Online Appendix for "Balance Sheet Constraints of Prime Brokers on Hedge Fund Performance: Evidence from GSIB Surcharge"

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Section OA.1 further introduces the capital requirements under the Basel III framework. Section OA.2 documents the proof for the theoretical model in Section 3. In Section OA.3, we exploit the use of leverage by hedge funds to examine the heterogeneous effects of the prime brokers' balance sheet constraints. Section OA.4 describes how we obtain mutual fund brokerage relationship data and other mutual fund variables. Section OA.5 describes how we compute the portfolio beta of fund family equity holdings.

OA.1 Capital Requirement under Basel III Framework

In this section, we provide more details of the capital requirements under the Basel III framework. As mentioned in Section 2, there are three common types of regulatory capital with different liquidity levels: CET1 capital, Tier 1 capital, and total capital. The CET1 capital is already discussed in Sections 2.1 and 6.1. We now briefly introduce Tier 1 and total capital in below. Tier 1 capital includes CET1 and additional tier 1 capital. The latter includes noncumulative, nonredeemable preferred stock and related surplus, and qualifying minority interest.[1] These items can also absorb loss, although they are not qualified for CET1. Total capital is the sum of Tier 1 and Tier 2 capital. Tier 2 capital includes hybrid capital instruments, loan-loss and revaluation reserves, as well as undisclosed reserves. It has a lower standard than Tier 1 and is harder to liquidate.

In Section 6.1 of the main text, we use CET1 capital requirement as an alternative balance sheet constraint measure. It consists of the minimum CET1 ratio and a capital conservation

[1] See, for example, the definition of regulatory capital in Basel III at https://www.bis.org/fsi/fsisummaries/defcap_b3.pdf.

buffer (CCB). The CCB is an add-on requirement on CET1 ratio and it can only be covered with CET1 capital. The buffer is 2.5% for all banks and is gradually phased-in since 2016. If the buffer falls below 2.5%, there will be automatic constraints on the capital distribution of banks, which impact dividends, share buyback, and bonus payments decisions. That is, banks have to meet this additional buffer to operate smoothly. Thus, we include the CCB on top of the CET1 ratio in our analysis.

As mentioned in Section 4, non-US GSIBs and US GSIBs surcharge levels are determined in different ways. In particular, there are two methodologies for setting the surcharge level, commonly referred to as Method 1 and Method 2 respectively. Method 1 is set by the Financial Stability Board in consultation with the Basel Committee on Banking Supervision. Method 2 is set by the Federal Reserve Board exclusively for US GSIBs. For both methods, the final surcharge level is determined by two steps. The surcharge level of non-US GSIBs are solely determined by Method 1. For US GSIBs, their surcharge level is set as the higher one from the two methods. The first step calculates the systemically important financial institution (SiFi) score, which is derived as a weighted sum of multiple quantitative systemic importance indicators. The second step maps the SiFi score to the corresponding surcharge. The two methods differ in both the systemic importance indicators in the first step as well as the mapping in the second step. Table OA.13, which replicates Tables A1, A2, A3, and A4 in Favara et al. (2021), reports the systemic importance indicators and the surcharge mapping for the two methods. We see that Method 2 replaces the Substitutability category in Method 2 by the Short-term wholesale funding in measuring the SiFi score.

Under the Basel III framework, there are other capital requirements which consider banks' off-balance-sheet activities. One example is the Basel III Tier 1 leverage ratio. Firstly introduced in 2009, the Basel III Tier 1 leverage ratio is a capital adequacy tool that measures a bank's Tier 1 capital divided by its total exposures, including average consolidated assets, derivatives exposures, and off-balance sheet items. The minimum requirement of the Basel III Tier 1 leverage ratio is 3%. For US banks, they have an additional leverage requirement, known as the supplementary leverage ratio (SLR), which is the US counterpart of the Basel III Tier 1 leverage ratio. The SLR is required to be even higher (between 5% and 6%). This can also acts as a constraint on bank balance sheets. Du et al. (2018) discuss that leverage ratio regulation limits CIP arbitrage activities. As explained in Section 2.1 of the main text, such non-risk-based capital requirements are out of the scope of this study.

OA.2 Proof of Results in Section 3

We first consider the unbinding case with $0 < \delta^* < \overline{\delta}$. Plugging $\delta^* = (\mu_r - c)/\gamma\sigma_r^2 - 1$ into (3), we have

$$\mathsf{E}(R^*) = \frac{(\mu_r - c)^2}{\gamma\sigma_r^2} + c, \qquad \mathsf{var}(R^*) = \frac{(\mu_r - c)^2}{\gamma^2\sigma_r^2},$$

and

$$\mathsf{S}(R^*) = \frac{\mu_r - c}{\sigma_r} + \frac{\gamma\sigma_r c}{\mu_r - c}.$$

Note that for the unbinding case, the risk aversion coefficient satisfies

$$\frac{\mu_r - c}{\sigma_r^2(1+\overline{\delta})} \leq \gamma \leq \frac{\mu_r - c}{\sigma_r^2}. \tag{1}$$

In the unbinding case, only the increasing cost channel is at play. We take the derivative of the performance metrics with respect to the leverage cost c. For the expected return $\mathsf{E}(R^*)$, we have

$$\frac{d\mathsf{E}(R^*)}{dc} = -\frac{2(\mu_r - c)}{\gamma\sigma_r^2} + 1 < 0.$$

The last inequality uses $\gamma \leq (\mu_r - c)/\sigma_r^2$ in (1). For the return variance, we have

$$\frac{d\mathsf{var}(R^*)}{dc} = -\frac{2(\mu_r - c)}{\gamma^2\sigma_r^2} < 0$$

by the assumption $c < \mu_r$. Thus, the expected return and variance decrease in the leverage cost. Finally, the derivative of Sharpe ratio can be computed as:

$$\frac{d\mathsf{S}(R^*)}{dc} = -\frac{1}{\sigma_r} + \frac{\gamma\mu_r\sigma_r}{(\mu_r - c)^2} = \frac{\gamma\mu_r\sigma_r^2 - (\mu_r - c)^2}{(\mu_r - c)^2\sigma_r}.$$

It is negative if $\gamma \leq (\mu_r - c)^2/(\mu_r\sigma_r^2)$, which falls in the range of (1).

For the binding case, the optimal leverage is set at the maximum level, $\delta^* = \overline{\delta}$. The corresponding expected return, variance, and Sharpe ratio are given by:

$$\mathsf{E}(R^*) = (1+\overline{\delta})\mu_r - \overline{\delta}c, \qquad \mathsf{var}(R^*) = (1+\overline{\delta})^2\sigma_r^2,$$

and

$$\mathsf{S}(R^*) = \frac{\mu_r}{\sigma_r} - \frac{\overline{\delta}c}{1+\overline{\delta}\sigma_r}.$$

In the binding case, both the increasing cost and decreasing provision channels affect the hedge fund performance. Thus, we check both of them by taking the partial derivative with

respect to c and $\overline{\delta}$. For expected return, we have

$$\frac{\partial \mathsf{E}(R^*)}{\partial c} = -\overline{\delta} < 0 \quad \text{and} \quad \frac{\partial \mathsf{E}(R^*)}{\partial \overline{\delta}} = \mu_r - c > 0.$$

Thus, both increasing c and reducing $\overline{\delta}$ decrease the expected return. The variance $\mathsf{var}(R^*)$ is clearly unaffected by c and increases in $\overline{\delta}$. That is, the decreasing provision channel reduces the variance. Finally, the derivatives of the Sharpe ratio can be computed as:

$$\frac{\partial \mathsf{S}(R^*)}{\partial c} = -\frac{\overline{\delta}}{1+\overline{\delta}\sigma_r} < 0 \quad \text{and} \quad \frac{\partial \mathsf{S}(R^*)}{\partial \overline{\delta}} = -\frac{c}{(1+\overline{\delta}\sigma_r)^2} < 0.$$

Thus, increasing cost decreases the Sharpe ratio, while decreasing provision increases it.

OA.3 Heterogeneous Effect for High Leveraged Funds

In this section, we investigate how the effects of average GSIB surcharge vary by the leverage usage of hedge funds. We expect the prime brokers' balance sheet constraints to have stronger impacts on hedge funds with higher leverage usage, as they rely more on the funding from prime brokers.

To test this hypothesis, we firstly identify the hedge funds that are more likely to use high physical leverage. We define a fund type dummy $leverageHigh$ that takes the value of one if the fund satisfies both of the following conditions. First, the hedge fund only uses margin loan or FX credit to get leverage according to the information in TASS database. Second, the hedge fund's primary category is one of the following: Convertible Arbitrage, Fixed Income Arbitrage, Long/Short Equity Hedge, Equity Market Neutral, and Long-only. The two criteria are justified as follows. First, hedge funds obtain leverage mainly from two sources: physical leverage from borrowings or synthetic leverage using derivatives (McNamara and Metrick, 2019). Thus, we exclude hedge funds that use derivatives or futures for leverage exposure as derivatives take less balance sheet usage of prime brokers. Second, the five primary categories of hedge funds listed above usually employ higher leverage than others.[2]

In sum, the $leverageHigh$ dummy identifies the hedge funds that are more likely to obtain high leverage using the balance sheets of their prime brokers. However, one limitation of the above classification is that TASS only has snapshot data of a fund's leverage status. Thus, it cannot reflect the change in the fund's leverage status over time.

Similar to (9), we use the following regression to explore the heterogeneous effects of prime

[2]For example, arbitrage strategies often use high leverage, see at https://www.capitalfundlaw.com/blog/common-hedge-fund-strategies.

brokers' balance sheet constraints by hedge fund leverage status:

$$\begin{aligned} y_{i,t+1,t+12} &= \beta_0 + \beta_1 AvgSurcharge_{i,t} + \beta_2 AvgSurcharge_{i,t} \times leverageHigh_i \\ &+ \beta_3' X_{i,t} + \alpha_i + \eta_{s,t} + \varepsilon_{i,t}. \end{aligned} \tag{2}$$

Here we do not include $leverageHigh_i$ separately in the regression as it is absorbed by the fund fixed effect. The coefficient of our interest is β_2. If $\beta_2 < 0$, it indicates that the impact of average GSIB surcharge is larger for high leverage funds.

Table OA.10 reports the results for (2) with dependent variables being monthly excess return or risk-adjusted alpha. We see that β_2 is significantly negative in all cases. For example, with both $Style \times Month$ and fund fixed effects included, β_2 is -0.379 and -0.377 for excess return and alpha respectively, both significant at the 5% level. This suggests that the impacts of average GSIB surcharge is larger for high leverage funds, which is in line with our conjecture. The results further reveal the negative impacts of prime brokers' balance sheet constraints on hedge fund returns.

OA.4 Data Processing for Mutual Funds Sample

In this section, we briefly describe how we process the sample for mutual funds, which is used in our placebo tests in Section 5.4.

For mutual funds, their brokerage relationship data is obtained from the N-SAR and N-CEN fillings. In particular, we extract Forms N-SAR and N-CEN through the SEC's Electronic Data Gathering, Analysis, and Retrieval (EDGAR) system. Form N-SAR was rescinded on June 1, 2018 and was replace by Form N-CEN afterwards. Under the Investment Company Act of 1940, all registered investment companies are required to file Form N-SAR on a semi-annual basis. Similarly, Form N-CEN needs to be filed once a year by all registered investment companies. Following Han et al. (2024), we collect the Item 20 in Form N-SAR, which reports the brokerage commissions paid to the top ten brokers that receive the most commissions from an investment company, which may include multiple mutual funds in our sample. We assume the these are the brokers used by the mutual funds within the investment company and use them to compute the average GSIB surcharge. Same information is collected from the Item C.16 in Form N-CEN.[3] We combine the data from the two forms to construct a broker-mutual fund relationship panel from 2013 to 2021.

We obtain data on mutual fund monthly returns, total net assets (TNA), fund age,

[3]Form N-CEN reports the top ten brokers at the series (mutual fund) level. Consistent with the N-SAR data, we aggregate the commissions at the investment company level and select the top ten brokers based on total commissions.

turnover, and fund expenses from the CRSP Survivor-Bias-Free Mutual Fund Database. In the analysis, we only include U.S domestic equity funds, which are identified using the investment objective code (*crsp_obj_cd*). We classify mutual funds as active or passive using the CRSP index fund flag (index fund flag = "D" means the fund is pure index fund).

In Forms N-SAR and N-CEN, the investment companies use the central index key (CIK) as identifiers. On the other hand, the CRSP Mutual Fund Database use the fund number (*crsp_fundno*) as identifier. We link the two databases using the form *crsp_cik_map* from CRSP. Same as our main analysis for hedge funds, we assume the mutual funds use the same set of brokers if they belong to the same investment company.

Variable	Definition
Dependent Variables	
Excess return	Monthly mutual funds return less T-bill return. The data is obtained from the CRSP mutual fund database.
Alpha	Monthly hedge funds excess returns adjust by Fama French three factor.
Volatility	12-month mutual funds excess returns volatility.
Sharpe Ratio	12-month mutual funds average excess returns divided by volatility.
Information Ratio	12-month mutual funds average alpha divided by alpha's volatility.
Independent Variables	
AvgSurcharge	For each mutual fund, we average surcharges of its all broker's bank holding company. If a broker's bank holding company is non-GSIB, the surcharge is zero. The broker and mutual fund relationship is obtained from Form N-SAR and N-CEN. Surcharges for Non-US banks are from Financial Stability Board. Surcharges for US banks are from 10-K fillings.
log(TNA)	Logarithm of mutual fund Total Net Assets (in USD).
log(age)	Logarithm of mutual fund age in months.
Expense ratio	The expense ratio of a fund/share class
Turn ratio	The turnover rate of a fund/share class

OA.5 Computation of Fund Portfolio Beta

We describe how we compute the hedge fund portfolio beta used in Section 5.5 of the main text. We first estimate the market beta of each stock j at each quarter end. We run the following regression using the stock's daily returns in the past one-year window:

$$R_{jt} - r_{ft} = \alpha_j + \beta_j (R_{Mt} - r_{ft}) + e_{jt},$$

where R_{jt} is the return of stock j on day t; R_{Mt} denotes the market return downloaded from the Kenneth R. French website; r_{ft} is the one-month U.S. treasury bill rate.

At the end of each quarter, we calculate a market value-weighted portfolio beta for each hedge fund family in our sample. The weights are calculated using the equity holding data from the Thomson Reuters 13F fillings. For fund (family) i at quarter end q, its portfolio beta is defined as :

$$\text{FundBeta}_{i,q} = \sum_j \frac{\text{MV of stock } j \text{ holding}}{\text{MV of total equity holding}} \times \beta_{j,q} = \frac{1}{\sum_j p_{j,q} h_{i,j,q}} \sum_j p_{j,q} h_{i,j,q} \times \beta_{j,q},$$

where $p_{j,q}$ denotes the market price of stock j at the end of quarter q and $h_{i,j,q}$ denotes the shares of stock j held by family i in the quarter.

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Table OA.1: Average GSIB Surcharge and Hedge Fund 12-month Performance: Fama-MacBeth Regressions

This table reports results of the Fama-MacBeth regression of hedge fund next 12-month performance on prime brokers average surcharge. *AvgSurcharge* measures hedge funds' average exposure to capital surcharges on GSIB-affiliated prime brokers. The time period is from January 2016 to November 2021. t-statistics are based on Newey and West (1987) standard errors with 12 lags. $*$, $**$, and $***$ indicate that the coefficients estimated are statistically significant at the 10%, 5%, and 1% level, respectively.

	(1) return	(2) return	(3) alpha	(4) alpha	(5) volatility	(6) volatility	(7) SR	(8) SR	(9) IR	(10) IR
AvgSurcharge	-0.377***	-0.383***	-0.294***	-0.384***	-0.640***	-0.324*	-0.081**	-0.098***	-0.053	-0.086***
	(-5.68)	(-6.26)	(-3.27)	(-4.97)	(-3.90)	(-1.69)	(-2.38)	(-3.19)	(-1.03)	(-2.91)
log_AUM		-0.025		0.018		-0.050*		0.007*		0.011*
		(-1.20)		(0.78)		(-1.70)		(1.72)		(1.89)
log_age		0.056		-0.014		0.581***		-0.023		-0.033*
		(0.92)		(-0.29)		(4.44)		(-0.81)		(-1.87)
ManagementFee		-0.315**		-0.218		-0.782**		-0.006		0.031
		(-2.61)		(-1.39)		(-2.45)		(-0.12)		(0.63)
IncentiveFee		0.018		0.027**		0.069***		0.001		0.003
		(1.07)		(2.16)		(3.72)		(0.15)		(1.10)
LockUpPeriod		-0.002		0.004		0.030***		-0.005***		-0.002
		(-0.20)		(0.65)		(4.06)		(-3.91)		(-1.63)
HighWaterMark		0.320**		0.302**		-0.297		0.094		0.082*
		(2.41)		(2.62)		(-1.06)		(1.62)		(1.81)
PersonalCapital		-0.093		-0.093		0.715**		-0.038		-0.009
		(-0.56)		(-1.17)		(2.61)		(-0.73)		(-0.27)
log_minInvest		0.010		-0.004		0.088		-0.011		0.003
		(0.41)		(-0.09)		(1.20)		(-0.73)		(0.18)
RedemptionNoticePeriod		0.001		-0.001		0.000		0.002**		0.000
		(0.70)		(-0.64)		(0.13)		(2.51)		(1.16)
Style Dummy	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
N	9731	9731	9731	9731	9731	9731	9731	9731	9731	9731
adj. R^2	0.055	0.135	0.065	0.146	0.062	0.242	0.030	0.196	0.050	0.238

Table OA.2: Standardized Average GSIB Surcharge and Hedge Fund Performance: Fama-MacBeth Regressions

This table reports results of the Fama-MacBeth regression of hedge fund next 12-month performance on prime brokers average surcharge. *std.AvgSurcharge* a standardized average surcharge measure, with a mean of zero and standard deviation of one for each month. The time period is from January 2016 to November 2021. t-statistics are based on Newey and West (1987) standard errors with 12 lags. $*$, $**$, and $***$ indicate that the coefficients estimated are statistically significant at the 10%, 5%, and 1% level, respectively.

	(1) return	(2) return	(3) alpha	(4) alpha	(5) volatility	(6) volatility	(7) SR	(8) SR	(9) IR	(10) IR
std. AvgSurcharge	-0.261***	-0.254***	-0.237***	-0.267***	-0.545***	-0.334*	-0.056***	-0.056***	-0.059**	-0.067***
	(-4.46)	(-6.47)	(-4.18)	(-5.18)	(-2.92)	(-1.91)	(-3.39)	(-3.50)	(-2.49)	(-3.74)
log_AUM		-0.025		0.018		-0.050*		0.007*		0.011*
		(-1.20)		(0.78)		(-1.70)		(1.72)		(1.89)
log_age		0.056		-0.014		0.581***		-0.023		-0.033*
		(0.92)		(-0.29)		(4.44)		(-0.81)		(-1.87)
ManagementFee		-0.315**		-0.218		-0.782**		-0.006		0.031
		(-2.61)		(-1.39)		(-2.45)		(-0.12)		(0.63)
IncentiveFee		0.018		0.027**		0.069***		0.001		0.003
		(1.07)		(2.16)		(3.72)		(0.15)		(1.10)
LockUpPeriod		-0.002		0.004		0.030***		-0.005***		-0.002
		(-0.20)		(0.65)		(4.06)		(-3.91)		(-1.63)
HighWaterMark		0.320**		0.302**		-0.297		0.094		0.082*
		(2.41)		(2.62)		(-1.06)		(1.62)		(1.81)
PersonalCapital		-0.093		-0.093		0.715**		-0.038		-0.009
		(-0.56)		(-1.17)		(2.61)		(-0.73)		(-0.27)
log_minInvest		0.010		-0.004		0.088		-0.011		0.003
		(0.41)		(-0.09)		(1.20)		(-0.73)		(0.18)
RedemptionNoticePeriod		0.001		-0.001		0.000		0.002**		0.000
		(0.70)		(-0.64)		(0.13)		(2.51)		(1.16)
Style Dummy	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	9731	9731	9731	9731	9731	9731	9731	9731	9731	9731
Adjusted R^2	0.055	0.135	0.065	0.146	0.062	0.242	0.030	0.196	0.050	0.238

Table OA.3: Panel Regressions of Hedge Fund Performance on Rank-weighted Average GSIB Surcharge Exposure

This table reports the panel regression to examine the effects of hedge funds' average exposure to GSIB surcharges on fund's alpha. Alpha is adjusted by FH seven factors and traded liquidity factor. The dependent variable is hedge funds performance over next 12 months. *WAvgSurcharge* measures hedge funds' rank-based weighted exposure to capital surcharges on GSIB-affiliated prime brokers. The definition of *WAvgSurcharge* can be found in equation (15) of the main text. t-statistics in parenthesis are based on standard errors clustered at fund level. $*$, $**$, and $***$ indicate that the coefficients estimated are statistically significant at the 10%, 5%, and 1% level, respectively. The sample period spans from January 2013 to November 2021.

$$y_{i,t+1,t+12} = \beta_0 + \beta_1 \, WAvgSurcharge_{i,t} + \beta_2^{'} X_{i,t} + \alpha_i + \eta_{s,t} + \varepsilon_{i,t}$$

	(1) return	(2) return	(3) alpha	(4) alpha	(5) volatility	(6) volatility	(7) SR	(8) SR	(9) IR	(10) IR
WAvgSurcharge	-0.316***	-0.300**	-0.355***	-0.295**	-0.578**	-0.568***	-0.069***	-0.054	-0.100***	-0.090**
	(-4.32)	(-2.51)	(-4.67)	(-2.30)	(-2.29)	(-3.68)	(-3.79)	(-1.13)	(-5.35)	(-2.58)
Fund FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Style × Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17500	17483	17500	17483	17500	17483	17500	17483	17500	17483
Adjusted R^2	0.246	0.366	0.137	0.323	0.265	0.737	0.349	0.527	0.239	0.454

Table OA.4: Hedge Fund Performance on Average GSIB Surcharge: Different Surcharge Timing

This table reports the panel regression results for hedge fund performance on the average prime brokers' surcharge. The dependent variable is average excess return or average alpha over 12 months. *Surcharge_ante* uses the surcharge that is announced for next year. *Surcharge_interpolate* uses a linear interpolation for each month with the GSIB surcharge levels for the current and next year. t-statistics in parenthesis are based on standard errors clustered at fund level. $*$, $**$, and $***$ indicate that the coefficients estimated are statistically significant at the 10%, 5%, and 1% level, respectively. The sample period spans from January 2013 to November 2021.

$$y_{i,t+1,t+12} = \beta_0 + \beta_1 AvgSurcharge_{i,t} + \beta_2^{'} X_{i,t} + \alpha_i + \eta_{s,t} + \varepsilon_{i,t}$$

	Anticipated Surcharge		Interpolated Surcharge	
	(1) return	(2) alpha	(3) return	(4) alpha
Surcharge_ante	-0.287**	-0.298**		
	(-2.47)	(-2.41)		
Surcharge_interpolate			-0.290**	-0.297**
			(-2.49)	(-2.40)
Fund FE	Yes	Yes	Yes	Yes
Style × Month FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	17483	17483	17483	17483
Adjusted R^2	0.365	0.324	0.365	0.324

Table OA.5: Hedge Fund Performance on Average GSIB Surcharge: All Sample Result

This table reports the panel regression to examine the effects of hedge funds' average exposure to GSIB surcharges on fund's excess return. The sample include both leveraged hedge funds and un-leveraged hedge funds in the merged sample. The dependent variable is hedge funds performance over next 12 months. *AvgSurcharge* measures hedge funds' average exposure to capital surcharges on GSIB-affiliated prime brokers. t-statistics in parenthesis are based on standard errors clustered at fund level. $*$, $**$, and $***$ indicate that the coefficients estimated are statistically significant at the 10%, 5%, and 1% level, respectively. The sample period spans from January 2013 to November 2021.

$$y_{i,t+1,t+12} = \beta_0 + \beta_1 AvgSurcharge_{i,t} + \beta_2^{'} X_{i,t} + \alpha_i + \eta_{s,t} + \varepsilon_{i,t}$$

Panel A: Average excess return

	(1)	(2)	(3)
AvgSurcharge	-0.312***	-0.317***	-0.290***
	(-4.95)	(-4.90)	(-2.80)
Fund FE	No	No	Yes
Style × Month FE	Yes	Yes	Yes
Controls	No	Yes	Yes
Observations	20811	20811	20794
Adjusted R^2	0.236	0.243	0.371

Panel B: Average alpha

	(1)	(2)	(3)
AvgSurcharge	-0.338***	-0.359***	-0.267**
	(-5.48)	(-5.67)	(-2.47)
Fund FE	No	No	Yes
Style × Month FE	Yes	Yes	Yes
Controls	No	Yes	Yes
Observations	20811	20811	20794
Adjusted R^2	0.126	0.132	0.324

Panel C: Volatility of excess return

	(1)	(2)	(3)
AvgSurcharge	-0.615***	-0.527**	-0.473***
	(-2.59)	(-2.37)	(-3.21)
Fund FE	No	No	Yes
Style × Month FE	Yes	Yes	Yes
Controls	No	Yes	Yes
Observations	20811	20811	20794
Adjusted R^2	0.222	0.253	0.748

Panel D: Sharpe ratio

	(1)	(2)	(3)
AvgSurcharge	-0.067***	-0.077***	-0.072*
	(-4.73)	(-4.90)	(-1.70)
Fund FE	No	No	Yes
Style × Month FE	Yes	Yes	Yes
Controls	No	Yes	Yes
Observations	20811	20811	20794
Adjusted R^2	0.384	0.401	0.583

Panel E: Information ratio

	(1)	(2)	(3)
AvgSurcharge	-0.095***	-0.108***	-0.092***
	(-6.58)	(-6.71)	(-2.87)
Fund FE	No	No	Yes
Style × Month FE	Yes	Yes	Yes
Controls	No	Yes	Yes
Observations	20811	20811	20794
Adjusted R^2	0.301	0.319	0.529

Table OA.6: Hedge Fund Performance on Average GSIB Surcharge: Subsample Analysis

This table reports the panel regression results for hedge fund performance on the average prime brokers' surcharge. The dependent variable is average excess return or average alpha over 12 months. *AvgSurcharge* measures hedge funds' average exposure to capital surcharges on GSIB-affiliated prime brokers. The first two columns use sample from January 2013 to December 2019. Columns (3) and (4) only include hedge funds that are alive in TASS database. t-statistics in parenthesis are based on standard errors clustered at fund level. $*$, $**$, and $***$ indicate that the coefficients estimated are statistically significant at the 10%, 5%, and 1% level, respectively. The sample period spans from January 2013 to November 2021.

$$y_{i,t+1,t+12} = \beta_0 + \beta_1 AvgSurcharge_{i,t} + \beta_2^{'} X_{i,t} + \alpha_i + \eta_{s,t} + \varepsilon_{i,t}$$

	Before COVID-19		Live Hedge Funds	
	(1) return	(2) alpha	(3) return	(4) alpha
AvgSurcharge	-0.355***	-0.481***	-0.351**	-0.354**
	(-3.74)	(-3.92)	(-2.39)	(-2.59)
Fund FE	Yes	Yes	Yes	Yes
Style × Month FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	14072	14072	7854	7854
Adjusted R^2	0.381	0.359	0.325	0.244

Table OA.7: Hedge Fund Performance on Average GSIB Surcharge: Different Time Horizons

This table reports the panel regression results for hedge fund performance on the average prime brokers' surcharge. The dependent variable is average excess return or average alpha over one, three and six months. *AvgSurcharge* measures hedge funds' average exposure to capital surcharges on GSIB-affiliated prime brokers. t-statistics in parenthesis are based on standard errors clustered at fund level. $*$, $**$, and $***$ indicate that the coefficients estimated are statistically significant at the 10%, 5%, and 1% level, respectively. The sample period spans from January 2013 to November 2021.

$$y_{i,t+1,t+h} = \beta_0 + \beta_1 AvgSurcharge_{i,t} + \beta_2' X_{i,t} + \alpha_i + \eta_{s,t} + \varepsilon_{i,t}$$

	1 month		3 month		6 month	
	(1) return	(2) alpha	(3) return	(4) alpha	(5) return	(6) alpha
AvgSurcharge	-0.334***	-0.345***	-0.331***	-0.312**	-0.312***	-0.294**
	(-2.91)	(-2.63)	(-2.82)	(-2.34)	(-2.61)	(-2.19)
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Style × Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17442	17442	17483	17483	17483	17483
Adjusted R^2	0.173	0.074	0.220	0.133	0.278	0.211

Table OA.8: Hedge Fund Performance on Average GSIB Surcharge: Using TASS Snapshot Data

This table reports the panel regression in (8) of the main text with TASS snapshot data. We obtain a one-time fund-level snapshot of prime brokers as of July 2023 from the TASS database. The sample is based on leveraged hedge funds. The dependent variable is average monthly excess return and risk-adjust alpha over 12 months. *AvgSurcharge* measures hedge funds' average exposure to capital surcharges on GSIB-affiliated prime brokers. t-statistics in parenthesis are based on standard errors clustered at fund level. $*$, $**$, and $***$ indicate that the coefficients estimated are statistically significant at the 10%, 5%, and 1% level, respectively. The sample period spans from January 2013 to November 2021.

$$y_{i,t+1,t+12} = \beta_0 + \beta_1 AvgSurcharge_{i,t} + \beta_2^{'} X_{i,t} + \alpha_i + \eta_{s,t} + \varepsilon_{i,t}$$

	(1) return	(2) return	(3) alpha	(4) alpha	(5) volatility	(6) volatility	(7) SR	(8) SR	(9) IR	(10) IR
AvgSurcharge	-0.176***	-0.137*	-0.157***	-0.101	-0.177	-0.313**	-0.050**	-0.021	-0.043**	-0.015
	(-3.51)	(-1.93)	(-3.02)	(-1.31)	(-0.85)	(-2.23)	(-2.36)	(-0.82)	(-2.31)	(-0.64)
Fund FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Style × Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	37506	37406	37506	37406	37506	37406	37506	37406	37506	37406
Adjusted R^2	0.186	0.316	0.105	0.252	0.187	0.732	0.258	0.430	0.199	0.353

Table OA.9: Panel Regressions of Hedge Fund Performance on Average GSIB Surcharge: Heterogeneous Effect on Fund Relative Size

This table reports the panel regression in (9) of the main text to examine how the effects of GSIB surcharge depend on the fund size. The dependent variable is average excess return, average alpha, volatility, sharpe ratio, and information ratio over 12 months. For each prime broker in a given month, we sort its connected hedge funds from large to small based on their AUM, and then get the median hedge fund size for the prime broker. *Large* is a dummy variable that equals one if the fund's size is greater than all respective median fund size of each of its prime brokers. t-statistics in parenthesis are based on standard errors clustered at fund level. $*$, $**$, and $***$ indicate that the coefficients estimated are statistically significant at the 10%, 5%, and 1% level, respectively. The sample period spans from January 2013 to November 2021.

$$\begin{aligned} y_{i,t+1,t+12} &= \beta_0 + \beta_1 AvgSurcharge_{i,t} + \beta_2 AvgSurcharge_{i,t} \times Large_{i,t} \\ &+ \beta_3 Large_{i,t} + \beta_4^{'} X_{i,t} + \alpha_i + \eta_{s,t} + \varepsilon_{i,t}. \end{aligned}$$

	(1) return	(2) alpha	(3) volatility	(4) sharpe	(5) IR
AvgSurcharge	-0.349***	-0.335**	-0.558***	-0.095**	-0.106***
	(-2.94)	(-2.56)	(-3.41)	(-2.08)	(-2.91)
AvgSurcharge × Large	0.144*	0.103	-0.004	0.065**	0.029
	(1.95)	(1.43)	(-0.05)	(2.10)	(1.04)
Large	-0.255**	-0.261**	0.077	-0.094**	-0.064
	(-2.32)	(-2.28)	(0.54)	(-2.01)	(-1.55)
Fund FE	Yes	Yes	Yes	Yes	Yes
Style × Month FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Observations	17483	17483	17483	17483	17483
Adjusted R^2	0.368	0.326	0.737	0.530	0.455

Table OA.10: Hedge Fund Performance on Average GSIB Surcharge: Funds with High Leverage

This table reports the panel regression results for hedge fund performance on average GSIB surcharge exposure. The sample is based on leveraged hedge funds. The dependent variable is average monthly excess return and risk-adjust alpha over 12 months. *leverageHigh* is a dummy which takes one if funds only use physical leverage and employ intensive leverage investment strategies. t-statistics in parenthesis are based on standard errors clustered at fund level. $*$, $**$, and $***$ indicate that the coefficients estimated are statistically significant at the 10%, 5%, and 1% level, respectively. The sample period spans from January 2013 to November 2021.

$$\begin{aligned} y_{i,t+1,t+12} =& \beta_0 + \beta_1 AvgSurcharge_{i,t} + \beta_2 AvgSurcharge_{i,t} \times leverageHigh_i \\ &+ \beta_3^{'} X_{i,t} + \alpha_i + \eta_{s,t} + \varepsilon_{i,t} \end{aligned}$$

	(1) return	(2) return	(3) alpha	(4) alpha
AvgSurcharge	-0.309***	-0.286**	-0.343***	-0.289**
	(-4.26)	(-2.46)	(-4.62)	(-2.34)
AvgSurcharge × leverageHigh	-0.195*	-0.379**	-0.327***	-0.377***
	(-1.87)	(-2.54)	(-2.95)	(-2.98)
Fund FE	No	Yes	No	Yes
Style × Month FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	17500	17483	17500	17483
Adjusted R^2	0.247	0.368	0.140	0.326

Table OA.11: Results for Alpha: Adjusted by Fung and Hsieh and Liquidity Factors

This table reports the panel regression in (8) of the main text to examine the effects of hedge funds' average exposure to GSIB surcharges on fund's alpha. Alpha is adjusted by Fung and Hsieh (2004) seven factors and traded liquidity factor. The dependent variable is hedge funds performance over next 12 months. *AvgSurcharge* measures hedge funds' average exposure to capital surcharges on GSIB-affiliated prime brokers. t-statistics in parenthesis are based on standard errors clustered at fund level. $*$, $**$, and $***$ indicate that the coefficients estimated are statistically significant at the 10%, 5%, and 1% level, respectively. The sample period spans from January 2013 to November 2021.

$$Alpha_{i,t+1,t+12} = \beta_0 + \beta_1 AvgSurcharge_{i,t} + \beta_2' X_{i,t} + \alpha_i + \eta_{s,t} + \varepsilon_{i,t}$$

	Alpha based on FH seven factors and liquidity factor		
	(1)	(2)	(3)
AvgSurcharge	-0.353***	-0.366***	-0.300**
	(-4.61)	(-4.55)	(-2.35)
Fund FE	No	No	Yes
Style × Month FE	Yes	Yes	Yes
Controls	No	Yes	Yes
Observations	17500	17500	17483
Adjusted R^2	0.117	0.125	0.318

Table OA.12: Hedge Fund Performance on Average GSIB Surcharge: Alternative Clustering Schemes

This table reports the panel regression in (8) of the main text with alternative errors clustering schemes. The dependent variable is average monthly excess return, risk-adjust alpha, volatility, Sharpe ratio, and information ratio over 12 months. In Panel A and Panel B we cluster standard errors by fund family level or both fund and month level. In Panel C, the standard errors are estimated by Driscoll and Kraay (1998) standard errors with 12 lags. $*$, $**$, and $***$ indicate that the coefficients estimated are statistically significant at the 10%, 5%, and 1% level, respectively. The sample period spans from January 2013 to November 2021.

$$y_{i,t+1,t+12} = \beta_0 + \beta_1 AvgSurcharge_{i,t} + \beta_2^{'} X_{i,t} + \alpha_i + \eta_{s,t} + \varepsilon_{i,t}$$

Panel A: Cluster by Fund Family Level

	(1) return	(2) return	(3) alpha	(4) alpha	(5) volatility	(6) volatility	(7) SR	(8) SR	(9) IR	(10) IR
AvgSurcharge	-0.313***	-0.293*	-0.349***	-0.297*	-0.565**	-0.558***	-0.077**	-0.069	-0.104***	-0.095**
	(-3.17)	(-1.77)	(-3.74)	(-1.84)	(-2.07)	(-2.76)	(-2.56)	(-1.09)	(-3.83)	(-2.21)
Fund FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Style × Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17500	17483	17500	17483	17500	17483	17500	17483	17500	17483
Adjusted R^2	0.246	0.365	0.136	0.323	0.264	0.737	0.350	0.528	0.240	0.454

Panel B: Cluster by Fund and Month Level

	(1) return	(2) return	(3) alpha	(4) alpha	(5) volatility	(6) volatility	(7) SR	(8) SR	(9) IR	(10) IR
AvgSurcharge	-0.313***	-0.293**	-0.349***	-0.297**	-0.565**	-0.558***	-0.077***	-0.069	-0.104***	-0.095***
	(-4.23)	(-2.44)	(-4.48)	(-2.36)	(-2.32)	(-3.28)	(-3.92)	(-1.51)	(-5.19)	(-2.72)
Fund FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Style × Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17500	17483	17500	17483	17500	17483	17500	17483	17500	17483
Adjusted R^2	0.246	0.365	0.136	0.323	0.264	0.737	0.350	0.528	0.240	0.454

Panel C: Using Discoll-Kraay Standard Errors

	(1) return	(2) return	(3) alpha	(4) alpha	(5) volatility	(6) volatility	(7) SR	(8) SR	(9) IR	(10) IR
AvgSurcharge	-0.313***	-0.293**	-0.349***	-0.297***	-0.565***	-0.558**	-0.0773**	-0.0689	-0.104***	-0.0951***
	(-4.20)	(-2.41)	(-4.32)	(-3.16)	(-2.93)	(-2.05)	(-2.50)	(-1.55)	(-4.10)	(-3.03)
Fund FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Style × Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Driscoll-Kraay SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	17683	17683	17683	17683	17683	17683	17683	17683	17683	17683

Table OA.13: Methodologies for GSIB Surcharge: Method 1 and Method 2

Panel A and panel B show weights assigned to systemic importance indicators used to calculate Method 1 and Method 2 score of each bank. Panel C shows the Method 1 and Method 2 surcharge of each bank as function of its score.

Panel A: Systemic Importance Indicator Weights for Method 1

Category	Systemic Importance Indicator	Weight (%)
Size	Total Exposure	20
Interconnectedness	Intra-financial system assets	6.67
Interconnectedness	Intra-financial system liabilities	6.67
Interconnectedness	Securities outstanding	6.67
Substitutability	Payments activity	6.67
Substitutability	Assets under custody	6.67
Substitutability	Underwritten transactions in debt and equity markets	6.67
Complexity	Notional Amount of OTC derivatives	6.67
Complexity	Trading and AFS securities	6.67
Complexity	Level 3 assets	6.67
Cross-Jurisdiction Activity	Cross-jurisdictional claims	10
Cross-Jurisdiction Activity	Cross-jurisdictional liabilities	10

Panel B: Systemic Importance Indicator Weights for Method 2

Category	Systemic Indicator	Weight (%)
Size	Total Exposure	4.423
Interconnectedness	Intra-financial system assets	12.007
Interconnectedness	Intra-financial system liabilities	12.49
Interconnectedness	Securities outstanding	9.056
Short-term wholesale funding	Short-term wholesale funding score	1
Complexity	Notional Amount of OTC derivatives	0.155
Complexity	Trading and AFS securities	30.169
Complexity	Level 3 assets	16.1177
Cross-Jurisdiction Activity	Cross-jurisdictional claims	9.277
Cross-Jurisdiction Activity	Cross-jurisdictional liabilities	9.926

Panel C: Method 1 and Method 2 score and GSIBs surcharge

Method 1 Score	Surcharge (%)	Method 2 Score	Surcharge (%)
130 or less	0	130 or less	0
130–299	1	130–299	1
230–329	1.5	230–329	1.5
330–429	2	330–429	2
430–529	2.5	430–529	2.5
530 or more	3.5 + 1.0 for each 100 bps above 530	530–629	3
		630–729	3.5
		730–829	4
		830–929	4.5
		930–1029	5
		1030–1129	5.5
		1130 or more	6.5 +0.5 for each100 bps above1130