

---

# NEGATIVE SWAP SPREADS

*Nina Boyarchenko, Pooja Gupta, Nick Steele, and Jacqueline Yen*

## OVERVIEW

- Market participants have been surprised by the decline of U. S. interest rate swap rates relative to Treasury yields of equal maturity over the past two years, with interest rate swap spreads becoming negative for many maturities.
- Although many factors have narrowed interest rate swap spreads, the authors focus primarily on the impact of regulatory increases in required leverage ratios.
- The authors argue that when exogenous factors narrowed spreads, the leverage requirements reduced incentives for market participants to enter into trades that would have counteracted the effects of exogenous shocks.
- The analysis suggests that, given balance sheet costs, spreads must reach more negative levels to generate an adequate return on equity for dealers—suggesting there may be a “new normal” level at which dealers are incentivized to trade.

An interest rate swap enables two counterparties to swap interest rates for a specific period, typically with one rate fixed and the other an agreed-upon floating rate, such as the three-month Libor (London interbank offered rate). At \$288 trillion outstanding in notional value,<sup>1</sup> the interest rate swap market is the largest over-the-counter derivatives market in the world, representing an important source of duration for both interest-rate risk management and investment.<sup>2</sup> Corporations use these swaps to transform their interest rate obligations between fixed and floating rates without having to change the mix of bonds they issue. The use of swaps enables issuers to hedge interest rate risk that could affect investment decisions.

Interest rate swap spreads are the difference between the fixed rate in a swap and the yield of a Treasury security of the same maturity. Historically, most swap spreads have been positive (Chart 1). A market participant may be able to narrow a positive spread by paying the floating rate Libor on an interest rate swap, receiving the fixed rate, and selling short a Treasury bond of the same maturity by lending cash against it in a reverse repurchase agreement (reverse repo).

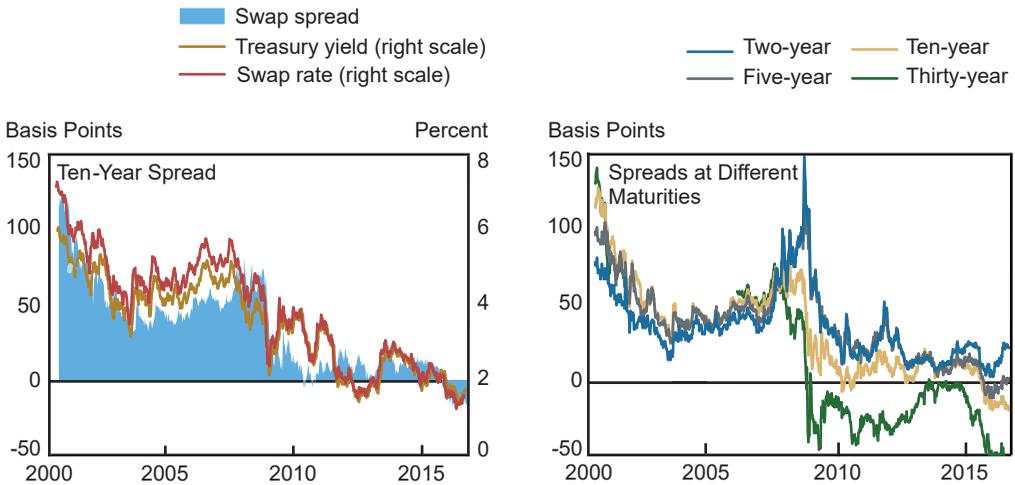
---

*Nina Boyarchenko is a senior economist, Pooja Gupta an analyst, and Jacqueline Yen an analyst at the Federal Reserve Bank of New York. At the time this article was written, Nick Steele was an analyst at the New York Fed. Currently he is a deputy director at the U.S. Department of the Treasury. Email: [nina.boyarchenko@ny.frb.org](mailto:nina.boyarchenko@ny.frb.org); [pooja.gupta@ny.frb.org](mailto:pooja.gupta@ny.frb.org); [jacqueline.yen@ny.frb.org](mailto:jacqueline.yen@ny.frb.org); [nicholas.steele@treasury.gov](mailto:nicholas.steele@treasury.gov).*

*The views expressed in this article are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of New York or of the Federal Reserve System. To view the authors' disclosure statements, visit [https://www.newyorkfed.org/research/epr/2018/epr\\_2018\\_negative-swap-spreads\\_boyarchenko.html](https://www.newyorkfed.org/research/epr/2018/epr_2018_negative-swap-spreads_boyarchenko.html).*

CHART 1

## Historical Evolution of Swap Rate, Treasury Yield, and Swap Spread



Source: Federal Reserve Board, H.15 release.

However, Libor generally exceeds the interest rate earned in the reverse repo transaction, making the overall trade uneconomical.<sup>3</sup> Thus, what makes negative swap spreads puzzling is that, when the swap spread is negative, a pure “carry” yield can be earned by paying the fixed rate on the interest rate swap, receiving the floating rate on the swap and holding long a Treasury bond of the same maturity. If interest rates were the only risk factors in this trade, holding to maturity would represent an arbitrage opportunity.

The deviations of swap spreads away from zero suggest the presence of other risk factors—such as counterparty risk for the execution of the swap leg of the trade, ancillary costs to the trade, and limits to arbitrage—which may make holding the trade to maturity infeasible. Market innovations, such as the introduction of mandatory central clearing for U.S.-dollar-denominated interest rate swaps, have reduced the counterparty risk priced into interest rate swaps. However, even the complete removal of counterparty risk premia priced into swaps could only push the Treasury-swap spread to zero, not into negative territory.

In this article, we suggest that regulatory changes help explain negative swap spreads. Although many factors have narrowed interest rate swap spreads<sup>4</sup> since the fall of 2015, we focus primarily on the impact of regulatory increases in required leverage ratios. We show the true cost of entering into a trade to widen interest rate swap spreads—paying a fixed swap rate and buying a Treasury with matched maturity—depends on the capital regulations faced by the firm. We also examine how higher regulatory leverage requirements have lowered the spread at which a market participant can earn the required return on equity (ROE).<sup>5</sup> To find the level at which an arbitrage yield is available, the cost to finance both the interest rate swap and the Treasury security must be considered. Likewise, the amount of equity that must be held for the trade also determines whether the ROE is high enough for market participants to enter into the trade.

We do not argue that it is the higher leverage ratios themselves that have narrowed spreads. Instead, when exogenous factors narrowed spreads, the leverage requirements reduced incentives for market participants to enter into trades that would have counteracted the effects of exogenous shocks. The exogenous factors that market participants have identified as narrowing spreads since fall 2015 include notable selling of foreign reserves by foreign central banks, particularly China; increased swapping of fixed-rate into floating-rate debt; and increased demand by insurance and pension funds to match the extending durations of their liabilities as longer-term government yields declined. These factors put downward pressure on fixed interest-rate swap rates, narrowing their spread to U.S. Treasury bonds. This narrowing revealed the changed economics of spread-widening positions, which will be examined in more detail below.

Our empirical contributions are closely related to the theoretical work on swap spreads by Jermann (2016). Jermann models swap spreads in an environment in which banks face an additional cost for holding Treasury securities. This additional cost creates limits to arbitrage by introducing a wedge between the net benefit of holding a Treasury security long and the benefit of entering into a pay-fixed swap. That model is motivated by the introduction of similar capital regulations to the ones we examine.

The only other article we are aware of that studies negative swap spreads presents a demand-based explanation. Klingler and Sundaresan (2016) find evidence that demand by underfunded pension funds for interest rate swaps is associated with negative thirty-year swap spreads. However, the authors acknowledge that this driver is specific to the thirty-year swap spread. In contrast, regulatory drivers affect the pricing of swap spreads of all maturities.<sup>6</sup>

The rest of this article is organized as follows. Section 1 reviews theoretical arbitrage trades and the recent performance of those trades. Section 2 explains the mechanics of the Treasury-swap trade in detail and examines how post-crisis regulation affects the incentives to engage in this trade. We draw policy conclusions in Section 3.

## 1. RECENT TRENDS

The negative Treasury-swap spread trade provides a potential trading opportunity for market participants. In particular, if a market participant anticipates that swap spreads will move closer to historical levels, they could enter into a pay-fixed swap while simultaneously holding a long Treasury position of matched maturity. The pay-fixed swap insures the participant against potential future interest rate fluctuations. If the Treasury and the swap have equal risk profiles along all other dimensions, such as counterparty and liquidity risk, this trade represents an arbitrage opportunity in which the market participant earns the Treasury coupon and the three-month Libor from the floating leg of the swap and pays the fixed swap rate and the general collateral (GC) repo cost to finance the Treasury holding. If swap spreads move toward positive territory or stay the same until the unwinding or maturity of the trade, the trade is profitable net the difference between the three-month Libor rate and the GC-repo cost. As the spread between the three-month Libor and the GC repo narrows, the trade becomes less attractive.

Chart 1 (page 2) shows that, historically, the ten-year interest rate swap spread has been positive except for brief episodes. As discussed in the introduction to this article, counterparty

risk premia is one of the proposed explanations for positive swap spreads historically. Although the introduction of mandatory interest rate swap clearing on March 11, 2013, ameliorated the counterparty risk that market participants face, spreads to U.S. Treasuries remained positive for intermediate maturities until the second half of 2015. This suggests that the reduction in counterparty risk is not the main driver of negative swap spreads.

Furthermore, the floating rate of the interest rate swap is anchored to the three-month Libor rate, which reflects the credit risk of large financial institutions. In contrast, the Treasury position is funded using GC rates and the Treasury yield reflects only the credit risk of the U.S. government. The right panel of Chart 1 shows that the thirty-year swap spread became negative toward the end of 2008 and has remained negative since. At the same time, the swap spread on the two-year maturity swap has remained positive since 2000.

These moves in swap spreads were abnormal relative to historical experience. Before becoming negative in October 2015, the ten-year swap spread on average was 38 basis points, but has averaged -11 basis points since. Similarly, the thirty-year swap spread on average was 63 basis points before November 2008, but since has averaged -23 basis points.

## 2. TREASURY-SWAP SPREAD TRADE IN PRACTICE

In this section, we discuss how the Treasury-swap spread trade is implemented in practice, including the capital charges associated with each leg of the trade and the cost of funding both legs of the trade. We propose an explanation for the negative swap spreads that draws on two recent strands of the academic literature on asset pricing: intermediary asset pricing and the margin capital asset pricing model (CAPM). In intermediary asset pricing theory (He and Krishnamurthy 2013; Brunnermeier and Sannikov 2014; Adrian and Boyarchenko 2012), binding capital and liquidity regulations reduce the ability of market intermediaries to absorb shocks affecting either the buy or the sell side of the market. This increases the effective risk aversion of marginal investors in spread trades, potentially leading to prolonged deviations from parity in linked markets. At the same time, since the interest rate swap leg of the Treasury-swap spread trade requires posted margin, the margin CAPM of Garleanu and Pedersen (2011) applies, with deviations from the law of one price larger whenever the marginal cost of financing the margin requirement is higher.

It is important to note that in these theories, as in practice, regulatory constraints and margin requirements are not the source of the divergence in prices between linked markets. Rather, these constraints make market participants less willing to enter into spread trades once a shock occurs in one of the linked markets and thus prolong the dislocation.

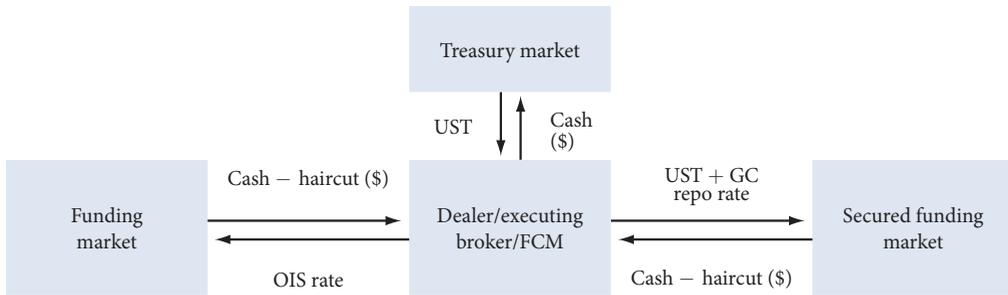
### 2.1 Mechanics of the Trade

The schematic of a typical Treasury-swap spread trade from the perspective of a dealer engaging in the trade on its own behalf is presented in Exhibit 1 below. A key assumption in this example, which we also make when we discuss the balance sheet impact of the trade, is that the dealer uses repo financing to purchase the cash instrument (Exhibit 1, upper panel).

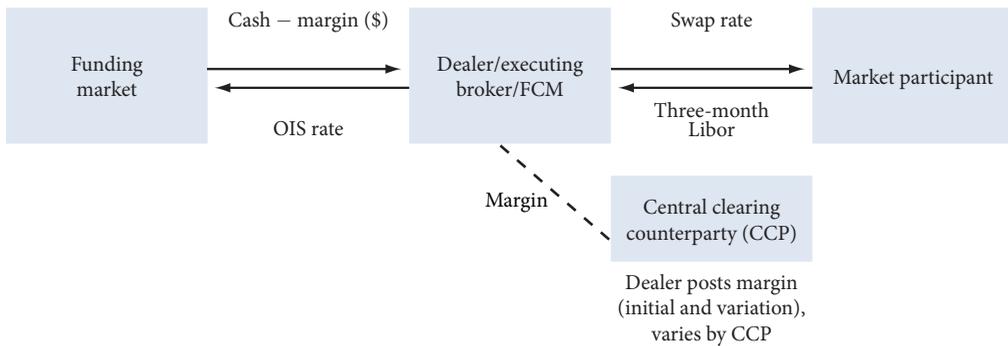
EXHIBIT 1

Mechanics of the Treasury-Swap Trade

Cash Leg



Swap Leg



Notes: UST is U.S. Treasury, GC is general collateral, and FCM is futures commission merchant.

The dealer buys a Treasury security and uses it as collateral to borrow in the GC finance repo market. The repo position requires a haircut, which we assume to be 2.8 percent in the balance sheet example below, and the dealer pays the GC repo interest rate, which we assume to be 0.3 percent in annualized terms, each day that its GC position is open.<sup>7</sup> The haircut on the repo is borrowed in short-term unsecured funding markets, with a 0.5 percent interest rate and one-year maturity.<sup>8</sup>

The swap side of the Treasury-swap spread trade is illustrated in the lower panel of Exhibit 1. The dealer enters into a pay-fixed swap with a maturity matched to the Treasury position with the appropriate central clearing counterparty (CCP). In a pay-fixed swap, the dealer pays the fixed interest rate on the swap to the CCP and receives the three-month Libor in return. The CCP requires both an initial margin, assumed to be 3.9 percent for a ten-year maturity, and a variation margin to be posted for the interest rate swap position, which the dealer again borrows in short-term funding markets at approximately the overnight indexed swap (OIS) rate.

In summary, even when the dealer engages in the Treasury-swap trade on its own behalf, four counterparties participate in the transaction: a Treasury market dealer, the counterparty

in the GC repo, the lender in the unsecured funding market, and the interest rate swap CCP. The mechanics are similar when the dealer engages in the trade on behalf of a customer, with an extra leg added for the transaction between the dealer and the client. We turn next to the balance sheet impact and equity costs of this trade.

## 2.2 Balance Sheet Impact of the Trade

The following discussion considers the balance sheet impact of entering a swap spread trade from the perspective of a dealer, focusing on calculating the dealer's supplementary leverage ratio (SLR). Under the SLR guidelines, derivatives affect this balance sheet calculation. The example here is illustrative and numbers may vary for an individual dealer and specific trade.

Consider first the balance sheet impact of the long-Treasury leg of the Treasury-interest rate swap trade, illustrated in Panel A of Table 1. Assume that the trade size is \$10 million and the dealer faces a 2.8 percent haircut when buying the Treasury using a three-month GC repo. The trade increases the Treasury position on the asset side of the balance sheet by \$10 million. Since the purchase is repo funded, the value of securities sold under agreements to repurchase on the liabilities side of the balance sheet increases by \$10 million, less the haircut. In addition, the dealer borrows the \$280,000 haircut on the repurchase agreement in short-term funding markets at a 0.5 percent interest rate, increasing its short-term debt.

The balance sheet impact of the interest rate swap, in which the dealer pays the fixed rate and receives the floating rate, is also illustrated in Panel A of Table 1. At the trade's inception, the fixed rate is set such that the fair value of the swap is \$0. As the three-month Libor reference rate fluctuates, the market-clearing fixed rate fluctuates as well. Thus, the fair value of the dealer's interest rate swap changes, which translates into either an increase in the "Derivatives with a positive fair value" line on the asset side or the "Derivatives with a negative fair value" line on the liabilities side.

In this example, the swap requires an initial margin of 3.9 percent. Since the dealer will be rebated the margin at trade termination, the margin is reflected as an increase in receivables on the asset side of the balance sheet. At the same time, since the dealer in this example borrows the initial margin in short-term funding markets at a 0.5 percent interest rate, its total short-term debt obligation also increases. In addition, the dealer computes its derivatives exposure, or potential future exposure (PFE),<sup>9</sup> for the centrally cleared interest rate swap, increasing its off-balance-sheet exposure.<sup>10</sup>

The cash flows and "carry" earned on a \$10 million ten-year swap spread trade with a holding period of one year, based on dealer estimates, is shown in Panel B of Table 1. In the trade, the dealer enters into a pay-fixed swap with a CCP, which requires it to post an initial margin (IM) of \$390,000. The dealer is assumed to borrow the initial margin from short-term funding markets, paying a 50 basis points interest rate (\$1,950). In addition to the swap, the dealer purchases the Treasury security, which is funded via repo financing markets. Thus the dealer borrows \$10 million to purchase the Treasury, which it posts as collateral for the repo. The repo rate for a ten-year Treasury is assumed to be approximately 30 basis points and represents a financing cost for the dealer. Furthermore, there is an assumed 2.8 percent haircut on the Treasury repo collateral, which means the dealer must borrow this additional amount on short-term funding markets at a 50 basis points interest rate to post to the repo lender.

TABLE 1

**A Dealer's Perspective: Balance Sheet Impact and the Cost to Trade a Treasury-Swap Trade**

U.S. Dollars

Panel A: Balance Sheet Impact

Assets		Liabilities	
Cash		Short-term debt	670,000
Treasury securities	10,000,000	Long-term debt	
Securities purchased under agreements to resell		Securities sold under agreements to repurchase	9,720,000
Derivatives with a positive fair value	0	Derivatives with a negative fair value	0
Receivables	390,000	Payables	
Total assets	<u>10,390,000</u>	Total liabilities	<u>10,390,000</u>

Panel B: Costs to Trade

Interest rate swap trade cost	
Initial margin funding ~ one-year OIS	-1,950
Income	
Three-month Libor ~ 0.6 percent	<u>60,000</u>
Subtotal swap income	58,050
Treasury in repo costs	
Treasury repo ~ 0.3 percent	-29,160
Haircut ~ one-year OIS	<u>-1,400</u>
Subtotal Treasury cost	-30,560
Net return from carry	
Swap income	60,000
Swap cost	-1,950
Treasury cost	<u>-30,560</u>
Subtotal before spread	27,490
Swap spread at -0.1 percent	<u>10,000</u>
Total after spread	<u>37,490</u>

Source: Authors' calculations.

Notes: The following assumptions were made: 2.8 percent haircut in the Treasury-collateralized repo trade, with a 0.3 percent interest rate; 0.5 percent interest rate charged in the unsecured funding market; 3.9 percent initial margin on the interest rate swap position; 0.6 percent three-month Libor; \$10 million swap notional value; and \$10 million Treasury position.

Therefore, the total cost to finance the long Treasury position is the Treasury repo rate plus the haircut financing charge, a total cost of \$30,560 in this example.

On the derivative portion of the trade, the dealer pays the fixed ten-year swap rate on the pay-fixed leg of the swap and receives three-month Libor on the floating leg, \$60,000. Since the dealer is receiving the Treasury yield and paying the swap rate, on net it is paying the swap spread<sup>11</sup> on the fixed leg of the trade. On the floating leg, the dealer earns three-month Libor while paying the GC repo rate for the Treasury financing and the short-term funding rate for financing the repo haircut and the swap margin. Thus, the net amount the dealer receives on the swap for the first period is the three-month Libor rate earned minus the initial margin funding costs and the Treasury financing cost. The dealer effectively pays the swap spread since it pays the swap rate on the swap and receives the Treasury yield through its long Treasury holding. Combining the amount received by the dealer with the amount paid by the dealer results in the net carry, or profit/income, which in this example is \$37,490. Thus, when swap spreads are negative, the dealer earns a positive carry on a long swap spread position since the Treasury yield it receives is greater than the swap rate it pays, net of the spread between Libor and repo rates.

## 2.3 Profitability of the Swap Spread Trade

The costs associated with swap spread trades have changed since the enactment of mandated clearing of interest rate swaps, which broadly went into effect at the beginning of 2014. Dealer costs have also changed because of implementation of the SLR. These additional costs may be passed on to clients that want to use dealers as their Futures Clearing Merchant (FCM) in order to trade swaps. Market participants note that the higher clearing costs have increased the fees charged by FCM's to clients, with reports that fixed fees can now be as high as \$10,000 per month.

### *Capital Charges*

The capital charge, or additional equity required for the arbitrage trade reflects the impact a trade has on the balance sheet. Specifically, the gross notional amount of repo financing, initial margin, repo haircut, and PFE of the derivative instrument require a dealer to hold additional equity under SLR before entering into a trade. In practice, each firm may have its own approach for deciding how much additional equity to hold, which may vary by business unit. The capital charges associated with different leverage ratio assumptions is shown in Table 2. For a swap spread trade, the largest capital charge stems from the cash position since the charge is based on the entire notional amount financed rather than the net repo liability. However, for higher leverage ratios, the equity associated with the derivatives transaction through the initial margin and PFE can also be large.

Anecdotal evidence suggests that dealers increasingly are evaluating trades through a profitability lens based on the ROE for a given trade, which has declined because of higher leverage requirements. Table 2 also shows ROE based on assumed SLRs ranging from 1 to 6 percent. Other key assumptions in this calculation are the spread between swap rates and Treasury yields, and the spread between three-month Libor and repo rates.

TABLE 2

## Components of Regulatory Equity Charges for Treasury-Swap Spread Trade

U.S. Dollars, Except as Noted

	Supplementary Leverage Ratio					
	1%	2%	3%	4%	5%	6%
Treasury	100,000	200,000	300,000	400,000	500,000	600,000
Haircut	2,800	5,600	8,400	11,200	14,000	16,800
Initial margin	3,900	7,800	11,700	15,600	19,500	23,400
Potential future exposure	600	1,200	1,800	2,400	3,000	3,600
Total equity cost	107,300	214,600	321,900	429,200	536,500	643,800
Total profit (return)	37,490	37,490	37,490	37,490	37,490	37,490
Return on equity (percent)	35	17	12	9	7	6

Source: Authors' calculations.

Notes: The following assumptions were made: 2.8 percent haircut in the Treasury-collateralized repo trade, with a 0.3 percent interest rate; 0.5 percent interest rate charged in the unsecured funding market; 3.9 percent initial margin on the interest rate swap position; 0.6 percent three-month Libor; \$10 million swap notional; and \$10 million Treasury position.

Table 2 suggests that ROE is very sensitive to the capital charge, which in turn is highly sensitive to leverage ratios. An increase or decrease of as little as one percentage point in the leverage ratio can have a big effect. Indeed, the impact on ROE is nonlinear. The ROE declines from 35 percent to 17 percent when the assumed leverage ratio increases from 1 percent to 2 percent, and from 17 percent to 11 percent when the ratio increases from 2 to 3 percent. The SLR for the largest U.S. banks is currently around 6.0 to 6.5 percent.<sup>12</sup> Around this level, ROE for the swap spread trade is at most 6 percent—less than half the 15 percent ROE reportedly targeted by dealers on average.

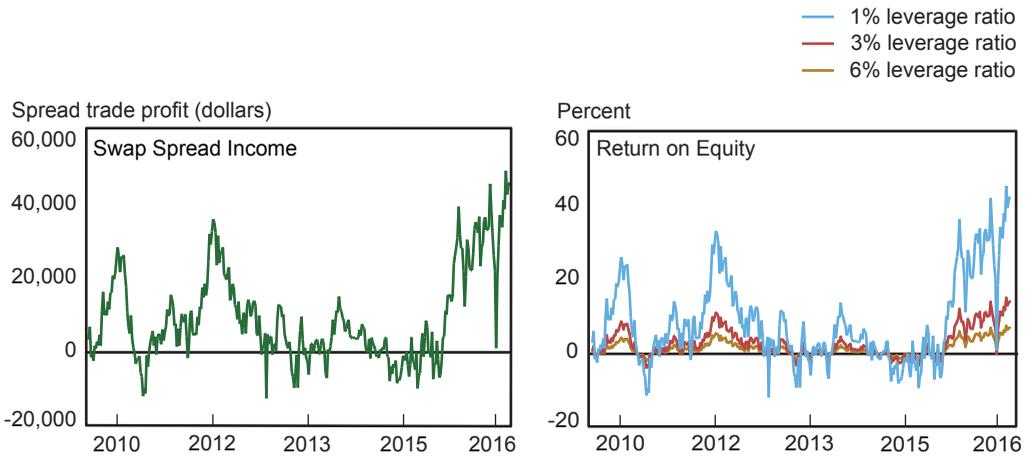
Compare this to the ROE that would have been earned historically on the Treasury-swap trade. The time series evolution of the profit from the Treasury-swap trade and the total equity cost under different leverage ratio assumptions are presented in Chart 2. As the swap spread and the Libor-OIS spreads fluctuate over time, the income earned on the swap spread trade fluctuates as well (Chart 2, left panel). When the minimum leverage level required by regulation is low, say 1 percent, the implied ROE fluctuates between -10 percent and +40 percent (Chart 2, right panel). However, for higher required leverage levels, the fluctuations are much more modest. With a 6 percent minimum leverage requirement, the implied ROE never reaches above 7.5 percent.

### *Breakeven Swap Spreads*

Although new regulations may have increased the swap spread cost for dealers, there should still be a level at which the difference in pricing between the cash and derivative markets makes dealers willing to enter into an arbitrage trade.

CHART 2

Profitability and Cost of Equity for Treasury-Swap Trade over Time



Sources: Bloomberg L.P.; authors' calculations.

Notes: The following assumptions were made: 2.8 percent haircut in the Treasury-collateralized repo trade, 3.9 percent initial margin on the interest rate swap position, \$10 million swap notional, and \$10 million Treasury position.

TABLE 3

Treasury-Swap Spread Required for Return on Equity at Different Dealer Leverage Ratios

Return on Equity (Percent)	Supplementary Leverage Ratio					
	1%	2%	3%	4%	5%	6%
5	21	16	11	5	0	-6
10	16	5	-6	-16	-27	-38
15	11	-6	-22	-38	-54	-70
20	5	-16	-38	-59	-81	-102
25	0	-27	-54	-81	-107	-134
30	-6	-38	-70	-102	-134	-166

Sources: Bloomberg L.P.; authors' calculations.

Notes: Spreads are reported in basis points. The following assumptions were made: 2.8 percent haircut in the Treasury-collateralized repo trade, 3.9 percent initial margin on the interest rate swap position, \$10 million swap notional, \$10 million Treasury position, and one-year holding period for the swap spread trade.

Table 3 conducts a sensitivity analysis of the breakeven ten-year swap spread needed to achieve a given ROE target at different SLR levels. In the past, when the balance sheet cost was very low because of risk weighting, a dealer could earn a 15 percent ROE at a spread up to 11 basis points simply through carry. At a 5 percent leverage ratio, the spread needs to

be -54 basis points to achieve a 15 percent ROE. Although this calculation is subject to many assumptions, it illustrates the costs dealers now face. These higher costs help explain why regulated institutions are less likely to execute swap spread trades unless spreads reach much more negative levels than in the past: A more negative swap spread increases the carry earned, making the trade economical even with the capital charge.

### 3. Conclusion

Although we cannot precisely measure the costs SLR capital requirements impose, it appears that executing swap spread trades is now more expensive for dealers than in the past largely because of the amount of capital that dealers must hold against these trades. The amount of capital required is driven principally by the cash product position of the trade rather than the derivatives portion. The SLR requires that the entire repo-financed Treasury position be recognized, while the derivatives portion is recognized only up to the margin posted on, and the potential future exposure of the position. As a result, while current negative swap spread levels may have presented attractive trading opportunities in the past—which would have reduced deviations from parity—our analysis suggests that, given the balance sheet costs, these spreads must reach more negative levels to generate an adequate ROE for dealers. This may represent a shift in the spread levels considered attractive for trading, suggesting there may be a “new normal” level at which dealers are incentivized to trade.

At the same time, although Treasury-swap spread trades might be attractive to financial institutions facing fewer regulations, such institutions frequently rely on the regulated financial sector to fund these leveraged positions. Dealers that find spread trades to be unprofitable for their own book are also less likely to provide leverage to their clients pursuing the same trades. Post-crisis regulation may thus also affect the ability of unregulated intermediaries to carry out leveraged trades.

## APPENDIX: POTENTIAL FUTURE EXPOSURE

Potential future exposure (PFE) is an estimate of the value of a derivative contract at future points in time, usually within a specified confidence interval such as 95 or 99 percent. It is essentially an estimate of the future replacement cost of the contract via a distribution of potential values rather than a single point estimate.

Although representative of the estimated future distribution, the PFE is defined as the upper bound of the forecasted credit exposures at the given level of confidence over a specified period of time. The PFE is not known with certainty because it estimates the market value in the future. In contrast, the current credit exposure, which is the greater of the present fair value of the contract and zero, is known with certainty since it captures only the current market value.

There are various methodologies used to calculate PFE including simulations of future paths of the inputs used to calculate the replacement value and using a constant exposure method based on a fixed percentage of the effective derivative notional value of the contract. The Basel Accord utilizes the latter methodology, calculating PFE by multiplying the notional value of the derivative contract with a fixed percentage that is based on the PFE Add-on Factor as indicated in the Accord. This factor is based on the asset class and remaining maturity of the derivative contract. Table A1 lists the PFE factor by asset class and maturity.

TABLE A1  
**Potential Future Exposure Add-On Factors**  
 Percent

	Interest Rates	FX and Gold	Equities	Precious Metals except Gold	Other Commodities
One year or less	0.0	1.0	6.0	7.0	10.0
More than one year up to five years	0.5	5.0	8.0	7.0	12.0
More than five years	1.5	7.5	10.0	8.0	15.0

Source: Basel III: Finalizing Post-Crisis Reforms, December 2017, <https://www.bis.org/bcbs/publ/d424.htm>.

## NOTES

*Acknowledgments: The authors thank an anonymous referee for comments on the previous draft of this article. The authors also thank Or Shachar, Jordan Pollinger, and Tony Baer for fruitful discussions on the structure of the market and impact of regulation on the cost-effectiveness of interest rate arbitrage trades.*

<sup>1</sup> As of the second half of 2015, BIS semiannual OTC derivatives statistics.

<sup>2</sup> Bretscher, Schmid, and Vedolin (2016) examine a large cross-section of hand-collected data on interest rate hedging by publicly traded firms over the past twenty years. They find that interest rate risk management does indeed help attenuate the impact of interest rate uncertainty on investment. Rampini, Viswanathan, and Vuillemy (2015) use shocks to other parts of bank balance sheets as a source of exogenous variation of institutions' incentives to hedge interest rate risk and find a positive and significant relationship between hedging and net worth, with distressed institutions reducing their hedging intensity.

<sup>3</sup> Since Libor is the interest rate at which banks borrow, it reflects the credit risk of these institutions. The reverse repo rate on U.S. Treasuries lent in general collateral (GC) repo markets, in contrast, is essentially credit risk free.

<sup>4</sup> An interest rate swap spread is termed to "narrow" when it becomes smaller, even when the gap between the swap spread and the yield paid on a matched-duration U.S. Treasury security is negative.

<sup>5</sup> The approach in this article builds on the analysis in Korapaty and Marshall (2015).

<sup>6</sup> Klingler and Sundaresan provide a comprehensive review of the extensive literature on swap rates and Treasury yields, as well as the use of swaps by nonfinancial corporations.

<sup>7</sup> These assumptions are based on interest rates prevailing in the fall of 2015.

<sup>8</sup> The interest rate charged in unsecured funding markets is approximately equal to the interest rate charged in an overnight indexed swap (OIS) with equal maturity. An OIS is an interest rate swap where the periodic floating payment is based on a return calculated from a daily compound interest investment and the reference rate is an overnight rate.

<sup>9</sup> The potential for future exposure (PFE) is a measure of counterparty/credit risk as represented by the maximum exposure under normal market conditions over a future specified period of time. The PFE is included in the denominator of the SLR along with other off-balance-sheet exposures and on-balance-sheet assets. See Appendix for details.

<sup>10</sup> When the dealer executes the trade on behalf of a client instead of itself, the balance sheet impact is similar except for three important differences. First, the initial margin the client posts with the dealer, which the dealer then posts with the CCP, increases the payables on the liabilities side of the dealer's balance sheet, depleting the equity cushion further. Second, if the dealer executes the interest rate swap leg of the trade by buying the swap from their client to face the CCP, the dealer's PFE to the overall trade increases. Finally, if the dealer provides funding to the client, the value of loans on the asset side of the balance sheet increases, expanding the dealer's balance sheet further.

<sup>11</sup> Recall that the swap spread is the difference between the swap rate and the Treasury yield.

<sup>12</sup> Current estimate based on 2015 earnings reports for JPMorgan Chase, Bank of America Merrill Lynch, and Morgan Stanley.

## REFERENCES

- Adrian, T., and N. Boyarchenko. 2012, revised 2015. “Intermediary Leverage Cycles and Financial Stability,” Federal Reserve Bank of New York STAFF REPORTS, no. 567.
- Bretscher, L., L. Schmid, and A. Vedolin. 2017. “Interest Rate Risk Management in Uncertain Times” (December): Available at SSRN: <https://ssrn.com/abstract=2716993>.
- Brunnermeier, M. K., and Y. Sannikov. 2014. “A Macroeconomic Model with a Financial Sector,” AMERICAN ECONOMIC REVIEW, 104, no. 2 (February): 379-421.
- Garleanu, N., and L. H. Pedersen. 2011. “Margin-based Asset Pricing and Deviations from the Law of One Price,” REVIEW OF FINANCIAL STUDIES, 24, no. 6 (April): 1980-2022.
- He, Z., and A. Krishnamurthy. 2013. “Intermediary Asset Pricing,” AMERICAN ECONOMIC REVIEW, 103, no. 2 (April): 732-70.
- Jermann, U. J. 2016. “Negative Swap Spreads and Limited Arbitrage,” University of Pennsylvania (June): Available at SSRN: <https://ssrn.com/abstract=2737408>.
- Klingler, S., and S. M. Sundaresan. 2016. “An Explanation of Negative Swap Spreads: Demand for Duration from Underfunded Pension Plans,” (October): Available at SSRN: <https://ssrn.com/abstract=2814975>.
- Korapaty, P., and W. Marshall. 2015. “Funding Rates and Swap Spreads—Drivers, Frictions, and Potential Lower Bound,” Credit Suisse U.S. Interest Rate Strategy Focus, November 30.
- Rampini, A. A., S. Viswanathan, and G. Vuillemey. 2015. “Risk Management in Financial Institutions,” (October): Available at SSRN: <https://ssrn.com/abstract=2677051>.

*The views expressed are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System. The Federal Reserve Bank of New York provides no warranty, express or implied, as to the accuracy, timeliness, completeness, merchantability, or fitness for any particular purpose of any information contained in documents produced and provided by the Federal Reserve Bank of New York in any form or manner whatsoever.*