

The Cost of Leverage: Evidence from Swaps

March 10, 2026

Abstract

The cost of leverage is not a single market price. Using regulatory data on equity total return swaps, I show that leverage costs vary dramatically across assets and dealers, driven by the dealer's hedging strategy. Net long dealers face their own funding cost; net short dealers face the asset's borrowing cost. Internal netting of opposing trades creates a cross-subsidy: inventory-reducing trades earn discounts of 8–14 basis points. A quasi-natural experiment—Credit Suisse's exit from prime brokerage—demonstrates that losing one dealer raised leverage costs on affected securities by 66 basis points, 194% of the unconditional mean.

Keywords: Leverage cost, total return swaps, intermediation

JEL Classification: G12, G14, G24

1 Introduction

The cost of leverage is central to the trading strategies of sophisticated investors, yet it is routinely treated as uniform across assets and approximated with aggregate proxies such as leveraged fund returns or credit spreads.¹ This paper overturns that assumption. Using novel regulatory data on equity total return swaps (TRS), I demonstrate that the cost of leverage varies dramatically across assets and—more surprisingly—across the dealers who supply it.² The underlying mechanism is the dealer’s hedging strategy. When a dealer’s book is net long an asset, her marginal hedging cost is her own funding cost; when net short, it is the asset-specific short-sale cost. This creates a powerful incentive to internally match opposing client trades, generating a cross-subsidy in which traders on the minority side of the dealer’s book face significantly lower leverage costs.

I formalize this mechanism in a model of dealer pricing and hedging. Traders choose between swap contracts and margin loans. The dealer, facing inventory-holding costs, sets spreads that satisfy traders’ participation constraints while managing her net exposure. Internal matching is strictly preferable to spot-market hedging: it avoids both the capital cost of carrying a hedging position and the transaction costs and slippage of spot trading. The model yields two sharp, testable predictions. First, swap spreads exhibit a discontinuity at the point where a dealer’s net position crosses zero—reflecting the discrete shift in marginal hedging cost. Second, dealers offer substantial spread discounts, including negative spreads, to attract trades that reduce inventory risk. Traders on the “majority” side of the dealer’s book thus subsidize “minority” traders, whose positions serve as an internal hedge.

I test these predictions using newly available U.S. regulatory filings (N-PORT) that provide position-level data on swap contracts, including notional amounts, spreads, and—

¹See, for example, Tang and Xu 2013; Frazzini and Pedersen 2021; Lu and Qin 2021.

²Variation in short selling costs has been widely documented (see, for example, Geczy et al. 2002; Kolasinski et al. 2013), but the cost of leverage for long positions has been considered constant in the cross section of stocks.

critically—dealer identity. These data allow me to reconstruct each dealer’s net position in every underlying security and directly observe the spreads charged. This represents a significant advance over prior work that infers leverage costs from fund-level returns and can therefore only estimate fund-level or market-average costs.³ My approach delivers asset-level leverage costs and reveals how they vary with dealer-level dynamics.

The data strongly support the model. Swap spreads exhibit a sharp discontinuity when a dealer’s net exposure crosses zero, consistent with a shift in the marginal hedging cost. When dealers hold positive net exposure, traders seeking long (short) positions face leverage costs 14 (8) basis points higher (lower) than when dealers hold negative net exposure. Trades that reduce a dealer’s inventory are priced 6–8 basis points lower—a discount of 19–29%—confirming that dealers actively subsidize offsetting trades. Dealers’ residual exposure varies nearly one-to-one with their 13F holdings, consistent with full hedging of unmatched inventory in the spot market.

To establish causality on the effect of competition on leverage costs, I exploit Credit Suisse’s abrupt 2021 exit from the prime brokerage market following the Archegos collapse. On securities where Credit Suisse had intermediated swaps, leverage costs rose by up to 66 basis points—194% of the unconditional average—relative to unaffected securities.⁴ This effect exceeds estimates from the more interconnected CDS market, highlighting how the TRS market’s bilateral structure—characterized by virtually no interdealer trading—amplifies dealer market power.⁵

The paper makes three contributions. First, it advances the understanding of leverage costs by moving from aggregate time-series analysis to a micro-founded, cross-sectional explanation. I show that leverage costs are determined at the dealer-asset level by a specific hedging mechanism. While Brunnermeier and Pedersen (2008) and Gârleanu and Pedersen

³See, for example, Lu and Qin (2021).

⁴Eisfeldt et al. (2022) finds that CDS spreads increased by 8–24% following Lehman Brothers’ collapse.

⁵Directional net exposure in this case refers to the net exposure being either positive or negative, not the (absolute value) of the magnitude of the exposure.

(2011) demonstrate that funding costs matter for asset pricing in the aggregate, this paper identifies the *mechanism* by which the dealer’s hedging strategy determines whether the binding cost is dealer-specific funding or asset-specific short-sale costs. A direct implication is that traders can reduce leverage costs by selecting dealers with opposing net exposure.

Second, the paper contributes to the literature on OTC market structure by documenting how the near-absence of interdealer trading in the equity TRS market insulates dealers and sustains significant price dispersion and market power. This work extends the classical inventory management tradition of Garman (1976), Amihud and Mendelson (1980), and Ho and Stoll (1981), which establish that dealers set spreads to control inventory; here, we test this framework directly using observed swap spreads rather than bid-ask spreads, providing the first direct test in the swap market. This is in contrast to the CDS (see Collin-Dufresne et al. 2020; Eisfeldt et al. 2022), bond (see Di Maggio et al. 2017; Li and Schürhoff 2019; Shen et al. 2021), or securitization (see Hollifield et al. (2017)) markets, which are characterized by intermediation chains or hub-and-spoke structures. The theoretical framework differs in this aspect from, for example, Colliard et al. (2021), where dealers trade with each other to reduce the inventory holding cost.

Third, the paper contributes to derivatives pricing by providing a tractable framework and direct empirical evidence linking dealer balance-sheet costs to the prices investors face. Fleckenstein and Longstaff (2020) show that intermediaries’ marginal balance-sheet cost drives derivatives pricing through what is effectively balance-sheet rental. Lou (2023) develops a TRS pricing model demonstrating that asymmetric discount rates between buyer and seller create gains from trade. This paper complements both by identifying the dealer-level hedging mechanism that determines which balance-sheet cost is priced into any given swap.

2 Total Return Swaps

2.1 Uses of TRS contracts

Most securities, whether they are single stocks or stock indices, that underlie total return swaps have spot market alternatives that traders can use to gain exposure.⁶ There are, however, three broad reasons why traders might instead use TRS contracts: to gain leverage, to circumvent leverage restrictions, or to avoid disclosure requirements.

First, a TRS contract allows traders to gain exposure to some desired notional amount of the underlying asset while requiring them to post only a small amount of collateral with the counterparty. This feature avoids Regulation T margin limits. Traders can gain leverage far greater than the Regulation T 2x limit or the Options Clearing Corporation's (OCC) portfolio margin limits using swaps: A TRS contract may require no initial capital outlay from either party as long as they are reasonable creditworthy and any gains and cashflows are settled on a daily basis.⁷ In the case of Credit Suisse and Archegos (discussed in detail in Section 8 of this paper), the swap dealer only required 7.5% margin, effectively allowing the trader a more than 13-to-1 leverage ratio, although a more typical collateralization level is about 20% for U.S. equities.⁸

Second, mutual funds are generally limited in their capacity to take outright leverage to trade. To circumvent this restriction, they can enter TRS contracts with dealers, as these are considered normal derivatives positions and not direct leverage.

Third, informed traders may prefer TRS contracts over direct investments in the target company, as swaps, the resulting exposure, and the effective control are not disclosed in 13F institutional holdings reports, and were not required in 13D activist investor filings with the

⁶A swap, naturally, needs a reference asset or index, but indexes cannot be directly traded and might not have index futures. Indexes may, however, be tracked by liquid and easily tradeable ETFs.

⁷This is also apparent from the existence of 3x/-3x leveraged ETFs, which almost without exception achieve their leverage through total return swaps.

⁸Credit Suisse (2021b).

SEC until late 2023. In fact, in 2008, the SEC explicitly advised that total return swaps did not need to be disclosed in 13D filings⁹ but changed this guidance in 2023 following the collapse of Archegos.¹⁰ This exposure-without-disclosure aspect of TRS has been exploited by, e.g., Shaeffler AG in its takeover of Continental in 2008, in which it had entered TRS contracts with Merrill Lynch giving it effective control over 28% of Continental's shares.¹¹ Similarly, in the U.S., The Children's Investment Fund used TRS contracts in its proxy battle with CSX Corporation.¹²

2.2 Structure and function of TRS

In a total return swap, the swap buyer will receive the return of a reference asset, e.g. a stock or stock market index, and pay the swap seller (typically a large investment bank or broker-dealer) some benchmark interest rate (typically SOFR, the overnight bank financing rate, or the one-month Treasury yield) and a swap spread. The swaps have a zero value at the onset and often require minimal initial collateral to be posted, although they are most often subject to periodic variation margin adjustments. In effect, the swap buyer will receive the returns of the reference asset in exchange for the return of a fixed income asset.

As an example, a swap buyer might receive the return of the S&P 500 Index on a notional of \$50 million and pay SOFR + 45 basis points. If the asset increases in value, the swap buyer will receive the return net of the fixed income return; if the asset decreases in value, she will pay the swap seller the negative return of the asset in addition to the fixed income return.

Symmetrically, a trader who seeks a short position on a reference asset will *receive* the

⁹<https://corpgov.law.harvard.edu/wp-content/uploads/2008/06/sec-staff-advises-that-13d-disclosure-requirements-do-not-extend-to-total-return-equity-swaps.pdf>

¹⁰<https://www.sec.gov/news/press-release/2023-219>.

¹¹Pütz and Berwin 2008; Saltmarsh 2008

¹²Although The Children's Investment Fund was later found to be in violation of disclosure requirements relating to its swap position, the U.S. District Court declined to take a stance on more broadly requiring disclosure of such contracts in 13D and other filings. See Solomon (2011).

fixed income return (benchmark and the spread) plus the *negative* returns of the reference asset. Crucially, the spread may be negative.

Swaps are thus economically equivalent to levered positions in the reference asset. A long swap position corresponds to a levered position in the reference security, for which the trader would pay a margin loan rate, and a short swap position corresponds to a short sale, reinvestment of the short sale proceeds, and payment of a short selling or stock loan fee on the reference asset.

This gives the intuition for the dealer's hedging strategy. A dealer can replicate the cash flows to the swap buyer by borrowing money and investing in the reference security or basket. The dealer's profit from the swap thus comes from the spread she charges the trader. Similarly, if the dealer enters a short TRS with a trader, she can hedge it by short selling the security and investing the proceeds at the risk-free rate. Importantly, the efficiency of any swap trade increases from the dealer's perspective if she can find two traders seeking opposite exposure to the same asset: In this case, the dealer acts as an intermediary, transferring returns from one investor to the other, while capturing a spread without having to hedge the transactions individually in the spot market.

Goodman and Fabozzi (2005) provide a survey of different swaps and their functioning.

3 Theoretical framework

3.1 Swaps and alternative trades

In this section, I present and discuss a model for pricing equity TRS contracts. The key insight is that the contracts are economically equivalent to leveraged positions in the reference asset. As a result, traders enter into swap contracts if they provide some advantage over alternative ways to gain an equivalent exposure, e.g. leveraged trades in spot markets.

A trader that enters into a long swap contract with a dealer will receive the return R of

the reference asset, and pay the baseline fixed rate r plus a swap spread s_L . Alternatively, the trader could take a margin loan at a cost of $r + x_L$ (baseline rate plus the trader's credit spread).

The long trader will thus prefer a swap contract over a spot trade if

$$s_L \leq x_L \tag{1}$$

where (1) represents the incentive compatibility constraint that swaps are more advantageous than the spot markets.

A trader seeking a short position can enter into a short swap at a cost of $-r + s_S$, where s_S represents the spread the trades pays the dealer. This is akin to a short position in the spot market, which carries a cost of $-r + c_S$, where c_S represents the short selling cost of the asset, and $-r$ represents the income from reinvesting the short sale proceeds at the risk-free rate.¹³

The short trader will thus enter into a swap contract if

$$s_S \leq c_S \tag{2}$$

where (2) represents incentive compatibility with spot markets.

3.2 Hedging and pricing swaps

Next, I model the choices for a dealer who can face demand for both long and short swaps and chooses how and how much of the exposure she hedges.

In a long (short) TRS, a trader will contract with a dealer to receive (deliver) the return R of a specified asset or index on a nominal amount N on the swap expiry date and deliver

¹³The spread s_S can be negative, in which case the dealer *pays* a spread rather than receiving one. Expressing both the long and the short spreads as costs that the trader pays makes for more consistent and intuitive interpretation.

(receive) a pre-defined interest rate r on that same nominal N . The dealer will charge spreads s_L and s_S on long and short swaps, respectively. The dealer can hedge the exposure by taking a long (short) position in the reference asset and earn a profit equal to the spread net of her hedging costs. The profit of a dealer that has nominal amounts N_L and N_S of long and short swap exposure and takes hedging positions of H_L and H_S is thus:

$$\begin{aligned}\Pi = & -N_L \times (R - (r + s_L)) + H_L \times ((1 + R) - (1 + r + c_L)) \\ & + N_S \times (R - (r - s_S)) - H_S \times ((1 + R + c_S) - (1 + r)),\end{aligned}\tag{3}$$

where s_L and s_S are the spreads the dealer charges for long and short swaps, and c_L and c_S are the financing costs for long and short swap hedging, respectively. Importantly, as the dealer hedges a long swap by *borrowing* cash, c_L is the dealer's credit spread over the risk-free rate, i.e., their financing cost; c_S is the asset-specific short-selling or security borrowing cost.

The first line of Equation 3 shows the dealer's profit from selling N_L units of long swaps at a spread s_L and hedging H_L units at a cost of c_L . The second line of the equation shows the dealer's profit from selling N_S units of short swaps at a spread of s_S and hedging H_S units at a cost of c_S . The profit is expressed in terms of spreads that the dealer receives, as opposed to expressing the spread on the short swap leg as a spread that the dealer pays to her counterparty. The spreads s_L and s_S can be negative, in which case the dealer would pay the trader to take the position. N_L and N_S denote the total notional of long and short swap contracts, respectively, and H_L and H_S denote the dealer's hedging positions in the reference asset.

Assume that the dealer is risk neutral and sets swap spreads to maximize profit subject to traders' participation constraints. Also assume that the dealer bears a cost γP^2 for holding a net position $P = (H_L - N_L) - (H_S - N_S)$ in the reference asset. The dealer maximizes the objective function $O(H_L, H_S)$ with respect to the hedging amount H_L and H_S for long and

short swaps:

$$O(H_L, H_S) = \Pi - \gamma P^2, \text{ subject to} \quad (4)$$

$$P = (H_L - N_L) - (H_S - N_S), \quad (5)$$

$$H_L \geq 0, H_S \geq 0 \quad (6)$$

The quadratic inventory cost γP^2 has standard microstructure microfoundations. Under the assumption that dealers are risk-averse and face normally distributed returns on the reference asset, inventory holding costs arise from the variance of the dealer's position. Specifically, if the variance of returns is σ^2 , the variance of a position of size P is $P^2\sigma^2$. A risk-averse dealer with risk aversion parameter ρ will value this risk at $\frac{1}{2}\rho\sigma^2P^2$, providing the coefficient $\gamma = \frac{1}{2}\rho\sigma^2$ (Stoll 1978; Ho and Stoll 1981; Hendershott and Menkveld 2014). Importantly, this derivation shows that risk neutrality with a quadratic penalty is mathematically equivalent to risk aversion with mean-variance preferences. A key special case is the limit $\gamma \rightarrow \infty$, which represents the empirically relevant case where dealers target zero net exposure. This is consistent with survey evidence on dealer behavior and regulatory constraints such as the Basel III leverage ratio, which effectively impose a binding constraint on dealer net positions. From this, two possible outcomes arise depending on the dealer's net exposure $N_L - N_S$:

1. $N_L - N_S > 0$: $H_{L+}^* = N_L - N_S + \frac{E(R)-r-c_L}{2\gamma}$, and $H_{S+}^* = 0$.
2. $N_L - N_S < 0$: $H_{L-}^* = 0$, and $H_{S-}^* = N_S - N_L - \frac{E(R)-r-c_S}{2\gamma}$.

When $N_L = N_S$, the dealer is perfectly internally hedged with $H_L^* = H_S^* = 0$, and both hedging regimes yield identical predictions.

If the dealer's penalty from holding a non-zero exposure P against the swap asset is sufficiently high ($\gamma \rightarrow \infty$), the expressions for non-zero hedging simplify to $H_{L+}^* = N_L - N_S$ and $H_{S-}^* = N_S - N_L$: The dealer matches long and short trades internally, and hedges the

residual exposure fully. Formally, this is equivalent to the dealer having a binding constraint on the net position: $P = (H_L - N_L) - (H_S - N_S) = 0$.¹⁴

The intuition for this hedging strategy is simple: when a dealer has larger long swap exposure than short swap exposure, all of her *short* exposure effectively contributes to hedging her long swaps. The long swaps, however, are not fully hedged, and the dealer needs to hedge the remaining unmatched exposure $N_L - N_S$ in the spot market.

Given these outcomes, s_L and s_S can be solved by finding the value that makes the marginal profit for an additional unit of exposure of long and short swaps (N_L, N_S) weakly greater than zero. This yields:

$$\text{When } N_L - N_S > 0 : s_L \geq c_L \text{ and } s_S \geq -c_L. \quad (7)$$

$$\text{When } N_L - N_S < 0 : s_L \geq -c_S \text{ and } s_S \geq c_S. \quad (8)$$

This reveals that the (minimum) swap spreads depend on the dealer's exposure to the asset: If the dealer has net long exposure to the asset the spread is *dealer specific* and depends on the dealer's financing cost (Equation 7). If, instead, the dealer has net short exposure the dealer needs to short sell the underlying asset to hedge, and the spread will be *asset specific* and depend on its short-selling cost (Equation 8).

When $N_L = N_S$, both regimes coincide: $s_L \geq c_L$ and $s_S \geq c_S$ if the dealer's next marginal trade determines the hedging regime.

¹⁴Most broker-dealer banks act as intermediaries and aim to hold no directional exposure.

3.3 Equilibrium

If the dealer faces positive net swap demand $N_L - N_S > 0$, the equilibrium outcome combines the trader's (Equation (1)) and the dealer's (Equation (7)) participation constraints to yield:

$$c_L \leq s_L \leq x_L \quad (9)$$

$$-c_L \leq s_S \leq c_S. \quad (10)$$

Equation 9 shows that the spread and leverage cost on long positions must be greater than the dealer's and less than the trader's funding costs, i.e. the existence of trade hinges on the dealer being able to hedge at a lower cost than the trader's cost to take a leveraged position in the spot market. Similarly, Equation 10 shows that short traders will enter into swaps if the swap spread is lower than the short selling cost, and the dealer will sell these swaps as long as the spread is above the negative of her funding cost (i.e. her marginal hedging cost), as the short swap will offset the need to hedge in the spot market.

If the swap dealer faces a net negative demand for swaps $N_L - N_S < 0$, the equilibrium spreads will satisfy:

$$-c_S \leq s_L \leq x_L \quad (11)$$

$$c_S \leq s_S \leq c_S \longrightarrow s_S = c_S \quad (12)$$

In this case, the spread on short swaps equals the short selling cost of the reference asset irrespective of the competitive nature of the market (Equation (12)). The dealer will, in essence, make a zero economic profit on the short leg of the trade. The dealer's profit in this case comes from charging traders seeking long exposure a spread that exceeds the negative of the short selling cost, i.e. the marginal hedging costs. To satisfy the trader's participation constraint, the spread must also be lower than her funding cost.

Figure 1 illustrates the equilibrium spreads for long (Panel (a)) and short (Panel (b))

swaps. Long swaps always have a ceiling spread equal to the trader's credit spread x_L , but the floor spread is lower when the dealer faces negative net exposure: in this case, the dealer is willing to charge a *negative* spread as low as $-c_S$, equal to the short selling cost, i.e. her marginal hedging cost. When the dealer faces a positive net exposure, the floor spread on long swaps is equal to the dealer's own marginal funding cost c_L . A similar observation can be made for short swaps: When the dealer faces a negative net exposure to an asset, she must hedge by short selling. However, the trader faces the same short selling cost as the dealer. As a result the only swap spread that satisfies both the dealer's and the short seller's participation constraints is the asset's short selling cost, c_S . When the dealer faces net positive exposure, she is willing to charge the short seller a negative fee equal to her marginal hedging cost $-c_L$: this is the floor spread for swaps when the dealer has positive net exposure.

If the dealer and the trader split the surplus in a Nash bargaining setting with relatively equal bargaining power (or Bertrand competition in the case of multiple dealers, see Section 3.4 below), the observed spreads on swaps will exhibit a discontinuous step when the dealer's net exposure crosses zero: spreads and the leverage cost on long positions will increase, and the cost of short positions will decrease when the dealer's net exposure changes from negative to positive.

3.4 Multiple dealers

The baseline pricing model discussed above describes a single dealer's hedging and pricing strategy in the TRS market. Since total return swaps on a given asset are, in essence, commoditized products we can consider Bertrand price competition to estimate the equilibrium price when more than one dealer is present.

Following this logic, swap spreads should tend toward competitive pricing when competition between dealers in the swap market for a given asset increases. An important caveat to

this notion is that when dealers do not face the same marginal cost of production, the price should tend toward that of the second-lowest-cost producer(s), with the lowest-cost dealer(s) charging $\bar{c}_L - \epsilon$, where $\bar{c}_L$ is the credit spread of the second-lowest cost dealer(s). In this case, low-cost dealers would capture the entire market. However, a constraint to this could arise from, e.g. traders setting limits to their exposure against individual counterparties.

4 Hypotheses

The framework presented above describes how a dealer would hedge demand for TRS, and how a trader chooses between a TRS trade and an alternative in the spot markets. These choices establish bounds for the TRS spread, which measures the cost of leverage for traders: The spread must be high enough so that the dealer at least breaks even, but lower than the next-best alternative asset the trader can access.

This yields several empirical predictions. First, swap spreads will exhibit a discontinuity when the dealer's net exposure to the asset switches from negative to positive:

Hypothesis 1 *Swap spreads will exhibit a discontinuity at 0 net swap exposure, with a step up in long swap spreads and a step down in short swap spreads at 0.*

This arises from the dealer's hedging strategy, where the dealer will short sell the asset to hedge any negative exposure, but must buy to hedge any positive exposure. The dealer seeks to attract more swap traders on the smaller trade leg, so she may even offer negative spreads, as shown in Equation (10) for short positions and Equation (11) for long positions.

This shows that the cost of leverage depends on the dealer's net position. Additionally, the cost of leverage can be negative if there is substantial volume trading in the opposite direction: When short positions are larger than long positions, the dealer may offer very low spreads for long traders.¹⁵

¹⁵Symmetrically, the cost of short selling using swaps, i.e. the spreads s_S on short swaps, may be negative if there is little demand for short swap positions relative to long positions.

This yields the following hypothesis:

Hypothesis 2 *The cost of leverage depends on a dealer's net exposure, and can be negative when there is a substantial trade imbalance.*

In essence, Hypothesis 2 states that a dealer will charge lower (higher) spreads on new transactions that help net out (increase) their exposure, thus driving the leverage cost for the smaller trade leg.

Since the dealer will seek to hold a net zero position against the underlying, the model yields a prediction on dealer hedging:

Hypothesis 3 *A dealer's total hedging $H_T = H_L - H_S$ will be proportional to their net exposure: $H_T = N_L - N_S$.*

In other words, a dealer will buy the asset in the amount of their net exposure and short sell it to that amount if the net exposure is negative. This relationship links dealers' swap exposure to their holdings of the underlying asset: Dealers with large long exposure will hold larger positions in the underlying security.

5 Data

I obtain portfolio holdings data for all U.S. mutual funds and ETFs from regulatory filings that the funds must submit to the Securities and Exchange Commission. The N-PART filings identify all outstanding swap positions held by the funds. Importantly, the data includes the swap spreads, reference rates, notional amounts, and counterparties (dealers). The spreads enable me to directly measure the cost of leverage for traders. This is an improvement over previously used measures for leverage costs or tightness of leverage constraints such as the deviation of the return between the leveraged fund return and the leverage-adjusted

index return (Lu and Qin 2021; Frazzini and Pedersen 2021), the TED spread (Frazzini and Pedersen 2014), margin debt over market capitalization (Asness et al. (2020)), etc.

The N-PORT filings identify dealers by name and legal entity identifier (LEI). I map each dealer’s LEI to the parent company using the LEI mapping file available from the Global Legal Entity Identifier Foundation (GLEIF).¹⁶

The N-PORT sample consists of 211,560 total return swap positions between 820 funds and 41 swap dealers (identified at the parent company level) on 10,500 unique assets from the fourth quarter of 2019 to the second quarter of 2024. These match into 18,233 unique dealer-asset pairs and 89,510 quarterly dealer-asset observations. In 14,421 dealer-asset quarters, the dealer has exposure to both sides of the trade, whereas dealers have exposure only to the long (short) leg in 39,295 (35,716) cases. I exclude volatility and variance swaps from the sample.

It is important to acknowledge that N-PORT covers only registered investment companies (mutual funds and exchange-traded funds). The sample does not include hedge funds, family offices, or proprietary trading desks, which may also be significant users of leveraged swaps. Notably, Archegos Capital, which is central to the natural experiment in this paper, was a family office and thus not present in these data. This means the sample likely understates total swap market activity and may not capture the most aggressive leverage users. However, the pricing mechanism tested in this paper depends on dealer hedging costs, not trader identity. The dealer’s decision to offer lower spreads on trades that offset their inventory should apply across trader types, even if the cross-section of traders differs. Thus, while the sample provides a representative view of one major segment of the swap market (mutual funds and ETFs), the model’s predictions about the relationship between dealer exposure and pricing should generalize more broadly.

I collect N-CEN filings, which provide descriptive information about U.S. mutual funds,

¹⁶The GLEIF file that identifies company-parent-ultimate parent relationships is available at <https://www.gleif.org/en/lei-data/gleif-golden-copy/download-the-golden-copy/>.

as well as the 13F Institutional Holdings reports directly from the SEC. The latter enable me to match a dealer’s holdings in a given swap reference asset to her swap exposure. Dealers’ asset holdings are often submitted in so-called combination filings, which report the holdings at the parent or holding company level. The raw filings at the SEC enable me to map dealer names to the holding company-level 13F reports through the “List of Other Included Managers” in each filing.¹⁷

I obtain credit spreads for a subset of swap dealers from LSEG Data and Analytics (formerly Refinitiv) to proxy for dealers’ financing costs. I use the Markit Securities Finance data to estimate short-selling fees for each underlying security that can be identified by a CUSIP identifier. The Markit sample spans 2019 to 2021.

Table 1 presents descriptive statistics at the broker-asset level. Most dealers hold relatively close to zero net notional exposure against the swap reference asset: While the average net notional held by a dealer is \$17.27 million, the median is only ten thousand dollars. The 10th and 90th percentiles are -\$2.08 million and \$8.29 million, respectively; the distribution of notional exposure is highly right skewed. Similar patterns can be observed for long and short notional exposures.

Two observations can be made from the distribution of dealers’ net exposure. First, the average and median are both close to zero, indicating that dealers hold relatively equal long and short exposure and consistent with them aiming to match order internally. Second, the distribution is right skewed, with some dealers having large positive net exposure. This is consistent with the long swap exposure typically being larger.

A similar conclusion can be drawn from Figure 2 Panel (a), which plots dealer-asset level net notional exposure against market aggregate net notional in the asset. Most dealer-asset observations are close to zero on the horizontal axis, i.e. close to zero net notional across all dealers. The figure also shows that most dealers’ net exposure corresponds directionally to

¹⁷For example, neither *J.P. Morgan Securities LLC* nor *JPMorgan Chase Bank, N.A.* directly report their holdings; instead, the two dealers’ institutional holdings are reported by *JPMORGAN CHASE & CO.*

the market aggregate exposure: Few dealers hold a negative (positive) net swap exposure in an asset if the market aggregate swap exposure is positive (negative).¹⁸

This highlights the absence of interdealer trade where dealers would seek to trade with other dealers in a way to offset their exposure. This, in turn, would require there to be dealers with opposite directional exposures before the interdealer trade, and some dealer would as a result be able to bring her own net exposure (closer) to zero by trading with dealers that hold the opposite directional exposure. Since two dealers with positive (negative) exposure cannot realize hedging gains by trading with each other, the fact that dealers nearly always have the same directional exposure indicates that there is very little room for interdealer trading.

Figure 2 Panel (b) plots dealers' long and short notional against the total long notional in the market. The figure provides two observations: First, a substantial proportion of dealers have both long and short exposure. Second, despite many dealers having exposure in both directions, the long exposure generally dominates in magnitude, and most dealer-asset pairs with zero net notional exposure occur at relatively low directional exposures.

Dealers receive average long (short) swap spreads of 0.27% (0.34%). Notably, dealers earn positive spreads on both long and short swaps on average.

The number of outstanding swap trades for a dealer in a given asset is very similar for both long (1.21) and short (1.16) swaps. Moreover, the distribution of the number of trades is very similar (compare the 10th, 50th, and 90th percentiles) between the two trade legs.

¹⁸This is clear from the locations of most observations in the top-right and bottom-left quadrants of the figure.

6 Swap spreads and dealer inventory

6.1 Dealer net exposure

This section presents the main finding of the paper. I show that there is wide heterogeneity in the leverage cost that traders face at the asset- and dealer levels. When the dealer has a negative net exposure to swaps, she hedges by short selling the asset, subjecting her to the asset-specific short selling cost. However, she can avoid this cost if she can offset the short swap exposure by long swap contracts with other counterparties, i.e. internally hedging. Due to this, she is willing to offer the long swap traders a lower, even negative, spread up to the short selling cost of the asset.¹⁹

Symmetrically, when the dealer has a net positive exposure to swaps, she hedges by buying the reference asset, bearing her own funding cost. She can, again, avoid this by entering into offsetting short swap trades. Offsetting short swaps are preferable from the dealer's perspective as long as the cost is lower than hedging in the spot market. As a result, the dealer is willing to pay short swap traders a spread that is less or equal to her own funding cost. The dealer may, in short, be willing to offer short traders a negative spread equal to her funding cost.

This illustrates how the dealer's marginal cost of hedging gives rise to cross-subsidization between traders: the trader on the smaller side of the trade will face a lower leverage cost when the dealer matches the trades internally compared to when the dealer hedges the trades individually in the spot market.

Figure 3 shows this graphically. The figure plots average swap spreads against normalized dealer net notional. Long swap spreads increase by approximately 14 basis points when the dealer moves from a net negative to a net positive exposure against the asset. Short swap spreads decrease by 8-10 basis points. This aligns with the model, which predicts a

¹⁹In contrast, a marginal unit of short swap demand has to be hedged by a marginal unit of short selling, so the spread on short swaps must be at least the short selling cost of the asset.

discontinuity in spreads for both long and short swaps when the dealer’s hedging strategy changes from short selling to buying the asset (when the dealer moves from a net short to a net long exposure). The predictions are summarized graphically in Figure 1. Spreads on long (short) swaps display a discontinuous increase (decrease) when dealers’ net exposure changes from negative to positive.

To formally test Hypothesis 1, I regress average swap spreads on an indicator variable that is equal to one if the dealer’s net notional exposure to a given asset is positive (and is zero otherwise):

$$spread_{d,a,t} = \alpha + \beta_1 \times \mathbb{1}_{N>0,d,a,t} + X_{d,t}, \quad (13)$$

where $X_{d,t}$ is a vector of dealer and time fixed effects. Table 2 presents the results. Specifications (1)–(2) show the baseline results for long and short swap spreads, respectively. The spread on long swaps, i.e. the leverage cost for long traders, increases by 13.9 basis points when the dealer’s switches from net short to net long exposure, while the spreads on short positions decrease by 10.5 basis points. In both cases, the change is substantial, with swap spreads nearly doubling when the swaps change from providing hedging to having to be hedged directly. The result is robust to including calendar quarter and dealer-quarter fixed effects in Specifications (3)–(4) and (5)–(6), respectively. Importantly, Specifications (5)–(6) show that the threshold effect remains even within a dealer-quarter, i.e. dealers charge different spreads depending on the net exposure they hold at the asset level.

6.2 Cost of leverage and competition

Hypothesis 1 of the model predicts that the competitive level of spreads depends on a dealer’s financing cost when the dealer’s net exposure is positive, and depends on the short-selling cost of the swap reference asset when her net exposure is negative. As a result, swap spreads should be mostly explained by dealer-level explanatory variables when the dealer holds a

positive net notional on a given asset and mostly explained by asset-level variation when the dealer faces a negative net notional.

However, the connection between the dealer’s financing and short-selling costs and the swap spread is tight only when the dealer sets the spread at the competitive level, i.e., when the dealer cannot extract monopoly rents in the market. In contrast, if a dealer faces low competition, she will be able to set the spreads at higher levels closer to the participation constraint of the trader. In this case, i.e. when the dealer has more pricing power, observed swap spreads are less likely to respond to changes in credit spreads or short selling costs. The exception to this is the spread on short swap positions when the dealer has a negative net notional exposure: in this situation, the dealer’s marginal cost is equal to the trader’s participation constraint – the short selling cost – and spread sensitivity to short selling costs should be independent of competition.

To test Hypothesis 1, I compute the Herfindahl-Hirschman index (HHI) for dealer competition for each asset-quarter based on the total gross notional outstanding for each asset in a given quarter, and generate an indicator variable for high competition that is equal to one if HHI is below the median for any asset-quarter observation with more than one dealer. I additionally add all asset-quarter observations with only one dealer to the “high HHI” group. I then regress swap spreads on dealers’ six-month credit default swap (CDS) spreads and the short-selling cost for each security and the interactions with the high-competition indicator variable as well as a vector of fixed effects:

$$spread_{d,a,t} = \beta_1 Cost_{d/a,t} + \beta_2 Cost_{d/a,t} \times \mathbb{1}_{\text{High competition},a} + X_{d,a,t}, \quad (14)$$

where $Cost_{d/a,t}$ is either the dealer’s CDS spread (for dealer-asset observations with positive net notional exposure) or the short selling cost (for dealer-asset observations with negative net notional exposure). Each specification includes a Dealer $\times$ Stock fixed effect. Specifications (1)-(2) also include Stock $\times$ Quarter fixed effects to capture any time-varying stock

level effects, including stock-level short selling costs. Specifications (3)-(4) include Dealer $\times$ Quarter fixed fixed to capture time-varying dealer effects, including dealer CDS spread. The reported coefficients this identify the variation of interest, i.e. the effect of dealer funding costs when the dealer has a positive net exposure, and stock-level short selling costs when the dealer has a negative exposure.

Table 3 presents the results. Neither long nor short swap spreads respond to changes in the CDS spread when the dealer has a positive net notional exposure and holds high market power, consistent with dealers being able to price the trades at levels closer to traders' participation constraint (see Figure 1 and Section 3.3). In contrast, when dealers face high competition (i.e. have low pricing power), spreads on long swaps react strongly to changes in dealer's funding costs: when the dealer's funding cost increases by 1%, long swap spreads increase by 0.368%. Spreads on short swaps do not respond to changes in CDS spreads in either situation.

Specifications (3) and (4) study how swap spreads react to changes in the stock borrowing fee when the dealer has a negative net exposure to the asset through swaps. Specification (3) shows that the spread on long swaps does not change with the stock borrowing fee when there is little competition in the market. In contrast, when dealers face high competition, spreads on long swaps decrease with the stock borrowing fee, in line with the model although the effect is not statistically significant. The coefficients are positive in Specification (4), indicating that spreads on short swaps increase with the stock borrowing fee. Importantly, the difference in response is not statistically different between low and high pricing power situations, consistent with the spread being set based on the stock borrowing fee in both situations, and that dealers' pricing power does not play a role in it.

While the coefficients in Specification (4) are positive, in line with the model, they are smaller than the unit slope the model predicts in Equation 12 (see Section 3.3). One reason for this may be that the dependent variable in the regression is the dealer-level average spread of *all outstanding* swap contracts on an asset, whereas only *new* swap contracts would be

priced based on the current short selling cost. Due to this, the measured effect is likely to be diluted.

These findings are in line with the predictions of the model and, together with Figure 3 discussed in Section 6.1, support the model’s prediction that swap spreads are determined by the dealer’s financing cost when the dealer’s net notional exposure is positive and by the asset-specific short selling cost when the net notional exposure is negative.

7 Dealer hedging

7.1 Internal hedging

Hypothesis 3 presented in Section 4 posits that dealers will fully hedge their exposure from the TRS market. The theoretical framework further indicates that dealers will hedge first by internally matching offsetting trades, and only then by trading in the spot market.

Dealers’ preference to internally offset their exposure in the first instance suggests that a dealer should offer lower spreads on new short (long) swaps if she has existing net positive (negative) exposure. However, it is not evident that a dealer would discourage new trades that increase her exposure: As long as a dealer can charge a spread that more than compensates her for the hedging cost, any new trades will be profitable. Discouraging new trades by charging higher spreads does therefore not follow in the same way as enticing hedging trades through lower spreads.

To test whether a dealer’s hedging need and strategy directly affects leverage costs to traders, I identify new trades for a dealer by identifying new counterparties trading with the dealer in a given asset each quarter. A counterparty is identified as “new” for a given dealer if it did not have any outstanding trades with the dealer at the end of the previous quarter. To determine whether they increase or decrease the dealer’s exposure against the reference asset, I examine the direction of the trade (long vs. short) and the dealer’s net

exposure in the previous quarter: If the new trade is in the opposite direction than the dealer’s previous-quarter net exposure, I denote the trade as a “hedging” trade.

I estimate the regression at the dealer (d), counterparty (c), asset (a) level separately for long and short swaps:

$$spread_{d,c,a,t} = \beta_1 newtrade_{d,c,a,t} \times hedge_{d,c,a,t} + \beta_2 newtrade_{d,c,a,t} + \beta_3 hedge_{d,c,a,t} + \alpha_{d,a,t} \quad (15)$$

The dealer-asset-time fixed effects in the specification absorb any time-varying dealer-asset characteristics, including the $hedge_{d,c,a,t}$ indicator variable. In addition, the triple-interacted fixed effect ensures that the identification is within a dealer-asset pair in a calendar quarter: the coefficients therefore specifically identify the effect of new trading relationships and new hedging trade .

Table 4 presents the results. New trades are, on average, charged higher spreads than existing trades: Spreads on new long swap positions are approximately 6.6 to 8.3 basis points higher. The effect of new trades is positive but statistically insignificant for short swaps, ranging from 0.79 to 2.2 basis points. The main coefficient of interest on the interaction between new trades and hedge trades shows that short spreads are approximately 6.3 and long spreads 7.6 basis points lower when the new trades hedge the dealer’s existing exposure.

This aligns with dealers attracting trades that help hedge any existing exposure. Moreover, the effects are economically significant when compared to the unconditional average spreads of 27 and 34 basis points for long and short swaps, respectively.

7.2 Hedging residual exposure

Section 7.1 above shows that dealers offer lower spreads to trades that internally offset their existing exposure. The framework in Section 3 predicts that dealers will trade in the spot market to fully hedge their residual exposure that is not netted out internally.

To test this, I focus on single-stock TRS contracts where the reference asset can be identified by CUSIP.²⁰ To identify dealers' hedging in the spot market, I calculate the change in their net swap exposure in a given reference asset (i.e. the residual swap exposure that is not internally offset) within a calendar quarter, and regress this against the change in their 13F holdings of that asset in the same quarter.

To examine how swap dealers hedge their residual exposure, I estimate the following regression:

$$\Delta 13F \text{ holdings}_{d,a,t} = \beta \Delta \text{Net exposure}_{d,a,t} + \alpha_d + \alpha_a + \alpha_t, \quad (16)$$

where $\alpha_d, \alpha_a, \alpha_t$ are dealer, stock, and calendar quarter fixed effects.

Table 5 presents the results. The baseline Specification (1) in Table 5 shows that dealers adjust their holdings by 0.7 shares for a one-share change in notional exposure. The effect is robust to including dealer, stock, and calendar quarter fixed effects. Notably, the coefficient is not statistically different from 1.0. This is suggestive of dealers fully hedging their net swap exposure by trading in the spot markets. However, due to 13F filings only reporting long positions, without taking into account any potential short positions that the reporting entity might simultaneously have, it is difficult to conclusively test the full-hedging hypothesis.

This data limitation is, however, mitigated by the fact that major broker-dealer banks are likely to manage their inventory efficiently: instead of holding overlapping long and short positions that each carry a holding cost and negate each other, the dealers are likely to only hold the necessary net position.²¹ Moreover, the estimation will be biased *against* finding a positive coefficient between changes in a dealer's residual swap exposure and their 13F holdings if the dealer hedges a (growing) net-short swap exposure by short selling (more)

²⁰As an example, I differentiate between, S&P 500 Index TRSs and swap contracts on S&P 500 ETFs, such as SPY or IVV.

²¹For example, instead of holding a long position of 1000 shares and a short position of 200 shares, the dealer is likely to only carry a long position of 800 shares.

instead of reducing their existing long position in a security.

8 Natural experiment

8.1 Background and timeline

On March 26, 2021, Archegos (a family office with \$36 billion of assets at its largest²²) collapsed after it failed to satisfy margin calls from its trading counterparties. This failure is attributed primarily to the fund’s large bets on a small number of companies via TRS contracts with six large investment banks. One of the banks, Credit Suisse, incurred approximately \$5.5 billion in losses following the fund’s failure.

Immediately following Archegos’s collapse and incurring substantial losses, Credit Suisse reduced its presence in swap intermediation: Its gross notional in short (long) swaps fell by 82% (55%) in the second quarter of 2021. Credit Suisse’s exit from swap intermediation had a large impact on competition, as the bank’s total notional exposure amounted to approximately 11% of all swap trades with U.S. mutual funds. The bank formally announced its exit from the U.S. prime brokerage market on November 4, 2021 as a part of its restructuring plan.²³ There was no change in the bank’s swap exposure around the exit announcement date (November 4, 2021). The bank completed its exit from prime brokerage and swap intermediation in the fourth quarter of 2022, when its long and short swap notional reduced to zero. Figure 4 Panel (a) shows the evolution of Credit Suisse’s swap exposure.

The bank’s exit timeline thus yields two distinct treatment dates: First, in the second quarter of 2021 when the bank exits most of its short swaps and more than half of its long swaps, and second, in the fourth quarter of 2022 when the bank entirely exits the market and its outstanding swap notional on both long and short swaps falls to zero.

In March 2023, UBS, another Swiss investment bank, announced that it would acquire

²²<https://www.bloomberg.com/features/2024-bill-hwang-archegos-collapse-timeline/>

²³See Walker 2021; Credit Suisse 2021a.

Credit Suisse. The acquisition was completed in June 2023. The combined entity did not recover the swap volume that Credit Suisse lost in Q2 2021 and Q4 2022: Figure 4 Panel (b) displays UBS’s swap exposure over time. The bank shows no sharp changes in its swap notional exposure around Credit Suisse’s market exit. This ensures that there was an effective market exit by a dealer and that the volume was not absorbed by the acquirer bank. Figure A.2 in the Appendix displays the swap notional evolution of six other major investment banks (of these, Deutsche Bank, Goldman Sachs, Morgan Stanley, and Nomura were also counterparties to Archegos).

The natural experiment around Credit Suisse’s exit from the market is similar to Di Maggio et al. (2017), who study the market for corporate bonds following the collapse of Lehman Brothers in 2007. Di Maggio et al. (2017), however, consider the intermediation chains in the bond market, whereas this paper identifies sources of heterogeneity in leverage costs by studying the market for OTC swaps.

8.2 Credit Suisse undercollateralization and trader default

It is important to note that substantial losses from trader default are rare in the prime brokerage business, which is intended to be low risk and where any exposure to counterparties is normally sought to be hedged and/or covered through adequate margining. This is evidenced by the internal audit and investigation at Credit Suisse (Credit Suisse (2021b)). The internal audit report attributes the losses from Archegos to an idiosyncratically deficient risk management practice, wherein the group’s own rules and margining requirements were flouted. In short, the bank could have avoided losses if it had promptly called additional variation margin and collateral from Archegos.

In the audit report, the bank examines its own shortcomings and risk management failures that led to the \$5.5bn loss caused by Archegos’s collapse. The report emphasizes that the failings were due to a lack of internal controls. One example of this is that Credit

Suisse had reduced Archegos’s default margin rate to 7.5% from its own and the industry standard 20%.²⁴ Additionally, Credit Suisse did have the capacity to call additional margin depending on Archegos’s position sizes relative to the securities’ daily trading volume, but “never memorialized [this] in any formal contract”, and “these constraints were never invoked or implemented [by Credit Suisse].”²⁵

Moreover, Credit Suisse was aware that it was “the only prime broker using static margining and that [its] margin rates were lower than those of other prime brokers.”²⁶

All this strengthens the idea that the Archegos’s default and the resulting losses at Credit Suisse are an exception in prime brokerage, and that the business is generally considered low-risk with customer default being rare. Considering this, the bank’s losses and subsequent exit from the market can be considered an unanticipated event and an exogenous shock to market participants and the competitive dynamics in the swap market.

8.3 Analysis

I define the “Treated” group as reference assets in which Credit Suisse held outstanding swaps in 2021Q1 and 2022Q3—the quarters immediately preceding each major reduction in the bank’s swap book. To avoid confounding the treatment effect, I exclude all securities in which Archegos had outstanding TRS trades with Credit Suisse.²⁷ The regressions further exclude Credit Suisse’s own outstanding trades and rely exclusively on TRS contracts intermediated by other broker-dealer banks, ensuring that the estimated effect captures the competitive externality of the exit rather than direct pricing changes on Credit Suisse’s own book.

The difference-in-differences identification relies on a parallel trends assumption: treated and control securities must have followed similar spread dynamics before Credit Suisse’s exit.

²⁴Credit Suisse (2021b), pp.72.

²⁵Credit Suisse (2021b), pp.72.

²⁶Credit Suisse (2021b), pp.139.

²⁷Archegos had outstanding TRS positions in ViacomCBS, Discovery Communications, iQIYI, Farfetch, Tencent Music, Baidu Inc., HSX Techedu, and Vipshop Holdings.

I assess this by estimating Equation 17 in an event-study framework, replacing the $Post_t$ indicator with calendar-quarter dummies and normalizing coefficients to zero in the quarter preceding the Archegos collapse. Figure 5 presents the results. Panel (a) reports coefficients for long swap spreads on securities where dealers hold net long exposure; Panel (b) reports the corresponding estimates for short swaps where dealers hold net short exposure. All pre-event coefficients are statistically indistinguishable from zero, supporting the parallel trends assumption. Post-treatment, long swap spreads rise immediately in the quarter of the collapse, while short swap spreads increase one quarter later—coinciding with Credit Suisse’s initial withdrawal from short swap intermediation. This asymmetric timing is consistent with the composition of Credit Suisse’s book: the bank’s short exposure contracted first and most sharply, while its long exposure persisted longer. The one-quarter lag in short swap spreads also reflects the mechanically smaller treated sample on the short side, which delays the repricing of replacement positions.

A potential threat to identification is that the Archegos collapse generated deleveraging spillovers beyond the securities directly held by Archegos. The treated group comprises all securities where Credit Suisse was active—not merely Archegos-linked stocks—so spillovers into correlated securities could bias the estimated treatment effect. Three features of the evidence mitigate this concern. First, Figure 5 illustrates the pretrend coefficients for the first Credit Suisse treatment date at the end of Q1 2021, normalized to zero in the preceding quarter. The pretrends are flat, indicating no differential drift in the periods preceding treatment. Second, the spread increase coincides precisely with Credit Suisse’s exit dates rather than with the broader market disruption of the Archegos collapse itself. Third, the pretreatment window, while relatively short, spans a period of relatively stable market conditions prior to the shock. Taken together, these patterns support a causal interpretation in which the observed spread increases reflect reduced dealer competition rather than broad deleveraging dynamics.

The baseline specification is a standard difference-in-differences regression. $Treated_a$

equals one for assets in the treated group; $Post_t$ equals one from 2021Q2 onward (from 2022Q4 for the second event window). The coefficient on the interaction term $Treated_a \times Post_t$ is the estimand of interest, capturing the differential change in swap spreads on treated securities following Credit Suisse’s exit. Dealer and asset fixed effects absorb unobserved time-invariant heterogeneity; the asset fixed effect subsumes the $Treated_a$ main effect.

$$spread_{d,a,t} = \beta_1 Treated_a \times Post_t + \beta_2 Post_t + \alpha_d + \alpha_a \quad (17)$$

Table 6 presents the results of estimating Equation 17: Panels (a) and (b) show the study effects on treatment immediately after 2021Q1 and 2022Q3, respectively. Specifications (1)-(2) show treatment effects for any asset in which Credit Suisse was active before the exit (2021Q1 and 2022Q3, respectively, in Panels (a) and (b)). Specifications (3)-(4) show effects for securities to which Credit Suisse had net short exposure, and (5)-(6) for securities to which the bank had net long exposure.

In Panel (a), short swap spreads on treated stocks increase by 15-66 basis points following Credit Suisse’s exit. The effect is the strongest on stocks in which the bank had a net short exposure (Specification (4)). Long swap spreads, in contrast, experience smaller increases between 3.5 and 4.3 basis points, and there is no statistically discernible effect on long spreads on treated securities in which Credit Suisse had a negative net exposure. This result suggests that the exit of a supplier from the market raises short swap spreads more than long spreads and that short spreads may be more reactive to competitive dynamics in the market.

Panel (b) displays results for the analysis around Credit Suisse’s final exit from prime brokerage after the third quarter of 2022. Short swap spreads increase, although the effect is smaller than in Panel (a). This result is consistent with the bank having almost no short exposure at the time. Long swap spreads, in contrast, now increase significantly, by approximately 5.9 basis points. The larger increase than in Panel (a) corresponds to the

bank’s complete exit from the market after the third quarter of 2022, as opposed to its partial exit in the second quarter of 2021. The difference in treatment effects across the two event windows is consistent with the composition of Credit Suisse’s book: the bank’s short exposure declined sharply in 2021, making the 2021 event primarily a short-swap competition shock, while its residual long exposure persisted until 2022, making the second event primarily a long-swap competition shock.

9 Conclusions

This paper develops a theoretical framework for the cost of leverage grounded in dealer pricing of derivatives contracts. I show that leverage costs exhibit substantial cross-sectional variation at the asset and dealer level—variation that cross-sectionally constant proxies such as the TED spread cannot capture.

The source of this variation is the dealer’s hedging strategy. A dealer hedges by short-selling or purchasing the reference asset, depending on the net direction of client demand. When net long, her marginal hedging cost is her own funding cost; when net short, it is the asset-specific short-sale cost. This mechanism generates a cross-subsidy: imbalances between long and short traders cause the minority side to face a lower—potentially negative—leverage cost relative to the baseline rate.

Using novel regulatory data in which U.S. mutual funds disclose their derivatives positions, counterparties, and costs, I reconstruct each dealer’s aggregate position at the asset level and test the model’s predictions directly. The data confirm a sharp discontinuity in leverage costs when a dealer’s net position crosses zero, consistent with the hedging cost shifting from asset-specific short-sale costs to dealer-specific funding costs. Traders whose positions provide an internal hedge to the dealer face approximately 10 basis points lower leverage costs, and dealers’ aggregate stock holdings move nearly one-to-one with their residual swap exposure—evidence of full spot-market hedging of unmatched inventory.

A natural experiment surrounding Credit Suisse’s sudden exit from prime brokerage provides causal evidence that dealer competition directly affects leverage costs. Following the exit, leverage costs on affected securities rose by up to 66 basis points relative to unaffected securities.

These findings carry broader implications. Traders can obtain cheaper leverage by identifying and trading with dealers holding opposing exposure—effectively acting as “hedge providers.” Because lower leverage costs reduce the profitability threshold for correcting mispricing, the dealer-level variation documented here has direct consequences for market efficiency.

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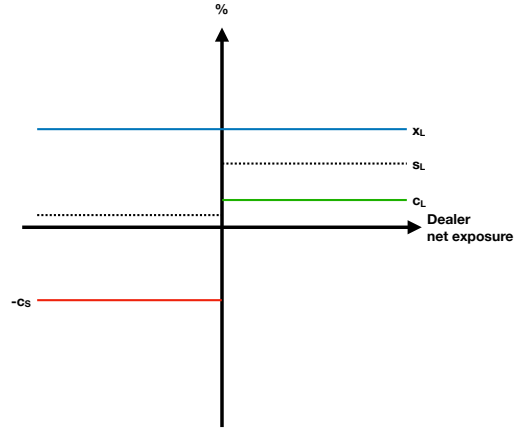
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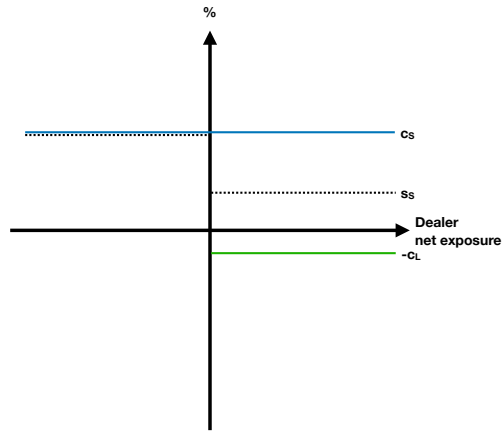
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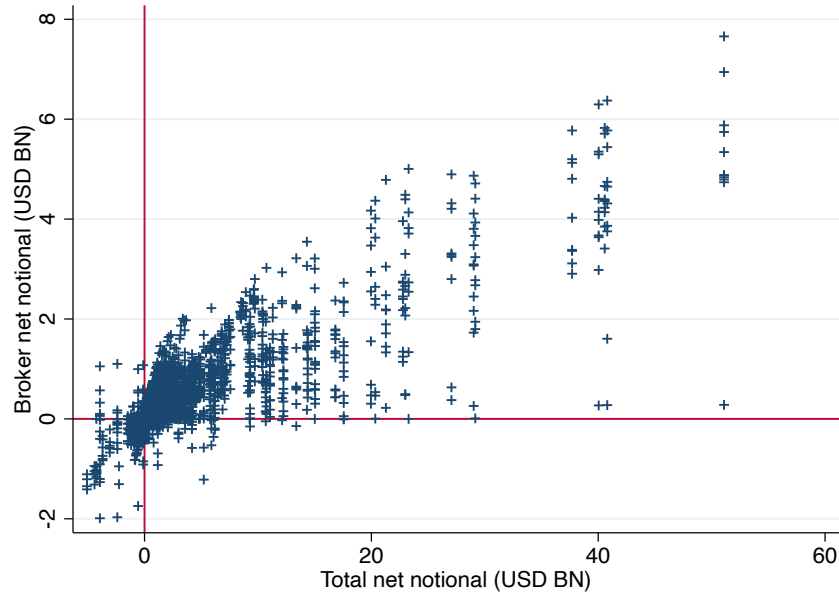
Panel (a): Spreads for long swaps



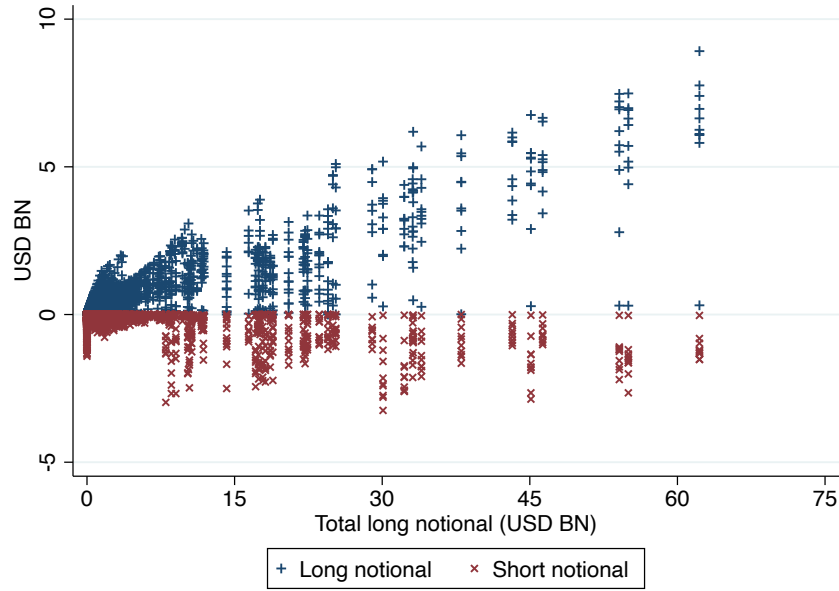
Panel (b): Spreads for short swaps

Figure 1: Predicted spreads

This figure presents the equilibrium spread ranges from the Model presented in Section 3: Panels (a) and (b) illustrate the spreads for long and short swaps, respectively, following Equations (9)-(12). The dotted lines show, for illustrative purposes, the midpoint between the upper and lower bounds for the spread in each case.



Panel (a): Dealer net notional and total market net notional



Panel (b): Dealer notional and total market long notional

Figure 2: Dealer notional vs. Total notional

This figure plots the notional swap exposure of dealers against market total notional. Panel (a) illustrates dealers' total net notional on an asset against the market total net notional. Panel (b) illustrates dealers' long and short notional exposures against the market total long notional exposure.

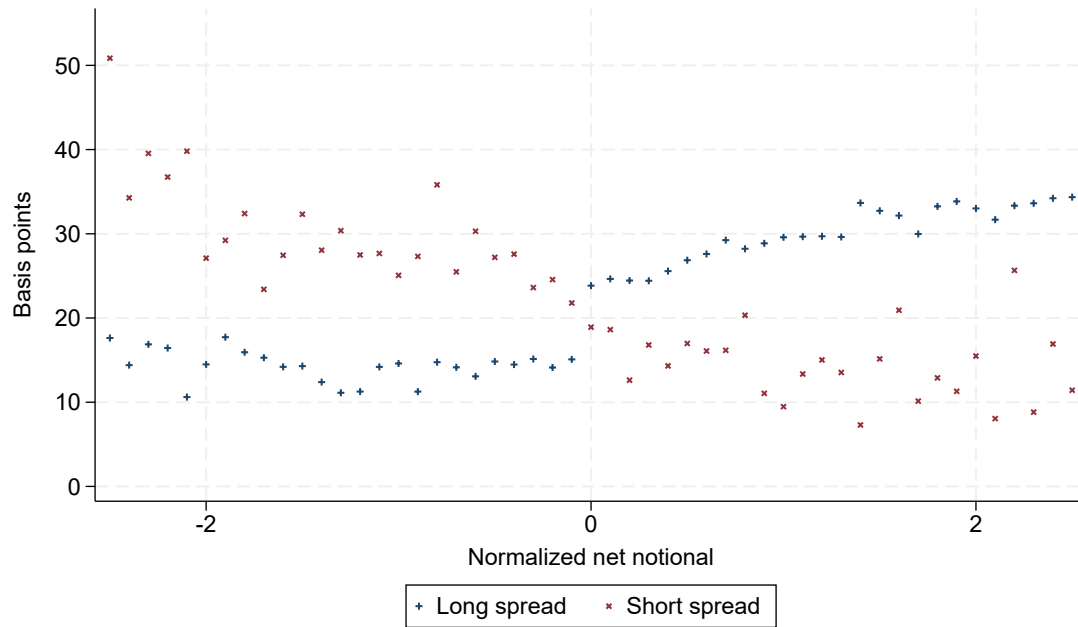
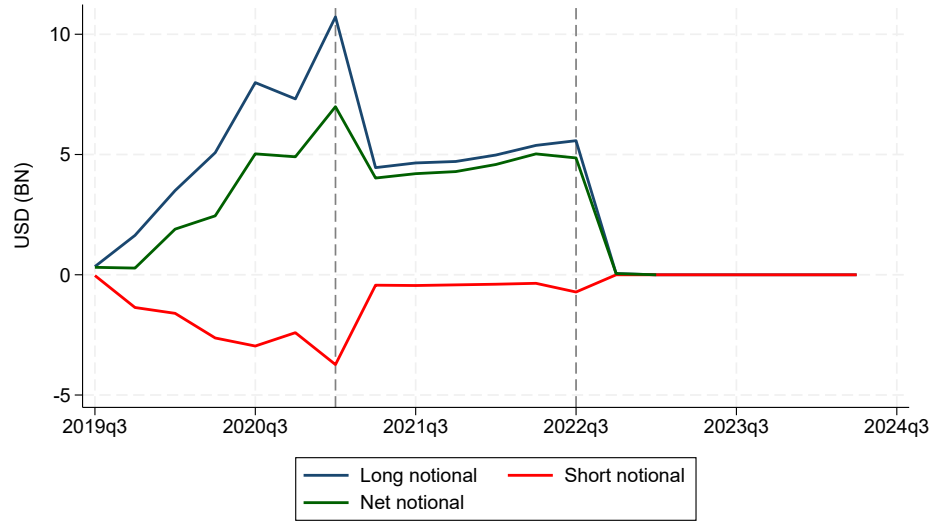
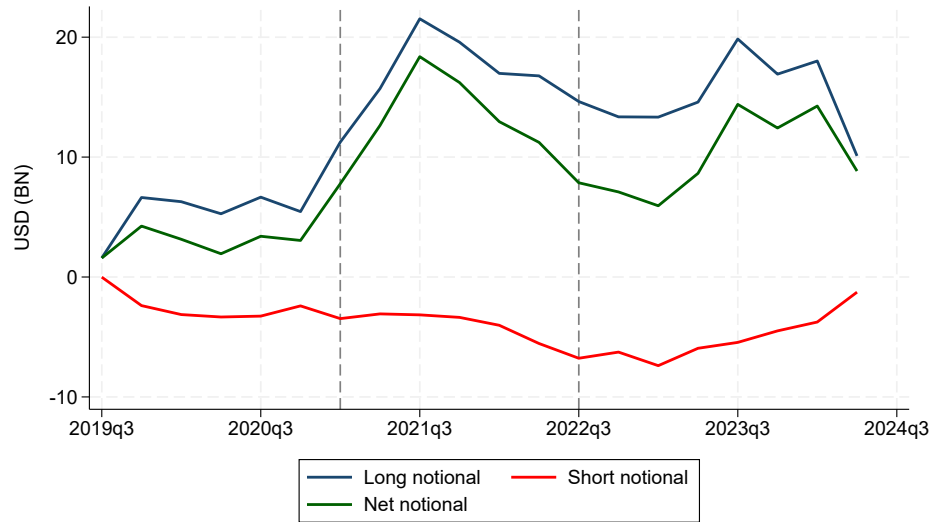


Figure 3: Swap spreads and net notional exposure

This figure plots the swap spreads as a function of the dealer's net notional on the underlying security or asset. Dealers' net notional exposure against an asset is normalized by dividing by the standard deviation of the net notionals of all dealers active in the asset. This figure is truncated at -2.5 and 2.5 standard deviations from 0 for clarity.

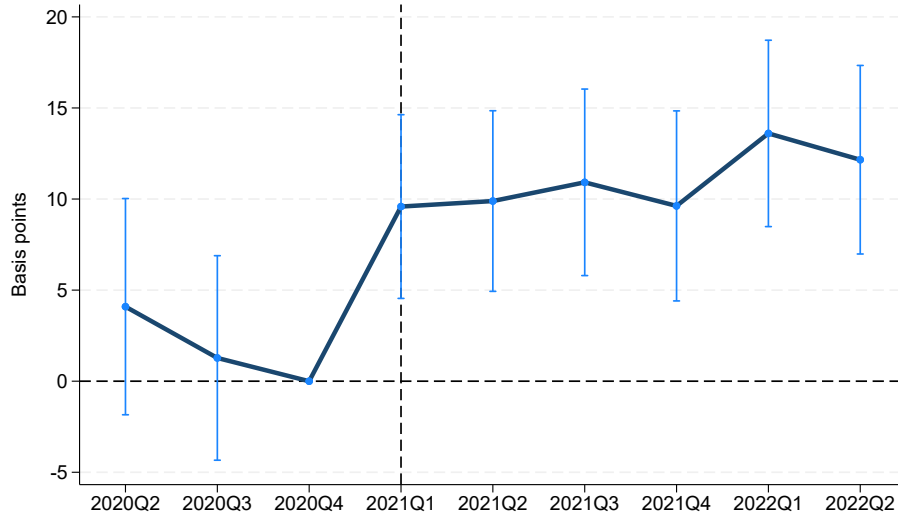


Panel (a): Credit Suisse

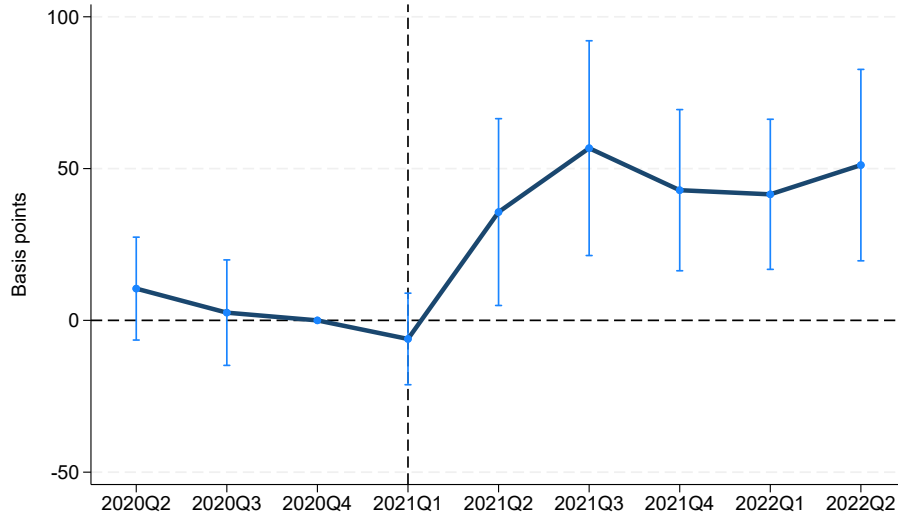


Panel (b): UBS

Figure 4: This figure plots the swap exposure of Credit Suisse and UBS against U.S. mutual funds.



Panel (a): Long swaps



Panel (b): Short swaps

Figure 5: This figure plots the pretrend difference in swap spreads between treated and untreated assets prior to Credit Suisse's first reduction in swap exposure after Q1 2021. Treated assets are assets in which Credit Suisse had outstanding swaps in the first quarter of 2021. The difference is normalized to zero in the quarter before Archegos's collapse.

Table 1: Descriptive statistics: Dealer-asset level

The table presents descriptive statistics at the broker-asset level. Net notional is measured by subtracting the notional value of short swaps from the notional value of long swaps. Long and short notional are presented for non-zero observations. The number of long and short swaps measures the number of trader counterparties for the broker-dealer. Long and short spreads are measured in basis points.

	mean	p10	p50	p90	sd
Net notional (USD MM)	17.27	-2.08	0.01	8.29	177.79
Long notional (USD MM)	42.05	0.01	0.39	32.91	287.06
Short notional (USD MM)	-14.21	-7.19	-0.42	-0.02	109.61
Num. Long swap trades	1.21	0.00	1.00	3.00	2.13
Num. Short swap trades	1.16	0.00	1.00	3.00	2.03
Long spread (bp)	26.91	0.00	25.00	65.00	32.76
Short spread (bp)	33.93	0.00	0.00	50.00	114.11
Observations	89,510				

Table 2: Swap spreads and dealer exposure

The table presents the regression analyses of swap spreads on dealer net exposure. t-statistics are in parentheses. $\mathbb{1}_{N>0}$ is an indicator variable that is equal to one when the dealer has a positive net notional exposure to a swap asset. The dependent variables are measured in basis points. *p $\leq$.1; **p $\leq$.05; ***p $\leq$.01

	(1)	(2)	(3)	(4)	(5)	(6)
	Long (bp)	Short (bp)	Long (bp)	Short (bp)	Long (bp)	Short (bp)
$\mathbb{1}_{N>0}$	13.943*** (42.32)	-10.466*** (-8.82)	13.867*** (41.39)	-9.702*** (-8.25)	13.757*** (38.70)	-8.125*** (-6.30)
Constant	14.482*** (49.65)	35.938*** (61.93)	14.550*** (48.63)	35.792*** (62.50)	14.656*** (45.55)	35.513*** (64.13)
Quarter	No	No	Yes	Yes	No	No
Dealer $\times$ Quarter	No	No	No	No	Yes	Yes
N	53,716	50,137	53,716	50,137	53,679	50,084
Adjusted R^2	0.018	0.001	0.028	0.012	0.137	0.099

Table 3: Cost of financing and short-selling cost

The table presents the regression analyses of swap spreads dealer funding costs and asset short selling costs. $\mathbb{1}_{\text{High competition}}$ is an indicator variable that is equal to one when the swap reference asset has a below-median Herfindahl-Hirschman index. The dealer CDS spreads are obtain from LSEG Data and Analytics (formerly Refinitiv). Stock borrowing fees are from Markit Securities Finance. t-statistics are in parentheses. * $p \leq .1$; ** $p \leq .05$; *** $p \leq .01$

	$N_L > N_S$		$N_L < N_S$	
	(1) Long (bp)	(2) Short (bp)	(3) Long (bp)	(4) Short (bp)
CDS spread (bp)	-0.185 (-1.51)	-0.367 (-0.48)		
CDS spread $\times \mathbb{1}_{\text{High competition}}$	0.552*** (4.21)	0.464 (0.45)		
Borrow fee (bp)			0.037 (0.54)	0.020** (2.20)
Borrow fee $\times \mathbb{1}_{\text{High competition}}$			-0.088 (-1.20)	0.026 (1.58)
Dealer $\times$ Stock	Yes	Yes	Yes	Yes
Stock $\times$ Quarter	Yes	Yes	No	No
Dealer $\times$ Quarter	No	No	Yes	Yes
N	6,192	1,685	1,401	13,302
Adjusted R^2	0.713	0.533	0.563	0.848
$\beta_1 + \beta_2$	0.368*** (4.584)	0.097 (0.141)	-0.051 (-1.033)	0.046*** (2.754)

Table 4: New trades

The table presents the regression analyses of swap spreads on variables that identify new and hedging swap trades for a dealer. Specifications (1) and (2) regress short and long swap spreads, respectively, only on the $Newtrade_{d,a,c,t}$ indicator variable, and Specifications (3) and (4) include the $Hedge_{d,a,c,t}$ indicator variable and its interaction with the $newtrade$ variable. $Newtrade_{d,a,c,t}$ is a dummy variable equal to one if the counterparty c did not have a position with dealer d in the previous quarter. $Hedge_{d,a,c,t}$ is a dummy variable equal to one if the trade is in the opposite direction of the dealer's previous-quarter net exposure. t-statistics are in parentheses. *p $\leq$.1; **p $\leq$.05; ***p $\leq$.01

	(1)	(2)	(3)	(4)
	Long (bp)	Short (bp)	Long (bp)	Short (bp)
New trade	6.546** (2.45)	0.790 (0.47)	8.267** (2.40)	2.180 (1.03)
New trade $\times$ Hedge			-7.627** (-2.18)	-6.252** (-2.55)
Dealer $\times$ Asset $\times$ Quarter				
Observations	52,253	65,597	52,253	65,597
Adjusted R^2	0.472	0.696	0.472	0.696

Table 5: Dealers' hedging

The table presents the regression analyses of changes in dealers' 13F holdings of stocks on changes in their net swap exposure to the stocks. 13F holdings are obtained directly from SEC, and measured in number of shares. Notional shares change is measured by dividing the dollar net notional exposure by the stock price in the respective quarter. t-statistics are in parentheses. *p $\leq$.1; **p $\leq$.05; ***p $\leq$.01

	(1) 13f hold change	(2) 13f hold change	(3) 13f hold change	(4) 13f hold change
Notional shares change	0.701** (2.49)	0.699** (2.55)	0.700** (2.47)	0.752** (2.57)
Quarter	No	Yes	Yes	Yes
Dealer	No	No	Yes	Yes
Stock	No	No	No	Yes
Observations	20,091	20,091	20,091	19,704
Adjusted R^2	0.001	0.005	0.006	-0.020

Table 6: Natural experiment: Credit Suisse market exit

The table presents the regression analyses of swap spreads on indicator variables that identify the treated stocks and the post-treatment time period around a natural experiment in which Credit Suisse exited the prime brokerage market. The treatment variables identify securities in which Credit Suisse was active in 2021Q1 (panel (a)) and 2022Q3 (panel (b)). Specifications (1)-(2) show treatment effects for securities in which Credit Suisse was active from 2021Q1 to 2022Q3. Specifications (3)-(4) show treatment effects for those to which Credit Suisse had net short exposure to, and Specifications (5)-(6) show effects for securities to which Credit Suisse had net long exposure. t-statistics are in parentheses. *p $\leq$.1; **p $\leq$.05; ***p $\leq$.01

Panel (a): Treatment after 2021Q1

	All trades		CS Net Short		CS Net Long	
	(1)	(2)	(3)	(4)	(5)	(6)
	Long (bp)	Short (bp)	Long (bp)	Short (bp)	Long (bp)	Short (bp)
Treatment $\times$ Post	3.445*** (4.27)	23.143*** (12.13)	-4.060 (-1.31)	66.110*** (7.52)	4.312*** (5.27)	15.002*** (9.43)
Post	1.610*** (7.31)	-8.088*** (-11.20)	2.056*** (9.58)	-6.729*** (-9.99)	1.562*** (7.06)	-7.123*** (-9.76)
Constant	24.744*** (155.73)	34.636*** (69.80)	24.773*** (155.09)	34.432*** (69.08)	24.757*** (156.28)	34.696*** (69.62)
Dealer	Yes	Yes	Yes	Yes	Yes	Yes
Security	Yes	Yes	Yes	Yes	Yes	Yes
Observations	53,535	50,552	53,535	50,552	53,535	50,552
Adjusted R^2	0.672	0.677	0.671	0.677	0.672	0.676

Table 6: Natural experiment: Credit Suisse market exit, continued

Panel (b): Treatment after 2022Q3

	All trades		CS Net Short		CS Net Long	
	(1)	(2)	(3)	(4)	(5)	(6)
	Long (bp)	Short (bp)	Long (bp)	Short (bp)	Long (bp)	Short (bp)
Treatment $\times$ Post	5.914*** (6.19)	9.545*** (4.83)	4.830 (1.00)	-2.704 (-0.56)	5.922*** (6.15)	10.788*** (5.15)
Post	0.773*** (3.20)	-9.454*** (-13.43)	1.263*** (5.37)	-8.817*** (-13.09)	0.805*** (3.33)	-9.466*** (-13.53)
Constant	25.673*** (244.76)	33.786*** (99.59)	25.658*** (243.85)	33.766*** (99.64)	25.674*** (244.72)	33.789*** (99.61)
Dealer	Yes	Yes	Yes	Yes	Yes	Yes
Security	Yes	Yes	Yes	Yes	Yes	Yes
Observations	53,535	50,552	53,535	50,552	53,535	50,552
Adjusted R^2	0.671	0.677	0.671	0.677	0.671	0.677

Appendix

A Figures

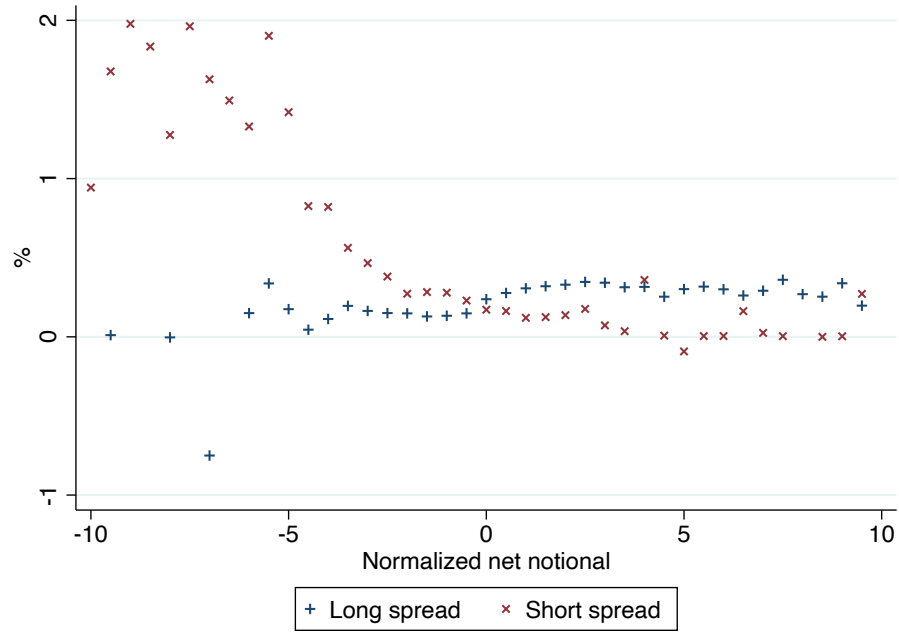
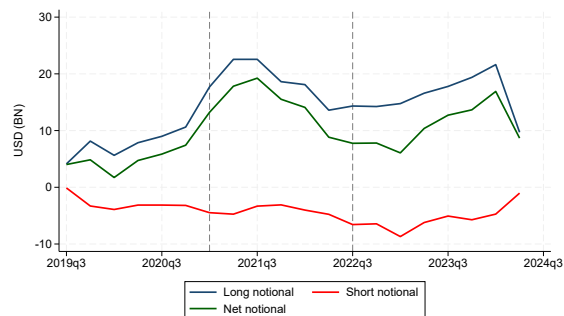
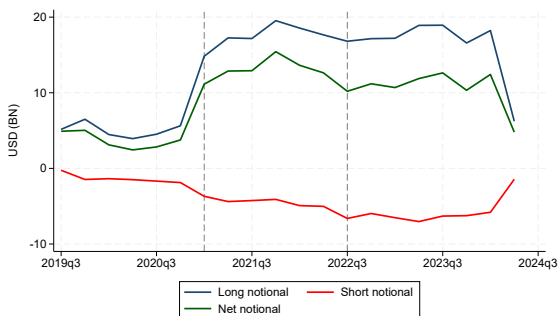


Figure A.1: Swap spreads and net notional exposure

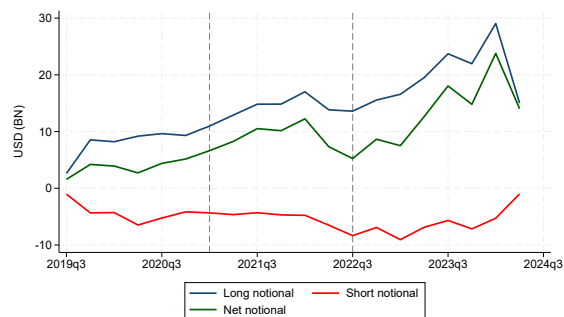
This figure plots the swap spreads as a function of the dealer's net notional on the underlying security or asset. Dealers' net notional exposure against an asset is normalized by dividing by the standard deviation of the net notionals of all dealers active in the asset.



BNP Paribas



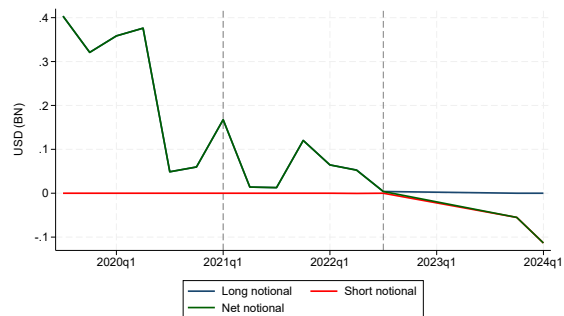
JP Morgan



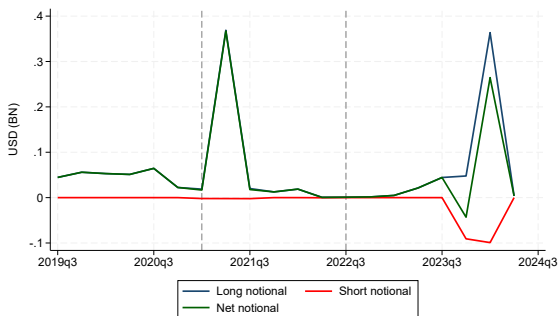
Goldman Sachs*



Morgan Stanley*



Deutsche Bank*



Nomura*

Figure A.2: Swap exposure of major prime brokers

This figure plots the swap exposure of U.S. mutual funds' largest counterparties. The swap exposures of UBS and Credit Suisse are shown in Figure 4.

*Deutsche Bank, Goldman Sachs, Morgan Stanley, and Nomura were also counterparties to Archegos.