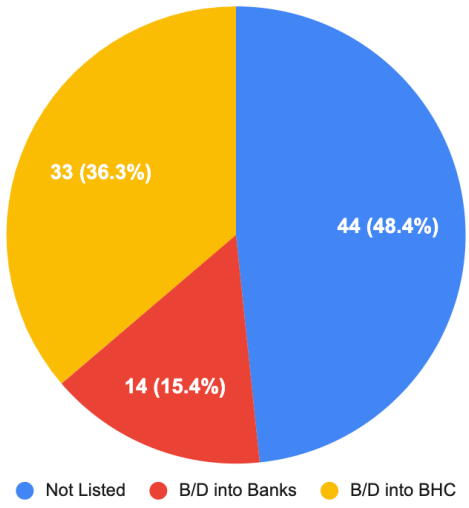
Rank Correlation Descriptive Statistics Across Top 100 Financial Institutions

	Mean	**Median**	**Std. Deviation**
Banks Level 3 Assets / Total Assets	91.60%	91.16%	3.33%
Banks Level 3 / Total FVA	88.79%	88.45%	4.43%
BHC Level 3 / Total Assets	92.18%	92.22%	3.10%
BHC Level 3 / Total FVA	90.00%	89.10%	3.71%

Finally, as referred to in Section 5, more detailed analysis was conducted to determine the location of the broker dealer of top-tier financial institutions. As discussed previously, particularly as it relates to Level 3 assets, given the type of product that generally constitutes a Level 3 asset, it is likely that more Level 3 assets are found within the broker dealer. A broker dealer, in contrast to banks, which act as depository institutions, are responsible for the buying and selling of securities. In other words, there is an increased risk profile where the broker dealer is located and determining whether the broker dealer sits within the bank or another arm in the

bank holding company will dictate whether the scope of interest includes banks and / or bank holding companies.

Figure 5
Location and breakdown of Broker Dealer for Top 100 Bank Holding Companies



Again, using the same observed dataset as previously described, resulting in 91 bank holding companies, the search engine[13] provided by the FFIEC was used to determine 1) whether or not the bank holding company had a registered securities broker dealer and 2) whether that broker dealer was found inside the bank or found elsewhere in the bank holding company. The breakdown of broker dealer locations is summarized in Figure 5. Of the 91 bank holding companies, 44 did not have listed securities broker dealer entities. Of the remaining 47, 14 (30%) indicated broker dealers that were structured as part of the banks and the other 33 banks (70%) had broker dealers that were listed as separate entities from the bank. For any bank holding companies that did not have listed securities broker dealers, it was assumed that they do not act in a broker dealer capacity. However, of the 8 G-SIB banks, the broker dealer universally was

[13] FFIEC search engine can be found at this link: https://www.ffiec.gov/npw/. The search engine works by searching for institution names or by RSSD ID, which is also found on the Federal Reserve's list of financial institutions.

located separately within the bank holding company. From this analysis, since I was not able to definitively conclude the location of the broker dealer for non-G-SIB institutions, the scope of my analysis focused on both. The primary reason, however, for choosing to observe bank holding companies and banks separately was due to the difference in minimum requirements.

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