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Trends in Credit Market Arbitrage

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Abstract

Market participants and policymakers alike were surprised by the large, prolonged dislocations in credit market arbitrage trades during the second half of 2015 and the first quarter of 2016. In this paper, we examine three explanations proposed by market participants: increased idiosyncratic risks, strategic positioning by some market participants, and regulatory changes. We find some evidence of increased idiosyncratic risk during the relevant period but limited evidence of asset managers changing their positioning in derivative products. While we cannot quantify the contribution of these two channels to the overall spreads, the relative changes in idiosyncratic risk levels and in asset managers' derivatives positions appear small relative to the post-crisis increase in cost of capital. We present the mechanics of the CDS-bond arbitrage trade, tracing its impact on a stylized dealer balance sheet and the return-on-equity (ROE) calculation. We find that, given current levels of regulatory leverage, the CDS-bond basis would need to be significantly more negative relative to pre-crisis levels to achieve the same ROE target.

Key words: CDS basis, capital requirements, M-CAPM

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1 Introduction

Corporate bonds represent an important source of funding for public corporations in the United States. When these bonds cannot be easily traded in secondary markets or when investors cannot easily hedge their bond positions in derivatives markets, the issuance costs to corporations increase, leading to higher overall funding costs. In this paper, we examine recent trends in arbitrage-based measures of liquidity in cash bond and credit default swap (CDS) markets and evaluate potential explanations proposed for the widening in both arbitrage trades that occurred between the middle of 2015 and early 2016.

The prolonged dislocation between the cash bond and CDS markets and between segments of the CDS market surprised market participants as, in the past, participants would execute "arbitrage" trades in anticipation of the spreads between the cash and derivative markets retracing to more normal levels. This type of trading activity serves to link valuations in the two markets together and helps correct price differences associated with transient or technical factors. The persistence and the magnitude of the dislocations during the first quarter of 2016 thus suggests that the limits-to-arbitrage in these markets have become more binding than in the past.

We examine three potential sources of the persistent dislocation: increased idiosyncratic risk, which makes the CDX-CDS arbitrage trade less attractive, strategic positioning in CDS products by institutional investors, which makes the CDS market more liquid relative to the cash market, and post-crisis regulatory changes. We do not attempt to quantify the contribution of each of these channels to the widening in the CDS-bond and the CDX-single name spread, but instead consider whether measures of these channels are qualitatively consistent with the limits to arbitrage mechanism.

Finally, we review the trade mechanics of the CDS-bond basis trade and set up a stylized balance sheet framework that can be used to assess the impact that capital regulation may be having on the incentives to enter into these types of trades. We lay out the trade mechanism in some detail, which allows us to quantify the impact that capital and derivatives trading regulation has on the incentives to engage in arbitrage trades for a stylized example. The numbers and exact version of the trade laid out in this piece are illustrative as there is not a standardized arbitrage trade. The exact terms vary depending on the dealer, investor, and cash securities used. This example and the Treasury-interest rate swap trade described in the Appendix are based on conversations with fixed income strategists who research and monitor such trade opportunities for their clients.

Many market participants, including dealer strategists and buyside investors, cite balance sheet constraints as an underlying factor contributing to the unusual price dislocations. In particular, market participants believe that balance sheet constraints impact prices through multiple channels such as liquidity in the cash markets and willingness to facilitate arbitrage trades between the cash and derivatives markets that would narrow the gap in pricing. We extend the balance sheet example to evaluate the profitability of these trades under various assumptions within a cost of capital framework. In this stylized framework, the profitability is defined as the return per additional dollar of equity required by the trade. The assumptions that we vary are the targeted leverage ratio and the target return-on-equity (ROE). While bank regulatory leverage levels were around 2 to 3 percent pre-crisis, they are now 5 to 6 percent. In our stylized examples, this can result in ROEs that are 2 to 3 times lower, making previously attractive trades significantly less economical.

The rest of the paper is organized as follows. Section 2 reviews the theoretical arbitrage trades and the recent performance of these trades. We turn towards potential explanations for basis dislocations in Section 3. Section 4 explains the mechanics of the CDS-bond trade in detail and examines how post-crisis regulation impacts the incentives to engage in this trade. We draw policy conclusions in Section 5.

2 Recent Trends

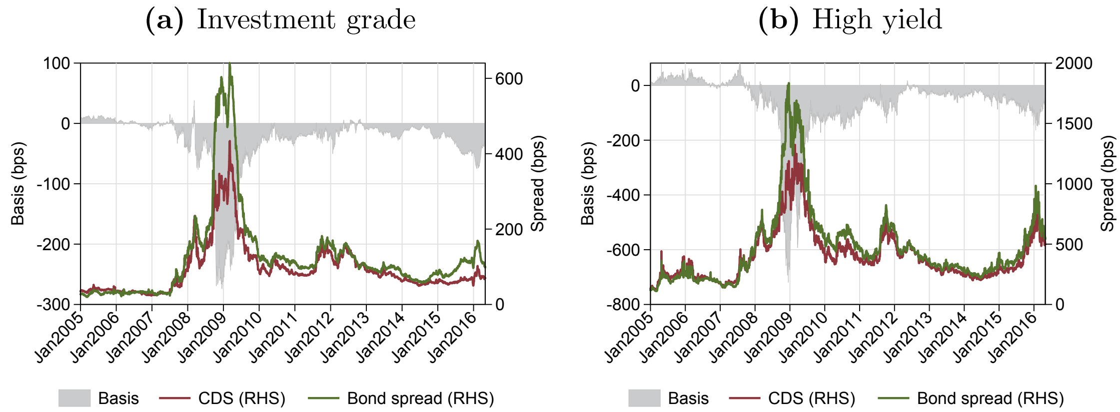
We focus on two particular credit arbitrage trades: the CDS - cash bond basis trade and the index CDS - single name CDS (CDX-CDS) basis trade. We discuss each of these in turn.

2.1 CDS-cash bond arbitrage trade

The first basis trade we consider, and the main focus of this paper, is the CDS - cash bond basis trade. In the CDS-bond trade, an investor buys (sells) a corporate bond and simultaneously buys (sells) protection on the same reference entity in the CDS market. This trade is generally considered to be an "arbitrage" trade in the sense that an investor earns a non-zero return on a default-risk free portfolio. The CDS-bond basis is then computed as the difference between the market CDS spread and the theoretical CDS spread implied by the yield on the cash bond. When the spread is negative, the basis is earned by purchasing the cash bond and purchasing protection in the CDS market.[1] In this trade, a market participant receives the bond coupons, pays the CDS par-equivalent spread, the repo interest rate and haircut (if the cash bond position is repo financed), and the funding cost for the initial and variation margin on the CDS position.

[1]This trade, while free of default risk, is exposed to interest rate risk. Some market participants enter into an asset swap (ASW), which converts the fixed coupons paid on the bond to a floating rate equal to the ASW spread plus LIBOR. In this case, the CDS-bond basis is defined as the difference between the ASW spread and the CDS par-equivalent spread.

Figure 1. Historical evolution of the CDS-bond basis. Time series of the CDS spread, the bond-implied CDS spread and the CDS-bond spread for investment-grade (left panel) and high-yield (right panel) reference entities. Source: JP Morgan.



In practice, the CDS-bond basis has historically deviated aways from zero and has varied over time (see Figure 1). One interpretation of the negative basis is that it measures deteriorating liquidity in the cash bond market relative to the CDS market: a more negative CDS-bond basis suggests that the CDS market is more liquid compared to the cash market and thus to transact in the more liquid market, investors are willing to accept a lower spread. While there is no consensus about a single driver that explains the violation of the arbitrage relationship, a number of authors have found that funding risk and limited intermediary capital contribute to the negative CDS basis. Bai and Collin-Dufresne (2013) find that funding risk, counterparty risk, collateral quality, and liquidity risk are all potential explanations for the extreme negative basis during the financial crisis. Trapp (2009) has similar findings and in addition finds that the profitability of credit basis trades is affected by unwind risk. Choi and Shachar (2014) use data on corporate bond and CDS holding of individual institutions during the financial crisis, and find that limited dealer capital prevent convergence of the basis, which was precipitated by the unwinding of pre-crisis basis trades by hedge funds. Using more recent data, Oehmke and Zawadowski (2015) argue the positive correlation between net notional of CDS outstanding and the negative bond basis suggests that arbitrageurs use the CDS market to lean against mispricing in the cash bond market. More generally, Mitchell and Pulvino (2012) find that limited risk-bearing capital at prime brokers during the financial crisis limited the amount of leverage available to hedge funds and thus severely restricted their ability to maintain similar prices of similar assets.

However, market participants were still surprised by how large and persistent the gap between CDS and cash bond spreads had been as, in the past, during normal times, when the CDS-bond basis became more negative, market participants such as dealers, hedge funds, sophisticated asset managers, and pension funds would execute CDS-cash bond trades; this in turn, would help to reduce the dislocation. Figure 1 plots the evolution of the CDS-bond basis for investment grade (left panel) and high yield (right panel) bond indices since January 2005. The CDS-bond basis has been increasing since January 2015 for investment grade bonds and since the middle of 2015 for high yield bonds, suggesting that the liquidity of the cash bond market has been deteriorating relative to the liquidity of the CDS market.

2.2 CDX-CDS arbitrage trade

For the CDX-CDS arbitrage trade, on the other hand, an investor buys (sells) protection on a CDX index and sells (buys) protection on the portfolio of single name CDS contracts that replicates the index. Similarly to the CDS-bond basis trade, this trade is considered to be default-risk-free as the portfolio of single name contracts perfectly replicates the payoffs from the index contract. The CDX-CDS basis is constructed as the absolute value of the difference between the spread on the CDX index and the spread implied by the spreads paid on the replicating portfolio of single-name CDS. Junge and Trolle (2014) argue that the CDX-CDS basis measures the overall liquidity of the CDS market, with changes to the basis accounting for 30% of CDS returns on average. In this trade, the arbitrageur receives the difference between the index spread and the equal weighted spreads on the underlying single name CDS, net of the funding cost of the initial and variation margins required for each CDS contract purchased and sold.

Figure 2. Historical evolution of the CDS-CDX basis. Time series of the CDX spread, the individual CDS-implied spread (CDS basket) and the CDS-CDX spread for investment-grade (left panel) and high-yield (right panel) CDX index. Source: Markit.

(a) Investment grade **(b)** High yield

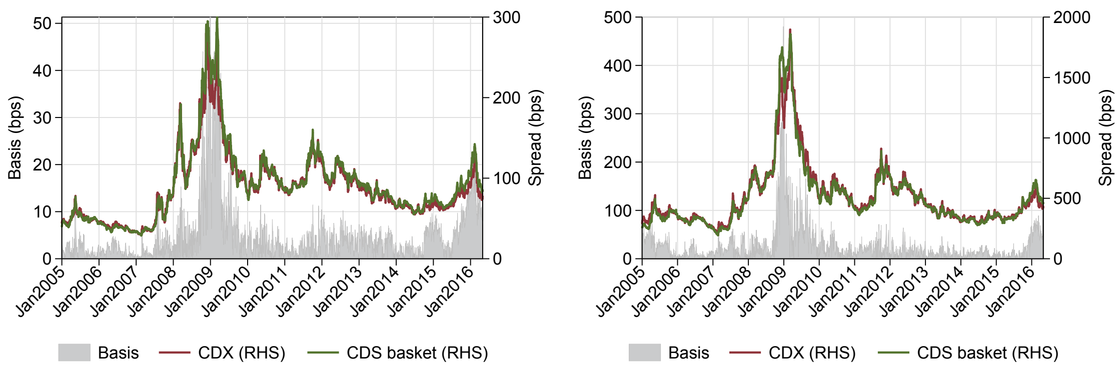


Figure 2 plots the time series evolution of the quoted spread, the single-name implied spread and the CDX-CDS basis for the North American investment grade (left panel) and North American high yield (right panel) on-the-run CDX indices. Similarly to the CDS-bond basis, the CDX-CDS basis has been increasing since the beginning of 2015, suggesting that while liquidity of the CDS market has been improving relative to the cash bond market, the liquidity of the CDS market has been deteriorating relative to the CDX market. In the month of February, the CDX-CDS basis reached peaks not seen since the financial crisis, reaching a third of the financial crisis peak.

2.3 Historical context

These moves in the credit bases were abnormal relative to historical experience. Table 1 below shows that both the one month and the six month changes in the

CDS-bond basis are in the bottom (most negative) 10-15th percentile of historical changes for the investment grade and high yield indices. For the CDX-CDS basis, both the one month and the six month changes are in the highest (largest) 5th percentile of the historical distribution of changes for both the investment grade and the high yield indices.

Table 1: Historical credit basis changes. Changes in the CDS-bond and CDX-CDS basis up to Jan 2016, and the percentile of the historical distribution represented by the changes.

A. CDS-bond basis

	1 month change	Percentile	6 month change	Percentile
IG	-13.181	10	-24.301	15
HY	-19.2	15	-46.859	15

B. CDX-CDS basis

	1 month change	Percentile	6 month change	Percentile
IG	3.357	95	12.312	95
HY	13.756	90	50.271	95

3 Potential Explanations

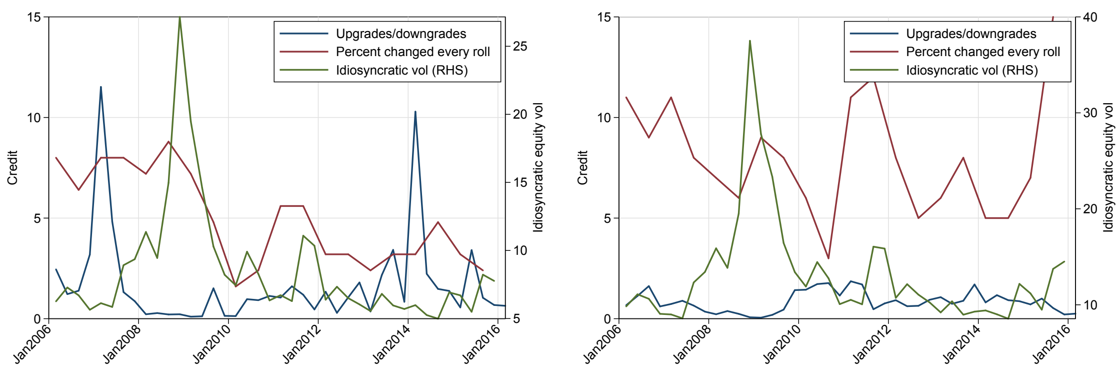
The proposed explanations for these recent changes can be grouped into three categories: greater idiosyncratic risk, which makes the CDX index a less attractive instrument for hedging individual exposures; strategic positioning by asset managers; and regulatory constraints, which reduce the attractiveness of engaging in arbitrage trades. In this section, we describe each of these in turn.

3.1 Idiosyncratic risk

Figure 3 plots three measures of idiosyncratic risk for investment grade (left panel) and high yield (right panel) firms: the fraction of names changed every CDX index roll,[2] the number of downgraded firms relative to the number of upgraded firms and the idiosyncratic equity return volatility. The fraction of names changed every CDX index roll is high when a large fraction of index constituents fails to satisfy either the credit rating or the liquidity requirement for inclusion in the new version of the index, implying higher idiosyncratic credit or liquidity risk. The number of firms within each broad rating category that get downgraded relative to the number of firms that get upgraded then focuses on changes in the downside rating risk of firms in each rating category. When this fraction is large, firms are more likely to be downgraded than upgraded. We follow Goyal and Santa-Clara (2003) in constructing the idiosyncratic equity return volatility, but average stock variance within a month-credit rating category to obtain an estimate of credit-rating-level idiosyncratic volatility.

Figure 3. Historical evolution of the idiosyncratic risk measures. Fraction of names changed every index roll, fraction of entities upgraded relative to the fraction of entities downgraded and idiosyncratic equity volatility for investment-grade (left panel) and high-yield (right panel) reference entities.

(a) Investment grade **(b)** High yield



While the credit-market-based measures (that is, the fraction of names changed every index roll and the number of downgraded relative to upgraded firms) suggest that the idiosyncratic risk in the high yield index has been increasing over the last year, the idiosyncratic risk in the investment grade index has remained in line with

[2]Changes to the inclusion methodology for the CDX HY index went into effect starting with the September 2015 roll in an effort to better align the derivative index with HY cash indices.

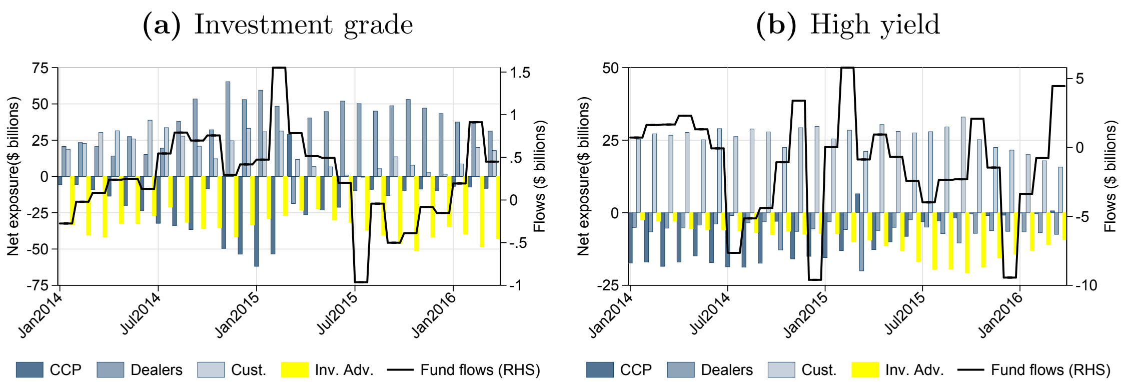
historical averages. This suggests that, while idiosyncratic risk may be contributing to the basis widening for lower quality firms, the basis for investment grade firms has widened for other reasons, although the idiosyncratic equity return volatility has increased slightly for both investment grade and high yield firms in the second half of 2015.

3.2 Strategic positioning

Some market participants have also suggested that mutual funds specializing in credit strategies may have shifted their portfolios to derivative products in anticipation of fund outflows. We use position snapshot data provided by the Depository Trust and Clearing Corporation (DTCC) to the Federal Reserve Board (FRB) to construct net positions in the relevant derivative products (the net position between CDX indices and the constituent single-name CDS on a given index). DTCC provides weekly snapshots of positions and transactions for contracts in which (1) one of the counterparties is an institution supervised by the FRB or (2) that reference institutions supervised by the FRB. In particular, the largest dealer banks in the US (Bank of America, Citibank, Goldman Sachs, JP Morgan Chase and Morgan Stanley) are supervised by the FRB. Boyarchenko et al. (2016) show that the positions data covers 75% of trades reported to DTCC's Trade Information Warehouse (TIW) in a median week; see Boyarchenko et al. (2016) for a more detailed description of the supervisory DTCC data, as well as a more detailed comparison between the supervisory sample and the TIW universe of transactions. Using the weekly position snapshots, we construct net positions for each CDS market participant, and aggregate by institution type - central clearing counterparty (CCP), DTCC dealer, non-investment advisor DTCC client and investment advisors. We identify investment advisors by matching participant names to Compustat firms and using the assigned 2 digit SIC.

Figure 4 shows the net position in the CDX-CDS basis trade in the investment grade

Figure 4. Net exposure to CDX indices by type of institution. Net exposure (CDX position net of the position in the replicating portfolio of single name CDS) for investment-grade (left panel) and high-yield (right panel) North American CDX indices, together with monthly net flows into mutual funds specializing in investment grade (left panel) and high yield (right panel) bonds. Source: DTCC, author calculations, Morningstar.



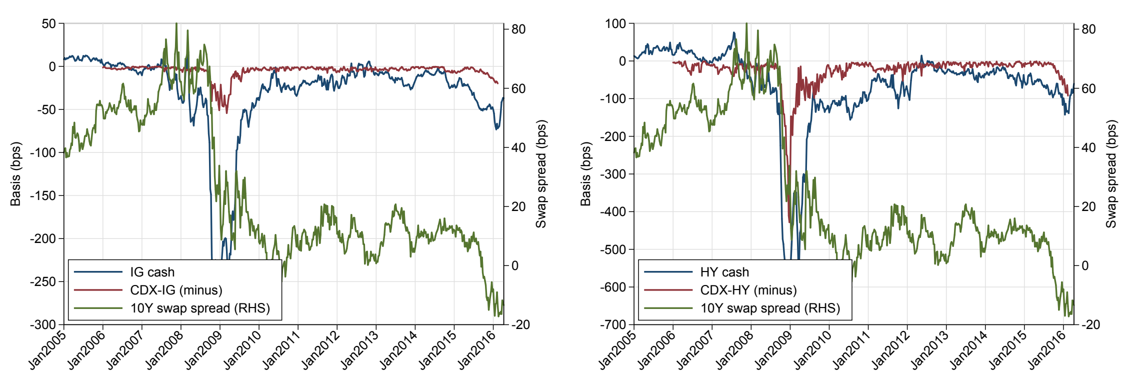
(left panel) and high yield (right panel) index by type of institution, together with the monthly net inflows into bond asset managers specializing in investment grade and high yield bonds, respectively. As suggested by market participant commentary, investment advisors have been increasing their long position (that is, selling more protection) in the CDX indices over the last year. While this increase is unusual for the high yield index, investment managers typically have a large sell exposure to the investment grade index. One potential explanation for this increase of sell exposures is strategic positioning: in anticipation of future fund outflows, investment advisors may choose to sell the more liquid CDS to take on credit risk exposure rather than buying the (relatively) less liquid corporate bonds. Indeed, increased outflows from both investment grade and high yield funds do seem to coincide with the increased use of derivative products. This further decreases the liquidity in the bond market relative to the CDS market, and thus is also a contributing factor to the widening of the CDS-bond basis. The increased CDX index exposure by investment advisors also leads to increased liquidity concentration, along with less frequent CDS rolls every 6 months, and makes basis trades more costly to enter and exit as it is more difficult to match CDS and bond maturities.

3.3 Regulatory changes

While we cannot directly measure the costs imposed by regulation on engaging in basis arbitrage trades, we can examine whether the widening in the credit bases coincide with basis widening in other markets. Figure 5 plots the two credit bases together with the spread between the fixed interest rate paid on interest rate swaps with a 10 year maturity and the yield on the 10 year Treasury security. The credit basis widening coincides with swap spreads becoming negative in the early part of 2015, and with the prolonged decline in the 10 year yield, which could be caused by binding balance sheet constraints for institutions that intermediate in these markets. It is also important to note that there is little correlation between the credit basis and the swap spread prior to 2015, further suggesting a recent structural change in these markets. We discuss the swap spread trade in greater detail in the Appendix and focus here on how regulatory changes impact the profitability of the CDS-bond basis trade.

Figure 5. Historical evolution of the CDS-bond basis, CDX-CDS basis and Treasury-swap spread. Time series of the CDS-bond basis and the CDX-CDS basis for investment-grade (left panel) and high-yield (right panel) reference entities, together with the 10 year Treasury-swap spread.

(a) Investment grade　　　　**(b)** High yield



4 CDS-Bond Trade in Practice

In this section, we discuss how basis trades are implemented in practice, including the capital charges associated with both legs of the trade and the cost of funding of both legs of the trade. In particular, this section approaches the basis deviations from the viewpoint of a confluence of intermediary asset pricing and margin asset pricing. In intermediary asset pricing theory (see e.g. He and Krishnamurthy, 2013; Brunnermeier and Sannikov, 2014; Adrian and Boyarchenko, 2012), binding capital and liquidity regulation increases the effective risk aversion of intermediaries, who are the marginal investors in these markets. Higher effective risk aversion leads to higher risk premia, including higher liquidity risk premia, and can thus prevent arbitrage trades from being executed. at the same time, since the CDS leg of the CDS-bond arbitrage trade requires posted margin, the margin CAPM of Garleanu and Pedersen (2011) applies, with the deviations from law of one price larger whenever the marginal value of financing the margin requirement is higher.

4.1 Mechanics of the trade

Figure 6 illustrates the different transactions required to complete the CDS-bond trade from the perspective of a dealer executing it for its own book. 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. The dealer buys a corporate bond in the corporate bond market, and uses the cash bond as collateral to borrow in the tri-party repo market. The repo position requires a haircut, which we assume to be 5% in the balance sheet example in section 4.2, and the dealer pays a tri-party repo interest rate, which we assume to be 0.5% APR, each day that it has an open repo position. The haircut on the repo is borrowed using an overnight indexed swap (OIS), with a 0.5% APR and 1 year maturity.

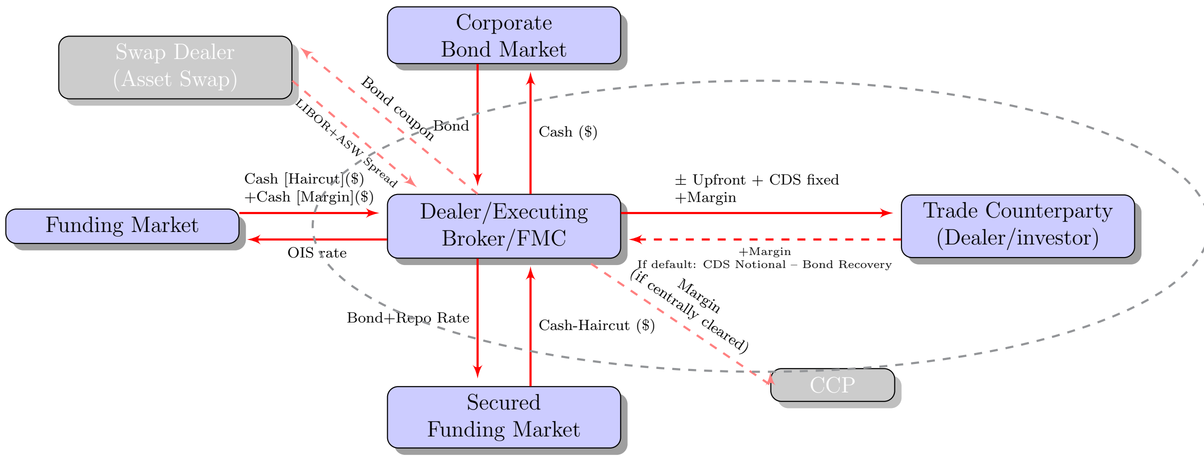
To conduct the derivatives leg of the trade, the dealer buys a CDS that protects the dealer from default on the corporate bond.[3] Since single-name CDS do not have mandatory clearing requirements but may be accepted for central clearing on a CCP, the dealer can face either a CCP (if the contract is cleared on a voluntary basis), another dealer or a non-dealer customer when entering into the CDS contract. For U.S. reference entities, the dealer pays the standard fixed rate of 100 or 500 basis points per period based on the notional of the CDS and also may either receive or pay an upfront amount since the fair value of the CDS contract may not be zero at inception (given that the standard fixed rate payments on the contract may be higher or lower than the actual market spread for the CDS). The CDS transaction requires posting initial margin to the CCP (or market participant if the CDS is not centrally cleared). To fund this initial margin, the dealer borrows the cash required from the funding market, paying an interest rate of 1-year OIS. If the values of the swap and/or CDS change over time, the dealer will need to post variation margin. When the dealer purchases the CDS from a participant other than the CCP, the dealer also requires its counterparty to post initial and variation margin to protect itself from the risk of the counterparty defaulting before the default of the reference entity.

4.2 Balance sheet impact

Table 2 illustrates how the credit basis trade impacts a dealer's balance sheet. The key assumptions in this example are the haircut charged on financing the corporate bond purchase in the repo market, the initial margin required on the single name CDS

[3] Market participants may also execute a third leg which is an asset swap in order to hedge the corporate bond's interest rate risk. In the asset swap, the dealer pays a fixed rate based on the bond's coupon and receives the equivalent floating rate based on LIBOR plus the ASW spread.

Figure 6. Mechanics of the Bond-CDS Trade



position, and whether the CDS is centrally cleared, which determines the potential future exposure (PFE) cost.

Panel A of Table 2 shows a representative dealer balance sheet before the dealer engages in the CDS-cash bond basis trade. On the asset side, the dealer holds some cash and cash-equivalent products, corporate bonds, securities purchased under agreements to resell (reverse repo positions), derivative instruments with a positive fair value, payment receivables, and other assets. On the liabilities side, the dealer issues both short- and long-term debt and equity. Other liabilities include securities sold under agreements to repurchase (repo positions), derivative products with a negative fair value, and payment payables.

Consider first the balance sheet impact of the long-corporate bond leg of the negative basis trade, illustrated in Panel B. Assume that the trade size is $10 million and that the dealer faces a 5 percent haircut when buying the corporate bond using repo funding. The trade increases the corporate bond 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 $500,000 haircut. In addition, the dealer borrows the \$500,000 haircut on the repurchase agreement in short-term funding markets at a 0.5 percent interest rate, increasing its short-term debt.

Table 2: Balance Sheet Impact and Cost to Trade of a CDS-Bond Trade. Stylized example of the balance sheet impact and the cost-to-trade a 5 year CDS-cash basis trade on Time Warner Cable February 2021, from a dealer's perspective. Assumptions: 5% haircut in the cash bond-collateralized repo trade, with a 0.48% interest rate; 0.5% interest rate charged in the overnight interest rate swap market; 4% initial margin from the seller of the CDS; 2% initial margin from the buyer of the CDS; 1% fixed spread on the CDS.

A. Starting Balance Sheet

Assets		Liabilities	
Cash		Short-term debt	
Corporate bonds		Long-term debt	
Securities purchased under agreements to resell		Securities sold under agreements to repurchase	
Derivatives with a positive fair value		Derivatives with a negative fair value	
Receivables		Payables	
Total Assets		**Total Liabilities**	

B. Balance Sheet with Cash Leg Only

Assets		Liabilities	
Cash		Short-term debt	+\$500,000
Corporate bonds	+\$10,000,000	Long-term debt	
Securities purchased under agreements to resell		Securities sold under agreements to repurchase	+\$9,500,00
Derivatives with a positive fair value		Derivatives with a negative fair value	
Receivables		Payables	
Total Assets	+\$10,000,000	**Total Liabilities**	+\$10,000,000

C. Balance Sheet with Cash and Derivative Legs

Assets		Liabilities	
Cash		Short-term debt	+\$700,000
Corporate bonds	+\$10,000,000	Long-term debt	
Securities purchased under agreements to resell		Securities sold under agreements to repurchase	+\$9,500,00
Derivatives with a positive fair value	+\$166,385	Derivatives with a negative fair value	+\$0
Receivables	+\$200,000	Payables	+\$166,385
Total Assets	+\$10,366,385	**Total Liabilities**	+\$10,366,385

D. Costs to Trade

Single-Name CDS Trade	**Amount**
Trade Size	
Notional	\$10,000,000
Initial Margin Received	\$400,000
Initial Margin Posted	-\$200,000
Upfront	\$166,385
CDS Costs	
IM Funding Cost ~1y OIS	-\$1,000
CDS running premium	
CDS Effective Spread	-\$65,500
CDS Fixed Premium	-\$100,000
Total CDS Payment	-\$66,500
Corporate Bond in Repo	
Trade Size	
Corporate Bond	\$10,000,000
Haircut ~5%	\$500,000
Costs	
Corporate Bond Repo ~0.48%	-\$48,000
Haircut ~1Y OIS	-\$2,500
Total Corporate Bond Cost	-\$50,500
Net Return from Carry	
CDS Payment	-\$65,500
CDS Cost	-\$1,000
Corporate Bond Cost	-\$50,500
Total Before Spread	-\$117,000
CDS-Cash Basis	\$134,000
Total After Spread	\$17,000

Panel C then illustrates the balance sheet impact of the dealer buying CDS protection, so that the dealer will be paying a standard fixed rate of 100 or 500 bps. At inception of the trade, if the market rate of the CDS contract differs from the standard rate paid, the fair value of the CDS will not be \$0 as with an interest rate swap –if the market rate of the CDS (i.e. the implied fixed rate on the contract that would result in an initial fair value of \$0) is higher than the fixed rate actually paid, the dealer will pay an upfront premium in addition to the standard fixed rate it pays and vice versa. In the example illustrated in Table 6, however, the market rate is lower than the fixed rate paid so the dealer receives an upfront payment of \$166,385, which represents the present value of the difference between the actual fixed rate paid (100 bps) and the market rate (65 bps) over the life of the contract.[4]

As the market rate of the CDS fluctuates, its fair value will change, translating into either an increase in the "Derivatives with a positive fair value" line on the asset side or an increase in the "Derivatives with a negative fair value" line on the liabilities side. Purchasing the CDS, however, requires an initial margin of 2 percent,[5] reflected as an increase in receivables. The dealer borrows the initial margin in short-term funding markets again at a 0.5 percent interest rate, increasing its total short-term debt issuance. In addition, the dealer computes its potential future exposure (PFE) for the CDS, which increases its off-balance-sheet assets. The PFE is calculated as the product of the effective notional principal of the CDS contract and the corresponding conversion factor provided by the Basel Committee's Basel III leverage ratio framework.[6] In this example, for a 5-year investment grade, non-cleared CDS, the applicable conversion factor used in the PFE calculation is 5 percent.

When the dealer puts on the trade on behalf of a client instead of itself, the balance sheet impact is similar except for three important differences. Firstly, the initial margin that 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. In addition, if the dealer puts on the CDS leg of the trade by buying the CDS protection from their client to face the CCP, the dealer's PFE to the overall trade increases. Finally, if the dealer provides funding to their client, the value of loans on the asset side of the balance sheet increases, expanding the dealer's balance sheet even further.

[4]The upfront premium also includes accrued interest from the last semiannual CDS coupon date.

[5]If the CDS is cleared, the investor purchasing the CDS posts half the amount of initial margin that is required by the clearing member for selling CDS protection –in this example, the clearing member requires 4% initial margin from a counterparty selling CDS and thus 50%*4% = 2% initial margin for a counterparty that is buying CDS protection.

[6]Our example assumes that the single-name CDS is not cleared and that bilateral netting is not applicable; if netting were applicable, netting could be used to offset up to 60% of the effective notional.

Panel D of Table 2 illustrates the cash-flows earned by a dealer holding a $10 million position in the CDS-bond basis trade for one year. The trade requires the dealer to buy a CDS from another market participant, for example, another dealer, which requires the dealer to post an initial margin (IM) for the trade ($200,000). The dealer also requires the seller of the CDS to post an initial margin ($400,000), to ensure the dealer from counterparty risk of the seller. The dealer borrows this initial margin from short-term funding markets, paying a rate based on the OIS on the loan ($1,000). In addition, if the 100 basis points fixed spread on the contract does not equalize the value of the protection bought to the present discounted value of the fixed payments, the dealer receives an upfront ($166,385) from the seller of protection.

In addition to the swap, the dealer holds a cash position in a bond that is deliverable into the CDS contract in case a credit event is realized. The purchase of this bond is financed through repo markets, so that the dealer borrows $10 million to purchase the bond which it then posts as collateral for the secured loan. The repo rate for the bond is assumed to be 480 basis points, and represents a funding cost to the dealer. In addition, the repurchase agreement requires a 5% haircut, which the dealer borrows once again in the short term funding markets (similar to the initial margin above), increasing the overall funding cost of the cash bond position. Thus, the total cost of funding the long bond position is the corporate bond repo interest rate plus the haircut financing charge, with $50,500 total cost of funding the $10 million position.

On the derivative side of the trade, the dealer pays the fixed spread and the upfront, which we convert to the equivalent running spread ($65,500). Since the dealer receives the bond yield and pays the CDS effective spread, it receives the CDS-cash basis. Combining the amount received by the dealer (the basis) with the total cost of the position (cost of funding of initial margins and cost of repo financing of the bond position) gives us the net carry (profit or income) on the trade, which is $17,000 in this example. Thus, when the CDS becomes cheap relative to the value of the bond, the dealer earns positive carry.

4.3 Profitability of the trade

The costs associated with CDS positions have changed since the enactment of mandatory clearing rules for index trades in 2013 and voluntary clearing of some single name trades. From the dealers' perspective, new capital regulation, in particular the finalization of the Supplemental Leverage Ratio (SLR) rule in September 2014, has increased costs of engaging in arbitrage trades. These additional costs may be passed on to non-dealer clients that use dealers as their Futures Clearing Merchant (FCM) in engaging in the swap trade.

Capital charges The balance sheet changes described above lead to a capital charge, that is, additional equity required, for the dealer. Specifically, the gross notional amount of repo financing, initial margin, repo haircut and potential future exposure (PFE) of the derivative instrument all require the dealer to hold additional equity to satisfy the SLR before entering into the trade. While each firm (and each business unit within the firm) may have its own approach for appraising how much additional equity should be raised, Table 3 computes representative capital charges associated with different levels of the target leverage ratio. As can be seen from the table, the largest capital charge stems from the cash bond leg of the trade: since the bond is not purchased outright but is instead repo financed, the capital charged is based on the entire notional financed. At the same time, market participants often engage in levered financing for these types of trades to meet acceptable return targets for the trade. For higher leverage ratios, however, the equity associated with the derivative leg of the trade can also be large, through the capital charge for the initial margin and the PFE.

Table 3: Equity Charges for Bond-CDS Trade. Components of regulatory equity charges for the corporate bond-CDS trade for different levels of the leverage ratio, together with the implied return on equity.

Supplementary Leverage Ratio	**1%**	**2%**	**3%**	**4%**	**5%**	**6%**
Corporate Bond	\$100,000	\$200,000	\$300,000	\$400,000	\$500,000	\$600,000
Derivative Fair Value: $\max(FV, 0)$	\$0	\$0	\$0	\$0	\$0	\$0
Haircut	\$5,000	\$10,000	\$15,000	\$20,000	\$25,000	\$30,000
Net Initial Margin	\$2,000	\$4,000	\$6,000	\$8,000	\$10,000	\$12,000
Potential Future Exposure	\$5,000	\$10,000	\$15,000	\$20,000	\$25,000	\$30,000
Total Equity Cost	\$112,000	\$224,000	\$336,000	\$448,000	\$560,000	\$672,000
Total Profit (Return)	**\$17,000**	**\$17,000**	**\$17,000**	**\$17,000**	**\$17,000**	**\$17,000**
Return on Equity	**15%**	**8%**	**5%**	**4%**	**3%**	**3%**

Anecdotal evidence suggests that dealers have been increasingly viewing their activity through the lens of the return on equity (ROE) generated by a given trade, which has declined across the board due to higher leverage (that is, stricter capital) requirements. Table 3 also reports the ROE on the CDS-bond trade based on assumed leverage ratios ranging from 1 to 6 percent. The ROE is very sensitive to leverage ratios, with a non-linear impact of higher leverage ratios on ROE. Indeed, the ROE declines from 16 percent to 8 percent for an increase from 1 percent to 2 percent in the assumed leverage ratio, and then declines a further 3 percentage points for an increase from a 2 to 3 percent leverage ratio. At around 6 percent leverage ratio – corresponding to the SLR for the largest U. S. banks in 2015 – the ROE for the CDS-bond trade is at most 3 percent, well below the 15 percent ROE reportedly targeted by dealers.

Breakeven basis While new regulations may have increased the cost for entering the CDS-bond trade for dealers, there should still be a level of the CDS-bond basis at the trade becomes attractive on an ROE basis. Table 4 conducts a sensitivity analysis of the breakeven CDS-bond basis needed to achieve a given ROE target for different levels of the leverage ratio. Whereas in the past, at low levels of regulatory leverage, a dealer could have earned 15 percent ROE when the CDS-bond basis was below negative 134 basis points simply through carry, the basis would need to be negative 218 basis points to achieve the same ROE target at 6 percent leverage ratio. While this calculation is subject to many assumptions, it is illustrative of the costs faced by dealers, and helps explain their reluctance to enter into arbitrage trades before spreads reach levels much more negative than in the past: a more negative basis increases the carry earned and makes the trade more economical in light of the capital charges.

Table 4: Bond-CDS Spread Required for ROE. The maximum bond-CDS spread that generates different levels of return-on-equity for disparate assumptions on the leverage ratio of the dealer. Spread reported in basis points.

	Supplementary Leverage Ratio					
ROE	**1%**	**2%**	**3%**	**4%**	**5%**	**6%**
5%	-123	-128	-134	-139	-145	-151
10%	-128	-139	-151	-162	-173	-184
15%	-134	-151	-167	-184	-201	-218
20%	-139	-162	-184	-207	-229	-251
25%	-145	-173	-201	-229	-257	-285
30%	-151	-184	-218	-251	-285	-319

4.4 Considerations for the CDX-CDS basis trade

For the CDX-CDS basis trade, many of the considerations discussed above still apply. The major difference is that the CDX-CDS basis trade does not have a cash product that has to be financed via leverage. At the same time, each individual CDS contract requires a margin to be posted with the counterparty to each contract. Since the index CDS contracts are mandatory centrally cleared, while single name CDS contracts are voluntary cleared, the margin requirements for the long and the short sides of the CDX-CDS trades cannot be offset against each other. For example, only about 40 percent of the single names underlying the investment grade index are eligible for central clearing; thus, to put on the CDX-CDS basis trade for the investment grade index (CDX.NA.IG), a market participant has to post margin with the CCP clearing the index (ICE), post margin with the CCPs clearing the eligible single name contracts (ICE, CME, LCH), and post and receive margin from counterparties for the remaining single name CDS contracts. In addition, since all of the CDS contracts trade on a standardized basis, all 126 contracts necessary for this trade will have non-zero upfront payments, further increasing the cost of entering into this trade.

5 Conclusion

Overall, we find that the widening in the credit basis can be broadly explained by changes to liquidity preference and liquidity concentration, increased idiosyncratic risk of the constituents of the high yield index, and increased funding costs tied to balance sheet constraints. While some of these factors may be transitory – for example, as the outlook for energy companies stabilizes, we would expect the idiosyncratic risk of high yield companies to decrease – others are more persistent and may point to potentially "new normal" levels for both the CDS-bond and CDX-CDS bases.

While we cannot precisely measure the costs incurred from mandated central clearing and SLR capital requirements, it does appear that executing swap spread and credit basis arbitrage trades is now costlier for dealers than in prior years, largely due to the amount of capital that dealers must hold against these trades. Of note, the amount of capital required is largely driven by the cash position of the trade, which is fully recognized despite being usually repo financed, rather than the derivatives portion. As a result, while current negative swap spread and CDS-cash basis levels may have been attractive to trade on in the past, which would have lessened the dislocations, our analyses suggests that these spreads must still reach more negative levels in order to justify adequate returns on equity for dealers given the balance sheet costs. Although this may represent a shift in what levels are considered attractive to trade on, it does suggests that there may be a “new normal” level at which dealers may again be incentivized to enter into these spread and basis trades, which eventually should narrow the dislocations. Indeed, both swap spreads and CDS-cash bases have become less negative in recent weeks, though this appears to be the result of an increase in demand for Treasury and corporate bond products following an alleviation in macro risks as opposed to the result of dealer arbitrage activity.

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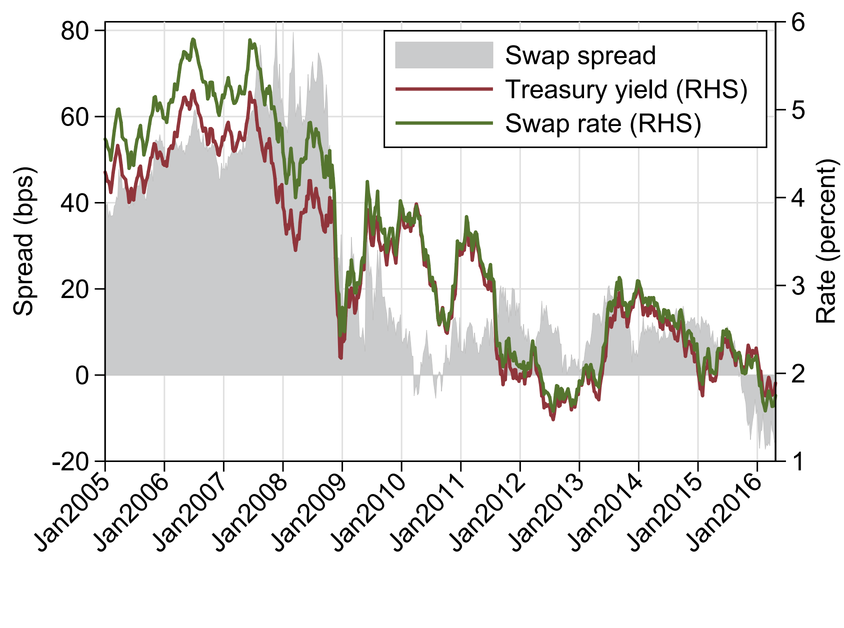
A Treasury-Interest Rate Swap Trade

The increases in the CDS-bond basis and the single-name-CDX basis have coincided with movements of the U.S. Treasury-swap spread moving into negative territory. As with the credit bases, commentary by market participants suggests that the negative Treasury-swap spread is due to post-crisis regulatory changes. In this Appendix, we review the mechanics of the trade and the associated cost of capital calculations.

A.1 Mechanics of the trade

The negative Treasury-swap 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 insure 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 3-month LIBOR (from the floating leg of the swap) and pays the fixed swap rate and the general collateral (GC) repo cost for financing the Treasury holding. If swap spreads do indeed move toward the positive territory (or stay the same) upon the unwind or maturity of the trade, the trade is profitable, net of the difference between the 3-month LIBOR rate and the GC-repo cost. As the spread between the 3-month LIBOR and GC repo declines, the trade becomes less attractive to the investor.

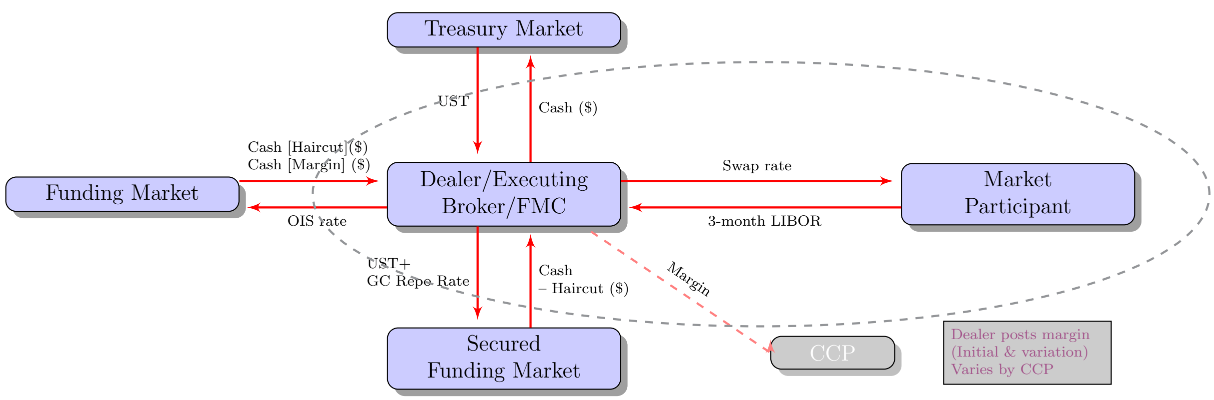
Figure 7. Historical evolution of swap rate, Treasury yield and swap spread



In practice, these types of trades are funded through leverage. Figure 8 presents the schematic of a typical Treasury-swap trade, from the perspective of a dealer engaging in this trade on their own behalf. The dealer buys a Treasury in the Treasury market, and uses the Treasury as collateral to borrow in the general collateral funded (GCF) repo market. The repo position requires a haircut, which we assume to be 2.8% in the balance sheet example below, and the dealer pays the GC repo interest rate, which we assume to be 0.3% APR, each day that it has an open GCF position. The haircut on the repo is borrowed using an overnight indexed swap (OIS), with a 0.5% APR and 1 year maturity.

To conduct the swap side of the trade, the dealer enters into a pay fixed swap with a matched maturity to the Treasury position with the appropriate CCP. In the pay fixed swap, the dealer pays the fixed interest rate on the swap to the CCP and receives the 3 month LIBOR in return. The CCP requires both an initial margin (assumed to be 3.9%) and a variation margin to be posted for the interest rate swap position, which the dealer again borrows in the OIS market.

Figure 8. Mechanics of the Treasury-Swap Trade



In summary, even when the dealer engages in the Treasury-swap trade on their own behalf, there are four counterparties to the transaction: a Treasury market dealer, FICC, an OIS dealer and the interest rate swap CCP. The mechanics are similar when the dealer engages in this trade on behalf of a customer, with an extra leg to the trade added to account for the transaction between the dealer and the client. We turn next to the balance sheet impact and equity costs of this trade.

A.2 Balance sheet impacts of the trade

Panel A of Table 5 below shows a representative dealer balance sheet before the dealer engages in the Treasury-interest rate swap trade. On the asset side, the dealer holds some cash and cash-equivalent products, Treasury securities, securities purchased under agreements to resell (reverse repo positions), interest rate derivatives with a positive fair value, payment receivables, and other assets. On the liabilities side, the dealer issues both short- and long-term debt and equity. Other liabilities include securities sold under agreements to repurchase (repo positions), interest rate derivatives with a negative fair value, and payment payables.The following discussion walks through the impact to the balance sheet of entering a swap spread trade from the perspective of a dealer calculating the impact to its balance sheet for the purposes of calculating its Supplementary Leverage Ratio (SLR) (i.e. the denominator of the ratio). Under the SLR guidelines, derivatives impact this balance sheet calculation. The numbers are meant to be illustrative and for any individual dealer and specific trade may vary.

Table 5: Balance Sheet Impact and Cost to Trade of a Treasury-Swap Trade. Stylized example of the balance sheet impact and the cost-to-trade a 10-year Treasury-swap trade, from a dealer's perspective. Assumptions: 2.8% haircut in the Treasury-collateralized repo trade, with a 0.3% interest rate; 0.5% interest rate charged in the overnight interest rate swap market; 3.9% initial margin on the interest rate swap position; 0.6% 3 month LIBOR.

A. Starting Balance Sheet

Assets	Liabilities
Cash	Short-term debt
Treasury securities	Long-term debt
Securities purchased under agreements to resell	Securities sold under agreements to re-purchase
Derivatives with a positive fair value	Derivatives with a negative fair value
Receivables	Payables
Total Assets	**Total Liabilities**

B. Balance Sheet with Cash Leg Only

Assets		Liabilities	
Cash		Short-term debt	+$280,000
Treasury securities	+$10,000,000	Long-term debt	
Securities purchased under agreements to resell		Securities sold under agreements to re-purchase	+$9,720,000
Derivatives with a positive fair value		Derivatives with a negative fair value	
Receivables		Payables	
Total Assets	+$10,000,000	**Total Liabilities**	+$10,000,000

C. Balance Sheet with Cash and Derivative Legs

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 re-purchase	+$9,720,000
Derivatives with a positive fair value	+$0	Derivatives with a negative fair value	+$0
Receivables	+$390,000	Payables	
Total Assets	+$10,390,000	**Total Liabilities**	+$10,390,000

D. Costs to Trade

Interest Rate Swap Trade	**Amount**
Trade Size	
Notional	$10,000,000
Initial margin ~ 3.9%	$390,000
Costs	
IM Funding ~ 1y OIS	-$1,950
Income	
3-mo LIBOR ~ 0.6%	$60,000
Total Swap Income	**$58,050**
Treasury in Repo	
Trade Size	
Treasury	$10,000,000
Haircut ~ 2.8%	$280,000
Costs	
Treasury repo ~ 0.3%	-$30,000
Haircut ~ 1y OIS	-$1,400
Total Treasury Cost	**-$31,400**
Net Return from Carry	
Swap Income	$60,000
Swap Cost	-$1,950
Treasury Cost	-$31,400
Total Before Spread	**$26,650**
Swap Spread at -0.1%	**$10,000**
Total After Spread	**$36,650**

Consider first the balance sheet impact of the long-Treasury leg of the Treasury-interest rate swap trade, illustrated in Panel B of Table 5. Assume that the trade size is $10 million and that the dealer faces a 2.8 percent haircut when buying the Treasury using repo funding. 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 in this example, increasing its short-term debt.

Panel C then illustrates the balance sheet impact of the dealer selling the interest rate swap, so that the dealer will be paying the fixed rate and receiving the floating rate. At inception of the trade, the fixed rate is set such that the fair value of the interest rate swap is $0. As the reference rate (3-month LIBOR) fluctuates, the fair value of the interest rate swap will change, translating into either an increase in the "Derivatives with a positive fair value" line on the asset side or an increase in the "Derivatives with a negative fair value" line on the liabilities side. The swap does, however, require an initial margin of 3.9 percent in this example, reflected as an increase in receivables. The dealer, in this example, borrows the initial margin in short-term funding markets again at a 0.5 percent interest rate, increasing its total short-term debt obligation. In addition, the dealer computes its derivatives exposure, or potential future exposure (PFE)[7], for the centrally-cleared interest rate swap, increasing the asset side of its balance sheet in the other category.

When the dealer puts on the trade on behalf of a client instead of itself, the balance sheet impact is similar except for three important differences. Firstly, the initial margin that 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. In addition, if the dealer puts on 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 their client, the value of loans on the asset side of the balance sheet increases, expanding the dealer's balance sheet even further.

Panel D of Table 5 provides the cash flows and "carry" earned on a $10 million 10-year swap spread trade with a holding period of one year, based on dealer estimates. The trade requires the dealer to enter into a pay-fixed swap with a CCP, which requires it to post an initial margin (IM) for the trade ($39,000). The dealer is assumed to borrow this initial margin amount from short-term funding markets, paying a rate based on OIS on the loan ($1,950). In addition to the swap, the dealer must hold a cash position which it does through the purchase of a Treasury via repo financing markets. Thus the dealer borrows $10 million to purchase the Treasury which it then posts as collateral for the secured loan. The repo rate for a 10-year Treasury is assumed to be about 30 bps and represents a financing cost to the dealer. Furthermore, there is an assumed 2.8 percent haircut on the Treasury repo collateral so the dealer must borrow this additional amount through short-term funding markets (at a rate again based on OIS) to post to the repo lender. Therefore, the total cost to finance the long Treasury position is the Treasury repo rate expense plus the haircut financing charge (a total cost of $31,400).

On the derivative portion of the trade, the dealer pays the fixed 10-year swap rate on the pay fixed leg of the swap and it receives 3-month LIBOR on the floating leg ($60,000). Since the dealer is receiving the Treasury yield and paying the swap rate, it is on net paying the swap spread[8] on the fixed leg of the trade. On the

[7] 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.

[8] Recall that the swap spread is the difference between the swap rate and the Treasury yield.

floating leg, the dealer earns 3-month LIBOR while paying the GC repo rate for the Treasury financing. Thus, the net amount the dealer receives on the swap for the first period is the 3-month LIBOR rate earned minus the swap cost (i.e. initial margin funding cost) and minus the cash trade leg cost (i.e. 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 is $36,650 in this example. 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.

A.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. The costs for a dealer have also changed due to the implementation of the Supplementary Leverage Ratio (SLR), and 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 have noted that the increased cost of clearing has increased the fees charged by FCM's to clients, with some reports that fees can now be as high as $10,000 per month.

Capital charges The capital charge (or additional equity required) for the arbitrage trade comes from the impact that the trade has on the balance sheet. Specifically, the gross notional amount of repo financing, initial margin, repo haircut, and potential future exposure (PFE) of the derivative instrument would all require a dealer to hold additional equity under SLR before entering into the trade. In practice, each firm may have its own approach for deciding how much additional equity to hold, and this may further vary by business unit. As such, Table 6 presents the capital charges associated with different leverage ratio assumptions. As can be seen from the table, for a swap spread trade the largest capital charge stems from the cash position because of the use of leverage (repo financing), instead of an outright purchase, since the capital charged is based on the entire notional financed. Leverage is, however, often required by investors in order to meet acceptable return targets on the trade as opposed to purchasing the cash product outright which results in relatively much lower gains. For higher leverage ratios, however, the equity associated with the derivatives transaction through the initial margin and PFE can also be large.

Anecdotal evidence suggests that dealers have been increasingly viewing their activities through a profitability lens – specifically, based on the return on equity (ROE) for a given trade – which has declined due to higher leverage requirements. Table 6 also presents ROE on this swap spread trade based on assumed leverage ratios ranging from 1 to 6 percent. In addition to the range of leverage ratios, key assumptions in this calculation are the spread between swap rates and Treasury yields, as well as the spread between 3-month LIBOR and repo rates.

Table 6: Equity Charges for Treasury-Swap Trade. Components of regulatory equity charges for the Treasury-swap trade for different levels of the leverage ratio, together with the implied return on equity.

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)	**\$36,650**	**\$36,650**	**\$36,650**	**\$36,650**	**\$36,650**	**\$36,650**
Return on Equity	**34%**	**17%**	**11%**	**9%**	**7%**	**6%**

Table 6 suggests that the ROE is very sensitive to the capital charge which, in turn, is highly sensitive to leverage ratios, including an increase or decrease of as little as one percentage point in the leverage ratio assumption. Indeed, the impact on ROE is non-linear, with the ROE noticeably declining from 34 percent to 17 percent for an increase from 1 percent to 2 percent in the assumed leverage ratio, and then from 17 percent to 11 percent for an increase from a 2 to 3 percent leverage ratio. The SLR for the largest U.S. banks is currently 6.0 to 6.5 percent;[9] at around this level of the leverage ratio, the ROE for the above swap spread trade is at most 6 percent, which is less than half of the 15 percent ROE reportedly targeted by dealers on average.

Breakeven swap spreads While new regulations may have increased the cost for entering the swap spread for dealers, there should still be a level of the dislocation between the cash and derivative markets at which dealers are willing to enter into the arbitrage trade.

Table 7 conducts a sensitivity analysis of the breakeven 10-year swap spread needed to achieve a given ROE target for different levels of the leverage ratio. Whereas in the past, when the balance sheet cost was very low due to risk-weighting, a dealer could have earned a 15 percent ROE at a spread above 11 basis points simply through carry; at a 5 percent leverage ratio, the spread would need to be negative 54 basis points to achieve a 15 percent ROE. While this calculation is subject to many assumptions, it is illustrative of the costs that dealers now face, and helps explain why they are less likely to execute a swap spread trade, which would help to lessen the dislocation (i.e. result in an increase in swaps spreads) until spreads reach much more negative levels than in the past; a more negative swap spread would increase the carry earned and therefore make the trade more economical given the capital charge.

[9]Current estimate based on 2015 earnings reports for JPM, BAML, and MS.

Table 7: Treasury-Swap Spread Required for ROE. The maximum Treasury-swap spread that generates different levels of return-on-equity for disparate assumptions on the leverage ratio of the dealer. Spreads reported in basis points.

	Supplementary Leverage Ratio					
ROE	**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