How Do Global Systemically Important Banks Lower Capital Surcharges?

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Abstract

Global systemically important banks (GSIBs) are subject to capital surcharges that increase with systemic importance indicators. We show that U.S. GSIBs lower their surcharges to a large extent by reducing one indicator—the notional amount of over-the-counter derivatives—in the fourth quarter of each year, the quarter that determines surcharges. This seasonal drop is stronger at GSIBs than at other banks; it increased after GSIB surcharges were introduced; and it is largely driven by interest rate swaps. We discuss implications of these results for the design of systemic importance indicators.

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Keywords: Bank capital requirements, GSIB surcharges, systemic importance, Basel III

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1 Introduction

In recent years, many countries introduced capital surcharges on global systemically important banks (GSIBs). GSIB surcharges are an amount of capital that these banks must hold in addition to minimum risk-based capital requirements. These surcharges are a major innovation in bank capital regulation because they increase with indicators of banks' systemic importance, and thus motivate banks to lower their systemic footprints. The incentives that GSIB surcharges create promote financial stability, but this benefit may fade if banks manage to cut those indicators without fundamentally lessening their systemic importance.

In this paper, we examine how U.S. GSIBs adjust their systemic importance indicators to lower surcharges. GSIB surcharges increase with scores that are linear functions of systemic importance indicators measured at year-end. Thus, GSIBs should attempt to lower their scores at the end of each year to reduce their surcharges. We test hypotheses based on quarterly variation in banks' behavior, which helps us separate the effects of surcharges from confounding effects of other regulatory changes. Even though some regulatory requirements introduced over the past few years, such as the supplementary leverage ratio, affect GSIBs and non-GSIBs differently, only GSIB surcharges should cause systemic importance indicators to drop in the fourth quarter of each year.

We test whether scores and indicators are lower in the fourth quarter than in the other quarters to understand whether and how U.S. GSIBs adjust their indicators in response to surcharges. We also test hypotheses that rely on specific characteristics of the U.S. GSIB rule that determine the strength of the incentives banks face to adjust their indicators. For example, some indicators only determine whether a bank is a GSIB, but not its surcharge, and thus GSIBs should not lower them materially at the end of the year. Also, two indicators are measured as annual and fourth-quarter averages, respectively, and therefore should also be less subject to window-dressing by GSIBs than the other indicators, which are measured at year-end.

Our empirical results support these hypotheses. GSIB scores drop in the fourth quarter compared with scores in other quarters more than scores of non-GSIBs. GSIBs also reduce systemic importance indicators in a manner consistent with those hypotheses. Indicators that determine whether a bank is a GSIB but not its surcharge do not decline at the end of the year. Also,

indicators measured as annual or fourth-quarter averages do not drop at year-end.

We find that U.S. GSIBs mainly reduce one indicator of systemic importance—the notional amount of over-the-counter (OTC) derivatives. These findings are consistent with reports that U.S. banks have lowered surcharges to a large extent by compressing OTC derivatives—terminating offsetting contracts and replacing them with another contract with the same market risk but a lower notional amount than the terminated contracts [Woodall and Osborn, 2017]. We show that year-end compression is more pronounced for derivatives cleared by central counterparties (CCPs) compared to derivatives settled bilaterally and for interest rate swaps compared to other types of contracts (forward and option contracts) and asset classes (foreign exchange, equity, and commodities). This finding is consistent with the evidence that the most standardized contracts, which are more likely to be cleared by CCPs and include interest rate swaps, can be more effectively compressed (see, for example, Financial Stability Board [2018]). We also use data that begin years before GSIB surcharges were introduced to account for seasonal patterns that already existed before, and we show that these year-end drops in notional amounts of OTC derivatives started after surcharges were introduced, which provides additional support to the hypothesis that surcharges incentivize banks to compress OTC derivatives at year end.

The papers closest to ours are from Behn, Mangiante, Parisi, and Wedow [2019] and Garcia, Lewrick, and Sečnik [2021]. Behn, Mangiante, Parisi, and Wedow [2019] study whether banks from the European Union (EU) that participate in its GSIBs assessment exercise—of which about one-third are GSIBs—lower their systemic importance indicators in the fourth quarter compared with EU banks that do not participate. Our results differ noticeably from those from Behn, Mangiante, Parisi, and Wedow [2019]. We find that U.S. GSIBs mainly reduce the notional amount of OTC derivatives in the fourth quarter, whereas those authors show that EU banks that participate in the exercise lower indicators of size and cross-jurisdictional activity. Garcia, Lewrick, and Sečnik [2021] analyze whether EU GSIBs reduce their indicators relative to other EU banks in the fourth quarter, and, similar to us, find that GSIBs' notional amounts of OTC derivatives drop at year end. However, they also find that GSIBs reduce the amounts of cross-jurisdictional claims and liabilities, whereas we find weak evidence of year-end changes in these indicators. We discuss how differences

in data, empirical strategies, and G-SIB frameworks help to explain differences and similarities in findings between these papers and ours.

More broadly, our paper contributes to a nascent literature that studies the effects of GSIB designation and surcharges on bank behavior. Favara, Ivanov, and Rezende [2020] use supervisory data on corporate loans and variation in surcharges over time and across U.S. banks to show that these surcharges reduce loan amounts extended by GSIBs. Degryse, Mariathasan, and Tang [2020] find that the announcement that a bank is designated as a GSIB lowers its supply of syndicated loans. Behn and Schramm [2020] show that the adoption of the GSIB framework raised interest rates on syndicated loans extended by GSIBs. These three papers analyze effects of GSIB status and surcharges on a specific bank business, namely corporate lending. Meanwhile, Violon, Durant, and Toader [2018] study the impact of GSIB designation on banks' balance sheet characteristics, and Goel, Lewrick, and Mathur [2019] use a differences-in-differences empirical strategy to show evidence that GSIBs changed their balance sheets associated with systemic importance relative to non-GSIBs after 2012. We differ from all these papers in that we examine effects on the systemic importance indicators that regulators actually use to determine GSIB surcharges. Also, we identify effects of GSIBs surcharges using variation in fourth-quarter systemic importance indicators, whereas those papers use different identification strategies.[1]

This paper is also related to the literature that examines how banks adjust parameters that determine their capital requirements. Carey [2002], Jacobson, Lindé, and Roszbach [2006], Mariathasan and Merrouche [2014], Behn, Haselmann, and Vig [2016], Firestone and Rezende [2016], Berg and Koziol [2017], and Plosser and Santos [2018] study how banks set risk parameters, such as internal ratings and probabilities of default, that affect capital requirements under the internal ratings-based approach. This literature presents evidence that banks respond to incentives created by capital requirements when setting risk parameters. We contribute to this literature with evidence that banks also adjust systemic importance indicators in a manner consistent with the incentives they face.

In addition, our paper contributes to the debate on tailoring bank regulation and on the effects of heightened capital requirements for large banks, which has influenced bank capital regulation in

[1]See also De Genaro, Salvador, and Fernandes [2021], who study the effects of capital surcharges for domestic systemically important banks in Brazil on the interest rate spreads that banks charge on their loans.

recent years [Hanson, Kashyap, and Stein, 2011; Greenwood, Hanson, Stein, and Sunderam, 2017; Quarles, 2018; Financial Stability Board, 2020a]. Our work is also related to discussions about the optimal choice of indicators to determine the systemic importance of banks [U.S. Congress, Senate, 2015; Passmore and von Hafften, 2018].[2] Our results indicate that banks respond to GSIB surcharges by lowering indicators of systemic importance, which is in fact one objective of those surcharges [Basel Committee on Banking Supervision, 2013; Board of Governors of the Federal Reserve System, 2015; Yellen, 2015].

Finally, our results on seasonal changes in notional amounts of OTC derivatives contribute to the literature on OTC derivatives compression and CCPs [Duffie and Zhu, 2011; International Swaps and Derivatives Association, 2015; D'Errico and Roukny, 2017; Duffie, 2018; Financial Stability Board, 2018]. This literature shows that settlement types—bilateral or through CCPs—and characteristics of OTC derivative contracts are associated with differences in notional amounts of derivatives eliminated through compression. We contribute to this literature with evidence that compression affects bank capital requirements and that this effect varies with contract and settlement type.

This paper is organized as follows. Section 2 describes GSIB surcharges and the adjustments banks can make to lower surcharges. Sections 3 and 4 discuss the data and the empirical strategy. Section 5 presents the results. Section 6 compares our findings with evidence from the GSIB literature and discusses their economic relevance. Section 7 concludes.

2 Background

2.1 GSIB Surcharges

In recent years, regulators have raised capital requirements on GSIBs to attenuate the risks that these banks pose to financial stability. In the United States, the Federal Reserve Board (FRB) adopted a rule in 2015 imposing risk-based capital surcharges on the largest and most interconnected

[2]The banking literature has studied other bank characteristics that are not included in the GSIB framework, but are related to categories of systemic importance indicators from the framework. For example, Goldberg and Meehl [2020] examine how measures of organizational, business, and geographic complexity of large U.S. banks have changed over time and Correa and Goldberg [2020] analyze how these measures affect systemic risk.

U.S. bank holding companies (henceforth banks). This rule requires that a bank whose measure of systemic importance exceeds a certain threshold be identified as a GSIB and be subject to a risk-based capital surcharge. The GSIB surcharge was introduced on January 1, 2016, and became fully phased in on January 1, 2019.[3]

A bank is identified as a GSIB if its method 1 score exceeds 130. The FRB set the threshold at this value not only because it is the same as in the Basel Committee on Banking Supervision's (BCBS) framework, but also because it separates all other U.S. banks from the eight U.S. GSIBs, which the FRB considered "significantly larger and more complex" [Board of Governors of the Federal Reserve System, 2015]. Indeed, the lowest method 1 score from a GSIB is more than twice the highest score from a non-GSIB. This observation attenuates concerns that strategic behavior from banks might determine their GSIB status, which would make the assignment of banks to treatment and control groups endogenous.

To calculate the method 1 score of a bank, the FRB uses 12 systemic importance indicators that belong to 5 categories of data: size (total exposures), interconnectedness (intra-financial system assets (IFSA), intra-financial system liabilities (IFSL), and securities outstanding), substitutability (payments activity, assets under custody, and underwritten transactions in debt and equity markets), complexity (notional amount of OTC derivative contracts, trading and available-for-sale (AFS) securities, and level 3 assets), and cross-jurisdictional activity (cross-jurisdictional claims and cross-jurisdictional liabilities).[4] The method 1 score is a linear function of these indicators and each of these 5 categories receives a weight of 20 percent.

Whereas the method 1 score follows closely the BCBS's framework, the U.S. rule also includes a method 2 score to determine surcharges. The method 2 score uses the same measures of size, interconnectedness, cross-jurisdictional activity, and complexity as method 1, but method 2 replaces

[3]The GSIB framework and the U.S. GSIB rule were introduced in publications from the Basel Committee on Banking Supervision and the FRB, respectively. Basel Committee on Banking Supervision [2013, 2018] describe the Committee's GSIB framework and includes an empirical analysis supporting the calibration of surcharges. Basel Committee on Banking Supervision [2014] provides more details about how GSIB scores are calculated in that framework. Federal Register [2015] contains the U.S. GSIB rule, which adopts the Basel Committee's framework with some changes. Board of Governors of the Federal Reserve System [2015] discusses the rationale and the calibration of surcharges for U.S. banks. See also Passmore and von Hafften [2018], who argue that GSIB surcharges are too small because the framework "underestimates the probability of bank failure, wrongly disregards short-term funding, and excludes too many banks."

[4]For this calculation, the value of the substitutability score is capped at 100.

the substitutability indicators with a measure of the bank's use of short-term wholesale funding (STWF); the method 2 score is also a linear combination of these indicators. The method 2 score does not determine whether a bank is a GSIB: As mentioned in this subsection, the GSIB status is determined by the method 1 score alone. A bank's GSIB surcharge is the higher of the method 1 and 2 surcharges, which are increasing functions of the method 1 and 2 scores, respectively.

The GSIB surcharge is the Common Equity Tier 1 (CET1), Tier 1, and total capital as a percentage of risk-weighted assets that a GSIB must hold in addition to the minimum Basel III requirements. Thus, a GSIB surcharge raises minimum requirements for GSIBs as follows:

$$\frac{E_j}{RWA} \quad = \quad k_j + Surcharge(method\ 1\ score,\ method\ 2\ score), \tag{1}$$

where E_j is the amount of capital of type $j \in \{CET1,\ Tier\ 1,\ total\ capital\}$, RWA stands for risk-weighted assets, and k_j is the Basel III minimum risk-weighted capital ratio j. Risk-weighted assets are the sum of bank assets multiplied by their respective risk weights. In equation (1), $Surcharge(.,.)$ does not vary with j, but it depends on a bank's method 1 and 2 scores.

The GSIB surcharge that a bank is subject to from January 1 to December 31 of year t must be calculated by December 31 of year $t-1$ using data as of December 31 of year $t-2$. Also, after the initial GSIB surcharge of a BHC is in effect, if the fully phased-in surcharge of this BHC increases, the higher surcharge is applied only two years after the measurement of the systemic indicators. However, if the fully phased-in surcharge decreases, then it becomes effective in the next calendar year. In Appendix A, we describe in detail how scores and surcharges are calculated.

2.2 How Can Banks Reduce Systemic Importance Indicators?

GSIB surcharges motivate banks to lower their systemic importance indicators to reduce those surcharges. Banks cannot accurately set their scores and surcharges because these scores depend on market prices of securities and on exchange rates, which banks cannot fully control, but they can still adjust their balance sheets to lower surcharges. Banks may employ various strategies to lower indicators at year-end and, in this subsection, we describe the two strategies that have received attention from academics, regulators, and market analysts. We also discuss how these strategies

affect indicators.

2.2.1 OTC Derivatives Compression

Banks may reduce the GSIB surcharges by compressing the notional amounts of their OTC derivative contracts. Notional amounts of derivative contracts are the dollar amounts of the underlying assets in those contracts. Compression is a netting operation in which counterparties substitute existing contracts with a new set of contracts that have approximately the minimum notional amounts necessary to keep each participants' net position unchanged.

Compression operations are generally performed by third-party vendors. Operations start with banks and other participants submitting contracts to the vendor. The vendor then matches contracts submitted by different participants and presents them with the contracts eligible for compression. Next, the vendor requests that participants agree on parameters and tolerances for compression and runs an algorithm that generates a new set of contracts (see, for example, TriOptima [2020]).

Banks use OTC derivatives compression to lower surcharges for three main reasons. First, notional amounts can be reduced while keeping net positions about unchanged. Second, the notional amount of OTC derivatives has a large weight on surcharges because it alone represents an entire systemic importance indicator. Third, compression is a quick operation: GSIBs can conduct it close to the end of the fourth quarter to reduce their year-end notional amounts and therefore lower their surcharges. Thus, OTC derivatives compression should lower the notional amount of OTC derivatives in the fourth quarter of each year after GSIB surcharges are introduced.[5]

This seasonal variation helps us to distinguish the effects of GSIB surcharges on OTC derivatives from the effects of other regulatory changes. In response to an agreement from the Group of Twenty in 2009, member countries of the Financial Stability Board, including the United States, implemented regulatory reforms in the OTC derivatives markets. These reforms were aimed at improving trade reporting, increasing the range and share of centrally cleared derivatives, and raising margin and capital requirements for non-centrally cleared derivatives, among other changes

[5] D'Errico and Roukny [2017] estimate that about three quarters of the notional amount of OTC derivatives in a sample of contracts from firms in the European Union can be eliminated with compression.

[Financial Stability Board, 2020b]. Yet the effects of these regulatory reforms should not vary over time in the same manner as the effects of GSIB surcharges.[6] In particular, these reforms should not cause any seasonal variation in the notional amounts of OTC derivatives. Thus, lower notional amounts of OTC derivatives in the fourth quarter of each year after GSIB surcharges can be interpreted as evidence of the effects of GSIB surcharges instead of the effects of other regulatory changes.

2.2.2 Repo Termination

Banks may reduce their repo actvity to lower GSIB surcharges. Banks that engage in repo—or repo-style transactions—generally borrow short-term wholesale funds and lend those funds overnight in these transactions. Reducing repo activity can be attractive because these are overnight transactions, and thus can be quickly terminated at year-end and resumed shortly after [Covas and Freedman, 2019].

Repo termination may leave an imprint on four systemic importance indicators. Banks engage in repo transactions to a large extent by borrowing from and lending to other financial institutions. Thus, repo termination may lower IFSA and IFSL. Likewise, a material fraction of banks' counterparties in these operations are foreign institutions. Therefore, repo termination may also reduce cross-jurisdictional claims and liabilities. Nevertheless, unlike OTC derivatives, repos affect several systemic importance indicators in the GSIB framework, implying that the effects of repo termination on systemic importance indicators may not be as clear as the effects of OTC derivatives compression.

3 Data

Bank-level data come from two datasets. Systemic importance indicators used to calculate GSIB scores come from the Banking Organization Systemic Risk Reports (FR Y-15).[7] All banks with

[6] See Financial Stability Board [2018] for a discussion about the incentives created by these reforms to centrally clear OTC derivatives and their effects on the behavior of counterparties. Also, Aramonte and Huang [2019] examine those incentives and changes in the use of central clearing across types of OTC derivatives in recent years.

[7] The FRB introduced the FR Y-15 in 2012 to calculate GSIB surcharges, to monitor the systemic risk profile of BHCs subject to enhanced prudential standards under section 165 of the Dodd-Frank Act, to identify other

total consolidated assets above a certain threshold must report FR Y-15 data and are thus included in the sample.[8] The FR Y-15 data in this paper range from the fourth quarter of 2013 to the second quarter of 2020. These data were collected annually in the fourth quarter of 2013 to 2015 and became quarterly in the second quarter of 2016. The STWF indicator is available for GSIBs starting in the fourth quarter of 2016, and for non-GSIBs beginning in either the fourth quarter of 2017 or the second quarter of 2018, depending on the bank's size.[9] The method 2 score also starts on those dates for the respective banks because it is a function of the STWF indicator. We restrict our sample to domestic banks that reported FR Y-15 data in all quarters of our sample period.

Table 1 summarizes these data and shows some differences between GSIBs and non-GSIBs. On average, GSIBs have higher dollar amounts than non-GSIBs for all systemic importance indicators. GSIBs are, in general, much larger than non-GSIBs, with a mean size of $177 billion, compared to $22.4 billion for non-GSIBs. Method 1 scores are also considerably higher for GSIBs than non-GSIBs: the highest method 1 score from a non-GSIB over the sample period is 62, which is less than half the GSIB threshold, equal to 130.

However, some non-GSIBs have systemic importance indicators that exceed those of some GSIBs. Indeed, all systemic importance indicators of GSIBs and non-GSIBs overlap. This fact suggests that non-GSIBs are a valid control group for GSIBs to examine the effects of surcharges on banks' behavior, and in particular the effects on systemic importance indicators.[10]

institutions that may present systemic risk, and to analyze the systemic risk implications of proposed mergers and acquisitions.

[8]The assets threshold was $50 billion at the start of the sample period and the Economic Growth, Regulatory Relief, and Consumer Protection Act of 2018 increased this threshold to $100 billion in the second quarter of 2018. Since the start of the sample period, 8 U.S. banks were GSIBs: Bank of America, Bank of New York Mellon, Citigroup, Goldman Sachs, JP Morgan Chase, Morgan Stanley, State Street, and Wells Fargo. The 19 non-GSIB banks in the sample are Ally, American Express, BBVA Compass, BMO Financial, Capital One, Citizens Bank, Discover, Fifth Third, HSBC, Huntington Bank, Keycorp, M&T Bank, MUFG, Northern Trust, PNC, Regions Financial, Santander, Truist, and US Bank. BB&T acquired SunTrust in December 2019 and changed its name to Truist. In our empirical analysis, we assume BB&T and Truist are the same bank.

[9]The asset thresholds for the collection of STWF data are as follows: assets greater than $700 billion, assets between $250 billion and $700 billion, and assets between $50 billion and $250 billion, where banks in each threshold are subject, respectively, to the aforementioned reporting dates. For a complete description of STWF reporting thresholds, see Schedule G of the FR Y-15 reporting instructions [Board of Governors of the Federal Reserve System, 2019].

[10]For instance, non-GSIBs PNC and US Bank have average size indicator values of $45.4 billion and $56.9 billion, respectively, which are greater than the $26 billion value of State Street, a GSIB. The GSIBs BNY Mellon and State Street each have average OTC derivative amounts of $99.4 billion and $162.3 billion, respectively, which are lower than the non-GSIB with the greatest amount of these holdings, HSBC, which has an average of $712.8 billion in OTC derivatives over the sample period.

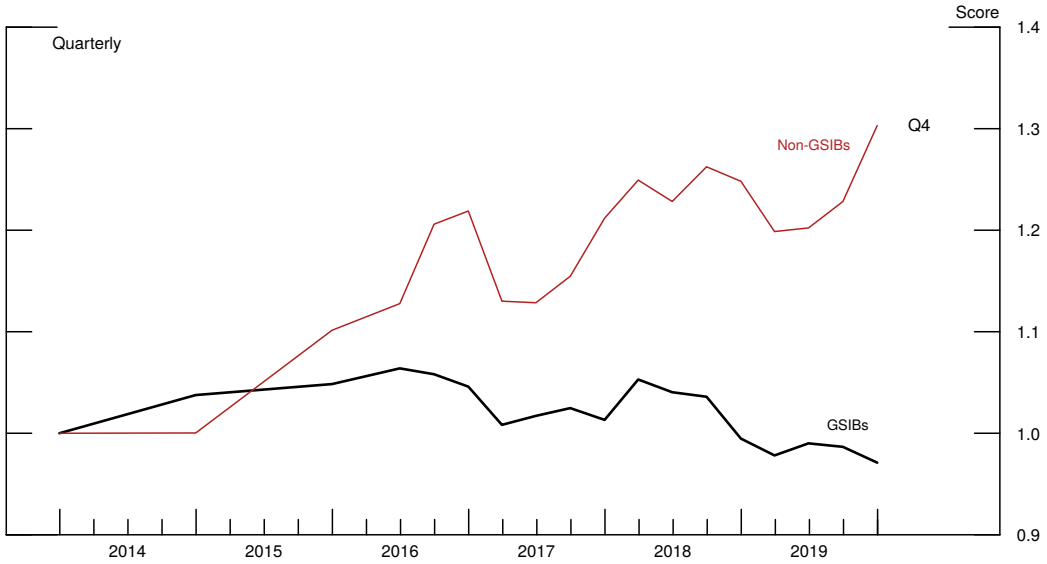
Table 1: Summary Statistics of Systemic Importance Indicators and Scores

Variable	Obs.	Banks	Mean	Std. Dev.	Min.	Max.
Panel 1. **GSIBs**						
Size	160	8	176.95	108.70	24.40	390.20
IFSA	160	8	19.59	9.76	2.77	46.14
IFSL	160	8	20.31	12.18	3.68	57.08
Secs. outstanding	160	8	38.87	21.30	3.87	83.69
Payments activity	160	8	11424.30	9755.61	958.48	36134.68
Assets	160	8	1186.78	1051.66	11.32	2977.82
Underwritten transactions	160	8	29.07	18.92	0.00	64.74
OTC derivatives	160	8	2721.76	1964.69	82.31	6800.37
Trading and AFS securities	160	8	13.56	8.18	1.39	44.63
Level 3 assets	160	8	1.60	1.17	0.00	6.93
Cross-jurisdictional claims	160	8	39.07	27.96	4.74	102.45
Cross-jurisdictional liabilities	160	8	36.69	26.15	7.39	105.59
Short-term wholesale funding	120	8	40.64	20.28	14.23	87.69
Method 1 score	144	8	273.00	108.00	138.00	505.00
Method 1 surcharge	144	8	1.51	0.53	1.00	2.50
Method 2 score	88	8	481.00	172.00	185.00	804.00
Method 2 surcharge	88	8	2.51	0.88	1.00	4.00
Panel 2. **Non-GSIBs**						
Size	380	19	22.44	13.35	6.46	66.41
IFSA	380	19	1.35	1.47	0.05	7.54
IFSL	380	19	1.05	1.08	0.00	6.57
Secs. outstanding	380	19	6.10	4.32	0.14	17.45
Payments activity	380	19	442.16	1001.52	1.89	4931.87
Assets	380	19	54.17	171.30	0.00	929.06
Underwritten transactions	380	19	1.24	1.75	0.00	7.65
OTC derivatives	380	19	49.39	158.85	0.76	846.46
Trading and AFS securities	380	19	0.67	0.63	0.01	4.36
Level 3 assets	380	19	0.13	0.19	0.00	1.06
Cross-jurisdictional claims	380	19	0.92	1.38	0.00	6.77
Cross-jurisdictional liabilities	380	19	0.78	1.66	0.00	8.44
Short-term wholesale funding	183	19	13.29	12.40	1.95	54.31
Method 1 score	342	19	18.00	15.00	4.00	62.00
Method 1 surcharge	342	19	0.00	0.00	0.00	0.00
Method 2 score	183	19	74.00	50.00	19.00	227.00
Method 2 surcharge	183	19	0.12	0.33	0.00	1.00

NOTE: All variables except scores and surcharges are measured in billions of dollars. Method 1 and 2 scores are measured in basis points and surcharges and the STWF ratio are measured in percentage points. The data are annual (collected in the fourth quarter) from 2013 to 2015 and quarterly from the second quarter of 2016 to the second quarter of 2020.
SOURCE: Banking Organization Systemic Risk Report FR Y-15.

Method 1 and 2 scores vary over time and between GSIBs and non-GSIBs in a manner consistent with the main hypothesis of our paper. Figure 1 shows method 1 scores of GSIBs and non-GSIBs from 2013 to 2019, which indicate that GSIBs lower their scores in the fourth quarter more than

Figure 1: Method 1 GSIB Scores, by GSIB status



NOTE: Each observation in this figure is the mean across GSIBs and non-GSIBs of each bank's method 1 score at each date normalized by the value the bank reported in the fourth quarter of 2013—the date of the first observation. The data are annual (collected in the fourth quarter) from 2013 to 2015 and quarterly from the second quarter of 2016 to the fourth quarter of 2019.
SOURCE: Banking Organization Systemic Risk Report FR Y-15.

non-GSIBs.[11] Since 2016, when the data became quarterly, the mean fourth-quarter score of GSIBs has stayed below the mean third-quarter score, but this fact doesn't hold for non-GSIBs.

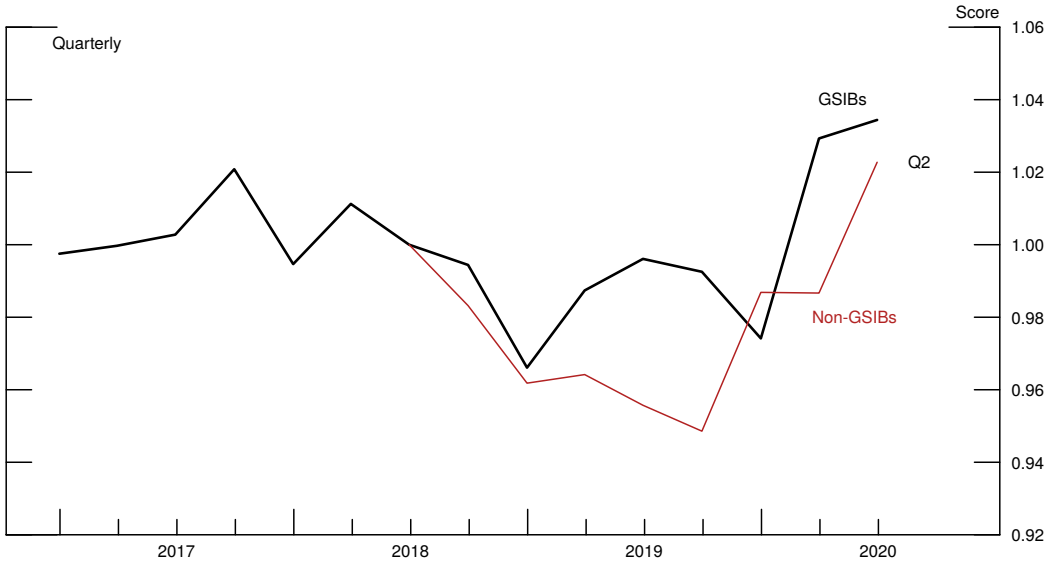
Figure 2 shows method 2 scores from 2016 to 2020, which also suggest that GSIBs lower their scores materially in the fourth quarter of each year.[12] Notably, Figure 1 shows that non-GSIBs' method 1 scores had a steeper slope than GSIBs', whereas Figure 2 shows similar slopes for method 2 scores. This difference in slopes can explained to a large extent by the 25-percent decrease in the amount of STWF by non-GSIBs over the sample period because the STWF ratio affects the method 2 score but not the method 1 score.

We also use quarterly data on BHC characteristics collected from the Consolidated Financial Statements for Holding Companies (FR Y-9C). Based on these filings, we use (or construct) data

[11] Even though systemic importance indicators are available from 2013 to 2020, method 1 scores range from 2013 to 2019. Method 1 scores are not available for 2020 because they depend on the GSIB denominators for 2020, which the Basel Committee on Banking Supervision will publish on November 2021.

[12] Method 2 scores from GSIBs start in the fourth quarter of 2016 because this is the first quarter when GSIBs had to report STWF data, which are necessary to calculate method 2 scores. Also, method 2 scores from non-GSIBs start in the second quarter of 2018 because this is the first quarter when all non-GSIBs had to report STWF data.

Figure 2: Method 2 GSIB Scores, by GSIB status



NOTE: Each observation in this figure is the mean across GSIBs and non-GSIBs of each bank's method 2 score at each date normalized by the value the bank reported in the second quarter of 2018—the first quarter when all banks were required to report STWF data. The data are quarterly and range from the fourth quarter of 2016 to the second quarter of 2020.
SOURCE: Banking Organization Systemic Risk Report FR Y-15.

on total assets, total capital ratio, tier-1 capital ratio, leverage ratio, return on assets, return on equity, net interest margin, delinquency rate, and charge off rate. Table 2 summarizes these data for GSIBs and non-GSIBs.

Table 2: Summary Statistics of Bank Characteristics

Variable	Obs.	Banks	Mean	Std. Dev.	Min.	Max.
Panel 1. **GSIBs**						
Total assets	160	8	139.81	85.74	22.83	321.31
Total capital ratio	160	8	16.31	2.24	11.73	22.93
Tier 1 capital ratio	160	8	14.27	1.87	11.28	19.90
Leverage ratio	160	8	8.11	1.03	5.44	10.34
ROA	160	8	0.22	0.13	-1.03	0.38
ROE	160	8	2.17	1.30	-9.41	3.69
NIMs	160	8	0.43	0.22	0.06	0.81
Delinquency rate	160	8	2.23	1.79	0.00	10.39
Charge-off rate	160	8	0.09	0.10	-0.03	0.46
Panel 2. **Non-GSIBs**						
Total assets	380	19	19.09	10.87	5.95	54.67
Total capital ratio	380	19	14.74	2.26	11.75	26.65
Tier 1 capital ratio	380	19	12.49	1.90	10.09	21.98
Leverage ratio	380	19	9.91	1.27	6.83	14.73
ROA	380	19	0.24	0.29	-2.37	1.26
ROE	380	19	2.07	2.49	-19.75	9.74
NIMs	380	19	0.88	0.47	0.19	2.36
Delinquency rate	380	19	2.09	1.27	0.47	8.36
Charge-off rate	380	19	0.20	0.24	-0.02	1.04

Note: Units are in billions of $'s
Source: Consolidated Financial Statements for Holding Companies FR Y-9C

NOTE: All variables are measured in percentage points, except total assets, which is measured in billions of dollars. The data are annual (collected in the fourth quarter) from 2013 to 2015 and quarterly from the second quarter of 2016 to the second quarter of 2020.
SOURCE: Consolidated Financial Statements for Holding Companies FR Y-9C.

4 Empirical Strategy

To analyze seasonal differences between scores and indicators of GSIBs and non-GSIBs, we first estimate the following equation:

$$Y_{it} = \gamma GSIB_i \times Post_t + \delta GSIB_i \times t + \sum_{s=2}^{4} \beta_s GSIB_i \times \mathbb{1}\{s = q(t)\} + \Psi X_{it} + \nu_i + \varphi_t + \varepsilon_{it}, \quad (2)$$

where Y_{it} is a score or a systemic importance indicator of bank i at time t. $GSIB_i$ is a dummy variable equal to one if bank i is a GSIB and zero otherwise.[13] $Post_t$ is the indicator of whether

[13]The list of banks that met the criteria to be subject to the GSIB surcharge did not change during the sample

the GSIB rule has already been introduced, that is, it is equal to zero for every t up to year 2014 and equal to one from 2015 on. The interaction term $\gamma GSIB_i \times Post_t$ measures an immediate and permanent change in systemic importance of GSIBs relative to non-GSIBs after the introduction of the GSIB surcharge. However, our empirical strategy does not rely on hypotheses about γ because the FR Y-15 data has a short pre-treatment time series—these data start only in 2013 and become quarterly only in 2016—which suggests that the differences-in-differences parameter γ may not be accurately estimated.

We allow GSIBs to follow a different time trend than non-GSIBs. Figures 1 show that method 1 scores of GSIBs and non-GSIBs have followed different trends, which indicates that a specification that accommodates this difference may provide better estimates of the effects of surcharges than a specification that does not. For this purpose, we add the term $\delta GSIB_i \times t$ to equation (2), where δ is a parameter to be estimated. X_{it} is a vector of bank characteristics that vary over time and contains measures of bank capitalization (total capital ratio, tier-1 capital ratio, and leverage ratio), profitability (return on assets, return on equity, net interest margin), and loan performance (delinquency rate and charge off rate). Ψ is a vector of parameters. ν_i and φ_t are bank and time fixed effects, respectively. ε_{it} is a bank- and time-specific unobservable error that has independent normal distribution with a mean of zero and variance of σ^2_ε.

Equation (2) also includes the terms $\sum_{s=2}^{4} \beta_s GSIB_i \times \mathbb{1}\{s = q(t)\}$, in which β_s, with $s \in \{2, 3, 4\}$ are parameters to be estimated, $\mathbb{1}\{.\}$ is the indicator function, and $q(t) \in \{2, 3, 4\}$ is the quarter of time t. Thus, $GSIB_i \times \mathbb{1}\{s = q(t)\}$ are interaction terms of the GSIB indicator with second-, third-, and fourth-quarter indicators, which leaves the first quarter as the reference case. These terms allow GSIBs' scores and systemic importance indicators to vary systematically across quarters relative to non-GSIBs'. In particular, they allow us to examine whether GSIBs lower their scores and indicators relative to non-GSIBs in the fourth quarter of each year. Because surcharges are determined by scores measured in the fourth quarter, GSIBs have a stronger incentive to lower their scores and indicators in those quarters. Based on this reasoning, we test the following hypothesis:

Hypothesis 1 $\beta_4 < 0$.

period. As a result, the GSIB status is fixed at the bank level throughout the sample period and the variable $GSIB_i$ does not need a subscript t.

All else equal, banks should have a stronger incentive to lower systemic importance indicators that affect method 2 scores than indicators that affect only method 1 score. Even though the method 1 score alone determines whether a bank is a GSIB, the method 2 surcharge has always been higher than or equal to the method 1 surcharge for all GSIBs, implying that the method 2 score has determined the surcharge that GSIBs are actually subject to. Thus, we also test

Hypothesis 2 *β_4 should be higher (that is, closer to zero) when the dependent variable is a systemic importance indicator that affects only the method 1 score (payments activity, assets under custody, and underwritten transactions in debt and equity markets) than when the dependent variable is an indicator that affects the method 2 score (all other indicators).*

Moreover, all else equal banks should incur higher costs when adjusting indicators measured as an average over the quarter and over the year as opposed to indicators measured at year-end because the latter would require banks to lower indicators for a shorter period of time.

Hypothesis 3 *β_4 should be higher (that is, closer to zero) when the dependent variable is a systemic importance indicator measured as an average over the quarter (total exposures) and over the year (STWF ratio) compared with indicators measured at the end of the year (all other indicators).*

5 Results

5.1 Baseline Results

We first test Hypothesis 1. Table 3 shows coefficient estimates of equation (2) using the natural logarithm of a bank's systemic importance score as the dependent variable. Columns 1 to 6 and columns 7 to 12 show estimates using the method 1 and 2 score as the dependent variable, respectively. When the method 1 score is the dependent variable, the equation includes the term $\gamma GSIB_i \times Post_t$, but the estimate of γ is never statistically significant. When the method 2 score is the dependent variable, the equation does not include this term because the STWF data needed to calculate this score are not available before 2016. Estimates of δ are always negative, but are statistically significant only when we use the method 1 score as the dependent variable. These

estimates of δ indicate that the gap between the average method 1 scores of GSIBs and non-GSIBs has narrowed over time.

In column 1, the specification does not include interaction terms between the GSIB indicator and quarter dummy variables. In columns 2 to 5, we add interaction terms between the GSIB indicator and first- to fourth-quarter dummy variables, respectively. Across these four columns, β_s is larger in absolute terms and statistically significant in column 5—β_4 is equal to -0.028—supporting Hypothesis 1. In column 6, we include interaction terms between the GSIB indicator and second- to fourth-quarter dummy variables, leaving the first quarter as the reference case. The estimate of β_4 remains about unchanged at -0.025 and significant, implying that method 1 scores of GSIBs drop about 3 percent compared with scores from non-GSIBs in the fourth quarter of each year.

Columns 7 to 12 repeat the specifications from the first 6 columns using the method 2 score as the dependent variable and confirm the evidence based on the method 1 score, which provides further support to Hypothesis 1. In columns 7 to 12, the estimate of β_4 is always negative and statistically significant, whereas estimates of β_1, β_2, and β_3 are never significant. The estimates of β_4 in columns 11 and 12, equal to -0.051 and -0.044 indicate that method 2 scores of GSIBs drop about 4 percent to 5 percent compared with scores from non-GSIBs in the fourth quarter of each year. This seasonal effect on method 2 scores is more important than the effect on method 1 scores because, in practice, method 2 surcharges are at least as high as method 1 surcharges and thus, conditional on whether banks are GSIBs, method 2 scores alone determine surcharges.

Table 3: Effects of GSIB Status on Systemic Importance Scores

	Method 1 score						Method 2 score					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
GSIB × post	-0.025	-0.026	-0.032	-0.026	-0.041	-0.043						
	(0.061)	(0.061)	(0.061)	(0.061)	(0.062)	(0.062)						
GSIB × time trend	-0.035**	-0.035**	-0.035**	-0.035**	-0.036**	-0.035**	-0.058	-0.059	-0.059	-0.055	-0.058	-0.057
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.038)	(0.037)	(0.038)	(0.036)	(0.038)	(0.036)
GSIB × 1st quarter		0.007						0.007				
		(0.008)						(0.016)				
GSIB × 2nd quarter			0.022			0.011			0.018			0.009
			(0.012)			(0.012)			(0.012)			(0.019)
GSIB × 3rd quarter				0.003		-0.003				0.021		0.012
				(0.009)		(0.010)				(0.020)		(0.026)
GSIB × 4th quarter					-0.028**	-0.025**					-0.051*	-0.044*
					(0.010)	(0.009)					(0.020)	(0.018)
Bank controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	486	486	486	486	486	486	243	243	243	243	243	243
Banks	27	27	27	27	27	27	27	27	27	27	27	27
R-squared	0.29	0.29	0.29	0.29	0.29	0.29	0.21	0.21	0.22	0.22	0.22	0.22

NOTE: This table presents estimates of equation (2). Each observation is a bank-time pair. In columns 1 to 6 and 7 to 12, the dependent variable is the natural logarithm of the method 1 and of the method 2 score, respectively. In columns 1 to 6, the data range from the fourth quarter of 2013 to the fourth quarter of 2019. In columns 7 to 12, the data range from the fourth quarter of 2016 to the second quarter of 2020. The frequency of the data is annual from 2013 to 2015 (collected in the fourth quarter) and quarterly from the second quarter of 2016 on. All specifications include as independent variables total assets, total capital ratio, tier-1 capital ratio, leverage ratio, return on assets, return on equity, net interest margin, delinquency ratio, and charge off ratio. All specifications also include bank and time fixed effects. Standard errors are clustered at the bank level. * and ** denote statistical significance at the 5 and 1 percent levels.

We conduct a simple exercise to gauge the effect of the GSIB status on surcharges that these estimates imply. Consider a GSIB that in the first quarter of a given year has a method 2 score between 530 and 629. GSIBs in this interval are subject to a 3.0-percent surcharge, the median and modal surcharge for U.S. GSIBs based on scores of the first quarter of 2020.[14] Holding all other characteristics in equation (2) constant, the -0.044 estimate of β_4 in column 12 implies that the fourth-quarter method 2 score of that bank should be 4.4 percent lower than its first-quarter score. Thus, GSIBs with a score between 530 and 554 in the first quarter would have a fourth-quarter score below 530 and therefore would enjoy a 0.5-percentage point drop in their surcharges, from 3.0 percent to 2.5 percent. GSIBs with first-quarter scores between 555 and 629 would keep their scores above the 530 threshold in the fourth quarter remain subject to a 3.0-percent surcharge. Thus, these year-end changes in scores can have noticeable economic effects.

In Table 4, we test Hypotheses 1 to 3 examining how GSIB surcharges affect systemic importance indicators. In each column of this table, we estimate equation (2) using the same specification as in column 6 of Table 3. In columns 1 to 12 of Table 4, the dependent variable is the natural logarithm of a systemic importance indicator measured in dollar amounts; in column 13, it is the STWF ratio measured in percentage points. Across the 13 columns of this table, the estimate of γ is statistically significant only in column 8, which uses the notional amount of OTC derivatives as the dependent variable. The -0.335 estimate in this column implies that this amount decreases by about one-third at GSIBs relative to non-GSIBs once GSIBs are subject to surcharges.

[14] Bank of America, Goldman Sachs, and Morgan Stanley were in this interval in the first quarter of 2020.

Table 4: Effects of GSIB Status on Systemic Importance Indicators

	Size	Interconnectedness			Substitutability			Complexity			Cross-jur. activ.		STWF
	Total exposures	Intra-fin. system assets	Intra-fin. system liabilities	Securities outstand.	Payments activity	Assets under custody	Underwr. debt and equity	Notional OTC der. amount	Trading and AFS securities	Level 3 assets	Cross-jur. claims	Cross-jur. liabilities	STWF ratio
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
GSIB × post	-0.101	0.180	-0.047	-0.007	0.150	0.038	-0.185	-0.335**	0.205	-0.502	-0.070	0.313	
	(0.055)	(0.174)	(0.150)	(0.152)	(0.147)	(0.093)	(0.141)	(0.090)	(0.204)	(0.246)	(0.127)	(0.154)	
GSIB × time tr.	-0.029**	-0.107**	-0.067	-0.006	-0.061	-0.003	-0.048	-0.089*	-0.133	-0.110	0.025	-0.055	-1.326
	(0.009)	(0.028)	(0.034)	(0.031)	(0.035)	(0.018)	(0.032)	(0.041)	(0.053)	(0.063)	(0.022)	(0.029)	(1.077)
GSIB × 2nd qtr.	0.009	-0.045	0.037	-0.004	0.029	0.011	0.000	-0.033	0.048	0.025	-0.001	-0.012	0.281
	(0.006)	(0.035)	(0.036)	(0.013)	(0.019)	(0.012)	(0.048)	(0.026)	(0.044)	(0.056)	(0.019)	(0.033)	(0.758)
GSIB × 3rd qtr.	-0.000	-0.014	0.003	0.009	-0.016	0.025	-0.059	-0.037	0.007	-0.023	-0.018	-0.078	-0.222
	(0.010)	(0.038)	(0.044)	(0.015)	(0.034)	(0.023)	(0.068)	(0.027)	(0.044)	(0.041)	(0.029)	(0.042)	(0.575)
GSIB × 4th qtr.	-0.001	0.001	0.045	-0.004	-0.030	-0.002	-0.018	-0.124**	-0.006	-0.022	-0.029	-0.076	-0.332
	(0.007)	(0.038)	(0.038)	(0.014)	(0.032)	(0.021)	(0.058)	(0.031)	(0.035)	(0.065)	(0.028)	(0.040)	(0.481)
Bank controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank f.e.?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time f.e.?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	540	540	460	520	480	400	320	540	480	360	540	460	303
Banks	27	27	23	26	24	20	16	27	24	18	27	23	27
R-squared	0.47	0.24	0.16	0.36	0.22	0.21	0.43	0.42	0.23	0.32	0.15	0.16	0.18

NOTE: This table presents estimates of equation (2). Each observation is a bank-time pair. In columns 1 to 12, the dependent variable is the natural logarithm of the dollar amount of a systemic importance indicator, and the data range from the fourth quarter of 2013 to the second quarter of 2020. In column 13, the dependent variable is the short-term wholesale funding ratio, and the data range from the fourth quarter of 2016 to the second quarter of 2020. The data frequency is annual from 2013 to 2015 (collected in the fourth quarter) and quarterly from the second quarter of 2016 on. All specifications include as independent variables total assets, total capital ratio, tier-1 capital ratio, leverage ratio, return on assets, return on equity, net interest margin, delinquency ratio, and charge off ratio. All specifications also include bank and time fixed effects. Standard errors are clustered at the bank level. * and ** denote statistical significance at the 5 and 1 percent levels.

Estimates of β_4 are negative in most columns, supporting Hypothesis 1 and suggesting that GSIBs lower their indicators in the fourth quarter to lower surcharges. However, these estimates are statistically significant only when we use the notional amount of OTC derivatives as the dependent variable. The -0.124 estimate in column 8 indicates that the OTC derivatives held by GSIBs drop by 12 percent relative to non-GSIBs at year-end, a large effect. The finding that estimates of β_4 are negative and significant only when the notional amount of OTC derivatives—an indicator that affects method 1 and 2 scores and that is measured at year-end—also supports Hypotheses 2 and 3. Moreover, this finding confirms that banks lower their surcharges by compressing OTC derivatives, as discussed in Subsection 2.2.1. Together, the results in Tables 3 and 4 show that GSIBs lower their scores in the fourth quarter of each year and that this adjustment is driven to a large extent by a drop in the notional amount of OTC derivatives.

We next examine separately the seasonal variation in notional amounts of contracts cleared through a CCP and bilaterally. This analysis helps to determine whether compression of OTC derivatives with the objective of reducing GSIB surcharges has caused the seasonal effects implied by the negative estimates of β_4 in Table 4. Contracts cleared through a CCP are generally more standardised and thus generally have a higher fraction of their notional amounts eliminated through compression [Financial Stability Board, 2018]. Therefore, estimates of β_4 should be lower for contracts cleared through a CCP than settled bilaterally if the estimates in Table 4 are in fact driven by banks' efforts to diminish surcharges.

In Table 5, we estimate equation (2) with the notional amounts of OTC derivative contracts cleared through a CCP (column 1) and settled bilaterally (column 2) as the dependent variable. The sum of these two items is the notional amount of OTC derivative contracts used in column 8 of Table 4. The estimate of β_4 is statistically significant column 1, but not significant in column 2. In addition, both estimates are negative, but the estimate using CCP-cleared derivatives is larger. Thus, the seasonal effects implied by β_4 in Table 5 support our interpretation that those effects are driven by GSIBs' effort to lower surcharges.

Table 5: Effects of GSIB Status on OTC Derivatives by Settlement Type

	Cleared by CCP	Settled bilaterally
	(1)	(2)
GSIB × post	-1.325**	0.071
	(0.222)	(0.296)
GSIB × time trend	-0.172**	-0.078
	(0.056)	(0.079)
GSIB × 2nd quarter	-0.024	0.063
	(0.042)	(0.086)
GSIB × 3rd quarter	-0.186	-0.008
	(0.152)	(0.041)
GSIB × 4th quarter	-0.148**	-0.103
	(0.047)	(0.061)
Bank controls?	Yes	Yes
Bank fixed effects?	Yes	Yes
Time fixed effects?	Yes	Yes
Observations	539	540
Banks	27	27
R-squared	0.62	0.23

NOTE: This table presents estimates of equation (2). Each observation is a bank-time pair. In columns 1 and 2, the dependent variable is the natural logarithm of the notional amount of OTC derivatives cleared by a CCP and settled bilaterally, respectively. The data range from the fourth quarter of 2013 to the second quarter of 2020. The frequency of the data is annual from 2013 to 2015 (collected in the fourth quarter) and quarterly from the second quarter of 2016 on. All specifications include as independent variables total assets, total capital ratio, tier-1 capital ratio, leverage ratio, return on assets, return on equity, net interest margin, delinquency ratio, and charge off ratio. All specifications also include bank and time fixed effects. Standard errors are clustered at the bank level. * and ** denote statistical significance at the 5 and 1 percent levels.

5.2 Evidence from Triple Differences

We next refine the main hypothesis of our paper and test it using bank-level data that cover a longer time period than the data on systemic importance indicators and scores that we have used so far. We use quarterly FR Y-9C data starting in 2004, which allow us to determine whether the seasonal drop in notional amounts of OTC derivatives of GSIBs relative to non-GSIBs actually

began when GSIB surcharges were introduced. We now use a triple differences empirical strategy: We estimate differences in the notional amounts of OTC derivatives between GSIBs and non-GSIBs, the fourth quarter of each year and other quarters, and before and after the GSIB surcharge was introduced. Estimates of these changes provide stronger evidence of window-dressing by GSIBs than the tests presented in Figure 1 because we can now separate seasonal differences between GSIBs and non-GSIBs observed prior to the introduction of the GSIB surcharge from seasonal differences observed after the introduction. Indeed, year-end changes in bank balance sheets had already been documented many years before GSIB surcharges were introduced [Griffiths and Winters, 2005], and thus seasonal effects unrelated to surcharges may affect the estimates of β_4 in Tables 3 to 5.

We now estimate the equation

$$\begin{aligned} Y_{it} = \gamma GSIB_i \times Post_t + \delta GSIB_i \times t + \sum_{s=2}^{4} \beta_s GSIB_i \times \mathbb{1}\{s = q(t)\} \\ + \sum_{s=2}^{4} \theta_s GSIB_i \times Post_t \times \mathbb{1}\{s = q(t)\} + \Psi X_{it} + \nu_i + \varphi_t + \varepsilon_{it} \end{aligned} \tag{3}$$

to test the following hypothesis:

Hypothesis 4 $\theta_4 < 0$.

Table 6 shows estimates of changes in the notional amounts of interest rate swap, forward, and option contracts. The contracts in the first three columns include interest rate, foreign exchange, equity, and commodity contracts.[15] The estimates of θ_4 provide further evidence of a drop in OTC derivative amounts by GSIBs relative to non-GSIBs after the introduction of the surcharge. The estimates in columns 1 to 3 are negative, and statistically significant for the OTC derivative type with the largest notional amount, namely swaps. The -0.110 estimate of θ_4 in column 3 indicates that the notional amounts of swap contracts drop about 11 percent in the fourth quarter by GSIBs relative to non-GSIBs after the introduction of the surcharges. In column 4, we restrict the sample in column 3 to interest rate swaps. The -0.127 estimate in column 4 is statistically significant

[15]These contracts do not include credit default swaps (CDS) because the FR Y-9C started covering CDS data a few years after the start of our series.

and close to the -0.110 estimate in column 3, which is expected given that the notional amount of interest rate swaps accounts for most of the notional amount of swaps.

The evidence from Table 6 that interest rate swaps drop in the fourth quarter of each year is consistent with the evidence from Table 5 that derivatives cleared by CCPs decline in that quarter as well because most of the notional amount of interest rate swaps is cleared by CCPs [Financial Stability Board, 2018]. In addition, interest rate OTC derivatives compression has increased materially in recent years worldwide [Ehlers and Hardy, 2019], which suggests that compression of these derivatives has to some extent driven the seasonal changes in notional amounts of OTC derivatives that we estimate in Subsection 5.1.

5.3 Examining the Main Identification Assumption

The main assumption of our empirical strategy is that, in the absence of GSIB surcharges, the difference between quarterly variation of systemic importance indicators of GSIBs and non-GSIBs would have remained unchanged over time. Using the notation from equation (3), we assume that θ_s would have been equal to zero for $s \in \{2, 3, 4\}$ if surcharges had never been introduced. This assumption is analogous to the parallel trends assumption in differences-in-differences models and it cannot be properly evaluated with the FR Y-15 data because they cover a short part of the pre-period of our analysis.[16]

To examine this assumption, we estimate a modified version of equation (3) using the FR Y-9C interest rate swap data used in column 4 of Table 6.

We now estimate the equation

$$Y_{it} = \gamma GSIB_i \times Post_t + \delta GSIB_i \times t + \xi_t \times GSIB_i \times \mathbb{1}\{q(t) = 4\} + \Psi X_{it} + \nu_i + \varphi_t + \varepsilon_{it} \qquad (4)$$

In this equation, we are mainly interested in the terms $\xi_t \times GSIB_i \times \mathbb{1}\{q(t) = 4\}$, which are by construction equal to zero for all observations from non-GSIBs and from all quarters except the fourth. Estimates of this term that are statistically significant for years before 2015 would indicate that our assumption is not valid.

[16] The FR Y-15 data start in 2013 and the U.S. GSIB rule was published in 2015.

Table 6: Effects of GSIB Status on OTC Derivatives by Contract Type

	All forwards	All options	All swaps	Interest rate swaps
	(1)	(2)	(3)	(4)
GSIB × post	-0.024	-1.207**	-0.345	-0.547*
	(0.221)	(0.322)	(0.245)	(0.235)
GSIB × time tr.	-0.027	0.050	-0.029	-0.014
	(0.031)	(0.030)	(0.055)	(0.049)
GSIB × 2nd qtr.	-0.088*	-0.080	-0.041	-0.042
	(0.040)	(0.064)	(0.030)	(0.031)
GSIB × 3rd qtr.	-0.046	-0.082	-0.017	-0.026
	(0.045)	(0.041)	(0.028)	(0.029)
GSIB × 4th qtr.	-0.079	-0.091	0.011	-0.004
	(0.066)	(0.054)	(0.025)	(0.028)
GSIB × 2nd qtr. × post	0.088	0.041	0.002	0.001
	(0.067)	(0.072)	(0.039)	(0.039)
GSIB × 3rd qtr. × post	0.019	0.016	-0.081*	-0.097*
	(0.092)	(0.080)	(0.035)	(0.036)
GSIB × 4th qtr. × post	-0.069	-0.050	-0.110*	-0.127*
	(0.078)	(0.082)	(0.045)	(0.047)
Bank controls?	Yes	Yes	Yes	Yes
Bank f.e.?	Yes	Yes	Yes	Yes
Time f.e.?	Yes	Yes	Yes	Yes
Observations	1,654	1,600	1,656	1,656
Banks	27	27	27	27
R-squared	0.41	0.28	0.43	0.44

NOTE: This table presents estimates of equation (2). Each observation is a bank-time pair. In columns 1 to 4, the dependent variable is the natural logarithm of the notional amount of forward, option, swap, and interest rate swap OTC derivatives, respectively. The data are quarterly and range from the first quarter of 2004 to the second quarter of 2020. All specifications include as independent variables total assets, total capital ratio, tier-1 capital ratio, leverage ratio, return on assets, return on equity, net interest margin, delinquency ratio, and charge off ratio. All specifications also include bank and time fixed effects. Standard errors are clustered at the bank level. * and ** denote statistical significance at the 5 and 1 percent levels.

Figure 3: Year-End Differences in Interest Rate Swap Amounts of GSIBs and non-GSIBs

NOTE: This figure compares notional amounts of interest rate swaps of GSIBs and non-GSIBs. The dependent variable is the natural logarithm of the notional amount of interest rate swaps help by bank i in period t. The solid line displays estimates of ξ_t, for each year from 2004 to 2019, in equation (4). The dashed lines display the lower and upper limits of the 95 percent confidence intervals. The estimates use quarterly FR Y-9C data ranging from the first quarter of 2004 to the second quarter of 2020.

Figure 3 presents coefficient estimates for these interaction terms. The estimates decline monotonically from 2015 on and are negative and statistically significant for years 2018 and 2019 only. This evidence supports the identification hypothesis that the difference between quarterly variation of systemic importance indicators of GSIBs and non-GSIBs would have remained unchanged over time in the absence of surcharges. Of note, the decline from 2015 on is consistent with the fact that surcharges increased from 2016 to 2019, as they were phased in, and therefore GSIBs' incentives to compress the notional amounts of OTC derivatives rose over this period.

6 Discussion

6.1 Comparison with Results from the GSIB Literature

The results in our paper are consistent with those from the literature on GSIB surcharges, but some of our findings differ from other papers', which demands some discussion. The papers closest to our are from Behn, Mangiante, Parisi, and Wedow [2019] and Garcia, Lewrick, and Sečnik [2021]. Behn, Mangiante, Parisi, and Wedow [2019] show that EU banks that participate in the EU GSIB assessment exercise lower their method 1 scores relative to other EU banks in the fourth quarter, a result that we find that also holds for U.S. GSIBs compared with U.S. non-GSIBs. These authors also find that EU banks that participate in the exercise lower systemic importance indicators of size and cross-jurisdictional activities, whereas we find that U.S. GSIBs mainly reduce a single indicator, the notional amount of OTC derivatives.

Garcia, Lewrick, and Sečnik [2021] examine whether EU GSIBs reduce their indicators relative to other EU banks in the fourth quarter. Similar to us, they find that GSIBs' notional amounts of OTC derivatives drop at year end. However, they also find that GSIBs reduce the amounts of cross-jurisdictional claims and liabilities, a result that Behn, Mangiante, Parisi, and Wedow [2019] also document, whereas we find weak evidence of year-end changes in these indicators.

Our empirical analysis differs from these two papers' in some important aspects, which can explain those differences in results. First, our sample is restricted to banks that report data to calculate GSIB scores and surcharges and compares within this sample GSIBs (8 banks) and non-GSIBs (19 banks). Meanwhile, Behn, Mangiante, Parisi, and Wedow [2019] use a sample that contains banks that do (22 banks of which 8 are GSIBs) and do not report (75 other banks) data to calculate scores and surcharges and compares reporters with non-reporters. For this reason, all banks in our treatment group are subject to GSIB surcharges, whereas most banks in the treatment group in Behn, Mangiante, Parisi, and Wedow [2019] are not. Garcia, Lewrick, and Sečnik [2021] also use non-reporters (134 banks) as a control group, but separates treated banks into GSIBs (13 banks) and non-GSIBs (19 banks). Accordingly, banks in our treatment and control groups are more systemically important than the respective banks in Behn, Mangiante, Parisi, and Wedow

[2019] and Garcia, Lewrick, and Sečnik [2021] on average.[17]

Second, banks in the European Union and in the United States are subject to different regulations that affect systemic importance indicators. For example, differences in the definition of the Basel III leverage ratio provide different incentives for EU and U.S. banks to borrow and lend in repo markets, in particular at quarter-end (see, for example, Egelhof, Martin, and Zinsmeister [2017]). EU banks report leverage ratios as a snapshot on the last day of the quarter, whereas U.S. banks report leverage ratios as averages of their daily values over the quarter. Also, the U.S. GSIB framework, which includes a method 2 score, provides banks different incentives for various activities compared with the EU framework, which follows more closely the BCBS framework and does not include a method 2 score.

More broadly, even though we only find evidence that U.S. GSIBs adjust the notional amount of OTC derivatives, U.S. GSIBs may have employed other strategies besides derivatives compression to reduce surcharges at year-end. In fact, analysts often mention year-end repo termination as an important strategy to reduce U.S. GSIB surcharges, which should affect indicators of cross-jurisdictional activities in the fourth quarter (see, for example, Covas and Freedman [2019], Demos [2019], and Noonan and Rennison [2019]). However, repo activity in the United States is largely concentrated in a handful of GSIBs. Moreover, repo activity, unlike OTC derivatives, does not have an exclusive systemic importance indicator and therefore its impact on systemic importance indicators may not be as clear as the effects of OTC derivatives compression. For this reason, our empirical strategy, which compares systemic importance indicators of GSIBs and non-GSIBs, may not be able to account for some of the effects of repo termination.

We view the lack of evidence of year-end effects on systemic importance indicators other than the notional amount of OTC derivatives possibly as a consequence of three more characteristics of our analysis. First, GSIB surcharges were recently imposed and the number of U.S. GSIBs is small. A longer time series and a larger number of GSIBs would help estimate seasonal differences between GSIBs and non-GSIBs more precisely. Second, some indicators, including the size and cross-jurisdictional activities indicators, encompass a large variety of assets and liabilities, which

[17]This comparison is based on mean method 1 scores reported in Table 1 of our paper, Table 2 of Behn, Mangiante, Parisi, and Wedow [2019], and Table 3 of Garcia, Lewrick, and Sečnik [2021].

should exhibit distinct seasonal variation. A study focused on specific assets or liabilities may help uncover those seasonal differences. Third, we use bank-level data, which does not allow us to control for characteristics of individual balance sheet items. Accounting for these characteristics would help to estimate seasonal differences between GSIBs and non-GSIBs more accurately.[18]

6.2 Economic Relevance of the Results

The main finding of this paper is that GSIBs lower their systemic importance indicators at year-end and this reduction is mainly driven by OTC derivatives compression. This evidence motivates the question of whether these seasonal changes have any meaningful economic impact. We discuss the implications of these changes for market functioning and financial stability.

In principle, a contraction of bank activity in OTC derivatives could have an impact on market functioning, which would likely cause shifts in prices of these derivatives. Yet GSIBs have generally reduced their notional amounts of OTC derivatives at year end through compression, which is intended to reduce notional amounts while keeping net positions of the parties that participate in compression unchanged. Consistent with this objective, as far as we know there is no evidence that OTC derivatives compression driven by GSIB surcharges has impaired market functioning.

Meanwhile, compression has lowered GSIB surcharges and thus could have consequences for financial stability. Compression affects GSIB surcharges because the notional amount of OTC derivatives is an input of method 1 and 2 scores. As we discuss in Section 4, method 2 surcharges are generally higher than method 1 surcharges, which implies that, conditional on a bank being a GSIB, its method 2 score alone determines its surcharge. Thus, compression lowers surcharges, which may reduce GSIBs' resilience to adverse shocks thereby increasing risks to financial stability.

One may counterargue this statement observing that the FRB most likely anticipated banks' strategic behavior. Thus, the FRB may have set the parameters of method 2 scores and surcharges higher to account for this behavior. In fact, one objective of surcharges was to motivate GSIBs to reduce their systemic footprints, which are measured with GSIB scores [Basel Committee on

[18] Favara, Ivanov, and Rezende [2020], Degryse, Mariathasan, and Tang [2020], and Behn and Schramm [2020] use credit registry data, which allow them to control for borrower and loan characteristics to estimate effects of GSIB surcharges and designation on corporate lending. However, these papers do not analyze year-end variation driven by surcharges.

Banking Supervision, 2013; Board of Governors of the Federal Reserve System, 2015; Yellen, 2015]. Therefore, this behavior may have been not only expected, but also an intended outcome.

However, the seasonal variation in measures of systemic importance that we document was most likely unwanted, in particular the drops in the fourth quarter, which have lowered surcharges. In addition, surcharges could not account for GSIBs' strategic behavior for two main reasons. First, the FRB calibrated surcharges in a way that "a GSIB should hold enough capital to lower its probability of failure so that its expected impact is approximately equal to that of a non-GSIB" [Board of Governors of the Federal Reserve System, 2015]. Thus, the FRB calibrated surcharges to induce GSIBs to hold just enough capital to meet this expected impact, and not to motivate them to keep a buffer to accommodate their strategic behavior. Second, the FRB used data from GSIBs and non-GSIBs to calibrate surcharges from the second quarter of 1987 to the fourth quarter of 2014, when GSIBs' year-end reactions to surcharges could not be observed yet. Therefore, our results could have economic meaningful implications for financial stability.

7 Conclusion

In this paper, we examined how U.S. GSIBs adjust their systemic importance indicators to lower GSIB surcharges. We show that U.S. GSIBs mainly reduce the notional amount of over-the-counter derivatives in the fourth quarter of each year: the quarter that determines GSIB surcharges. These findings are intuitive considering that banks can compress notional amounts of OTC derivatives without major changes to their net positions in those contracts. Therefore, OTC derivatives compression is a low-cost option to reduce surcharges compared to other alternatives.

Our findings have implications for the design of systemic importance indicators. We estimate that GSIBs' systemic importance indicators drop materially at year-end in response to surcharges. Yet method 2 coefficients, which map indicators into surcharges, were set using bank data from a period before surcharges were introduced. Thus, these coefficients do not account for those seasonal changes and possibly underestimate the systemic importance of banks. Ideally, GSIB surcharges should be robust to this strategic behavior.

In addition, our estimates indicate that these seasonal adjustments vary materially across indi-

cators. Even though this variation is not necessarily undesirable, it is most likely not optimal. In fact, the systemic importance indicators, their weights, and the linear relationship between indicators and scores in the GSIB framework were mainly determined by judgement from bank regulators as opposed to a model that maximizes social welfare taking into account banks' strategic behavior [Passmore and von Hafften, 2018]. Such a model would possibly support a framework that would induce a different seasonal pattern in systemic importance indicators.

Even though our results indicate that banks exploit opportunities in the GSIB rule to reduce surcharges, they also suggest that the rule has achieved some of its objectives. One of the objectives of the rule is to motivate GSIBs to lower their systemic footprints, and the results of this paper show that banks respond to the incentives the rule provides. Moreover, the evidence that banks respond to these incentives indicates that surcharges are important to keep the level of capital at GSIBs elevated.

Appendix A U.S. GSIB Rule

In 2015, the FRB adopted a rule imposing risk-based capital surcharges on the largest and most interconnected U.S. banks. This rule requires that a bank whose measure of systemic importance exceeds a certain threshold be identified as a GSIB and be subject to a risk-based capital surcharge. The GSIB surcharge was introduced on January 1, 2016, became fully phased in on January 1, 2019, and is applied to three minimum capital requirements: the minimum CET 1 capital ratio, the minimum tier 1 capital ratio, and the minimum total capital ratio. Table A.1 shows how the GSIB surchage was imposed on these three minimum capital requirements over time:

The minimum required CET 1 capital ratio, tier 1 capital ratio, and total capital ratio were equal to 4.5 percent, 6.0 percent, and 8.0 percent in 2015, respectively. These three minimum capital requirements increased by one quarter of the sum of the capital conservation buffer—equal to 2.5 percentage points for all BHCs—and the fully phased-in GSIB surcharge—which currently varies from 0 to 3.5 percentage points across BHCs—each year from January 1, 2016, to January 1, 2019. A BHC that does not meet these requirements is subject to limitations on capital distributions and on certain discretionary bonus payments.

Table A.1: Minimum Capital Requirements over Time

	2015	2016	2017	2018	2019
CCB	0.0%	0.625%	1.25%	1.875%	2.5%
GSIB surcharge	0.0%	0.25 × full GSIB surch.	0.50 × full GSIB surch.	0.75 × full GSIB surch.	1.00 × full GSIB surch.
Min. CET 1 capital + CCB + GSIB surch.	4.5%	5.125% + 0.25 × full GSIB surch.	5.75% + 0.50 × full GSIB surch.	6.375% + 0.75 × full GSIB surch.	7.0% + 1.00 × full GSIB surch.
Min. tier 1 capital + CCB + GSIB surch.	6.0%	6.625% + 0.25 × full GSIB surch.	7.25% + 0.50 × full GSIB surch.	7.875% + 0.75 × full GSIB surch.	8.5% + 1.00 × full GSIB surch.
Min. total capital + CCB + GSIB surch.	8.0%	8.625% + 0.25 × full GSIB surch.	9.25% + 0.50 × full GSIB surch.	9.875% + 0.75 × full GSIB surch.	10.5% + 1.00 × full GSIB surch.

NOTE: Capital requirements are valid from January 1 to December 31 of the respective year. CCB, GSIB, and CET 1 are acronyms for capital conservation buffer, global systemically important bank holding company, and common equity tier 1, respectively. "Full GSIB surch." is an abbreviation for fully phased-in GSIB surcharge.
SOURCE: Federal Register [2015].

A BHC is identified as a GSIB if a measure of its systemic importance—the method 1 score—exceeds 130. The FRB set this cutoff at 130 for two reasons. First, estimates of this score from the Board indicated a large drop between the eighth-highest score (146) and the ninth-highest score (51), which would make it natural to locate the threshold between these two values. Second, this threshold aligns the U.S. rule with international standards and facilitates comparisons across jurisdictions, because the Basel Committee on Banking Supervision (BCBS) also uses a threshold equal to 130. In fact, method 1 is also adopted by the BCBS to determine whether a bank is a GSIB and to calculate its GSIB surcharge.

To calculate the method 1 score of a BHC, the FRB uses five broad categories of data correlated with systemic importance: size, interconnectedness, cross-jurisdictional activity, substitutability, and complexity.[19] Each of these five categories receives a weight of 20 percent in a BHC's method 1 score. The contributions of these five categories are measured by the 12 indicators listed in Table A.2:

These 12 indicators are multiplied by their respective weights, shown on the rightmost column of this table, and divided by the respective aggregate global measure of each indicator. Each aggregate global measure is provided annually by the FRB and is the sum of the respective indicator scores

[19]For this calculation, the value of the substitutability score is capped at 100.

Table A.2: Systemic Indicator Weights for Method 1 Score

Category	Systemic indicator	Weight (percent)
Size	Total exposures	20.00
Interconnectedness	Intra-financial system assets	6.67
	Intra-financial system liabilities	6.67
	Securities outstanding	6.67
Substitutability	Payments activity	6.67
	Assets under custody	6.67
	Underwritten transactions in debt and equity markets	6.67
Complexity	Notional amount of over-the-counter (OTC) derivatives	6.67
	Trading and available-for-sale (AFS) securities	6.67
	Level 3 assets	6.67
Cross-jurisdictional activity	Cross-jurisdictional claims	10.00
	Cross-jurisdictional liabilities	10.00

SOURCE: Federal Register [2015].

from the 75 largest U.S. and foreign banking organizations (as measured by the BCBS) and any other banking organizations that the BCBS decides to include in the sample for the respective year. Each aggregate global measure is converted from euros to U.S. dollars using the exchange rate observed on December 31 of the reference year provided by the BCBS. The 12 indicators are then summed and the total is the method 1 score of the GSIB. Because the method 1 score of a BHC depends on characteristics of other banks and on exchange rates, a BHC cannot accurately manipulate its method 1 score by changing its own characteristics.[20]

The GSIB surcharge of a BHC is the higher of the method 1 and 2 surcharges. The method 1 fully phased-in GSIB surcharge of a BHC is determined by its method 1 score as follows:

As shown in Table A.3, the method 1 surcharge of a non-GSIB is equal to 0 and the surcharge of a GSIB is equal to 1 percent at least. This surcharge increases 0.5 percentage points for every 100 basis points in the method 1 score between 130 and 529 and 1 percentage point for every 100 basis points above 529. The larger impact of the score on the surcharge above a score of 529 provides a stronger incentive for GSIBs above this score to limit their systemic footprint.

The method 2 score of a BHC is equal to the 10 indicators multiplied by the fixed coefficients

[20]In fact, when the U.S. rule of GSIB surcharges was proposed, commenters argued to the Federal Reserve Board that an approach with a fixed denominator would provide more certainty to BHCs about the actions that they could take to reduce their GSIB surcharges [Federal Register, 2015].

Table A.3: Method 1 Fully Phased-in GSIB Surcharge

Method 1 score	Method 1 surcharge (percent)
130 or less	0.0
$130 - 229$	1.0
$230 - 329$	1.5
$330 - 429$	2.0
$430 - 529$	2.5
530 or more	$3.5 + 1.0$ for each 100 basis points above 530

SOURCE: Federal Register [2015].

in Table A.4.

Table A.4: Systemic Indicator Weights for Method 2 Score

Category	Systemic indicator	Coefficient (percent)
Size	Total exposures	4.423
Interconnectedness	Intra-financial system assets	12.007
	Intra-financial system liabilities	12.490
	Securities outstanding	9.056
Short-term wholesale funding	Short-term wholesale funding score	1.000
Complexity	Notional amount of over-the-counter (OTC) derivatives	0.155
	Trading and available-for-sale (AFS) securities	30.169
	Level 3 assets	161.177
Cross-jurisdictional activity	Cross-jurisdictional claims	9.277
	Cross-jurisdictional liabilities	9.926

SOURCE: Federal Register [2015].

The method 2 fully phased-in GSIB surcharge of a BHC depends on its method 2 score as described in Table A.5:

The GSIB surcharge that a BHC is subject to from January 1 to December 31 of year t must be calculated by December 31 of year $t-1$ using data as of December 31 of year $t-2$. Also, after the initial GSIB surcharge of a BHC is in effect, if the fully phased-in surcharge of this BHC increases, the higher surcharge is applied only two years after the measurement of the systemic indicators. However, if the fully phased-in surcharge decreases, then it becomes effective in the next calendar year.

Table A.5: Method 2 Fully Phased-in GSIB Surcharge

Method 2 score	Method 2 surcharge (percent)
130 or less	0.0
130 – 229	1.0
230 – 329	1.5
330 – 429	2.0
430 – 529	2.5
530 – 629	3.0
630 – 729	3.5
730 – 829	4.0
830 – 929	4.5
930 – 1029	5.0
1030 – 1129	5.5
1130 or more	6.5 + 0.5 for each 100 basis points above 1130

SOURCE: Federal Register [2015].

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