Trends in Credit Basis Spreads

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

OVERVIEW

- The second half of 2015 and the first quarter of 2016 saw a large, prolonged widening of spreads in credit market basis trades—between the cash bond and CDS markets and between segments of the CDS market.
- This article examines three potential sources of the persistent dislocation: (1) increased idiosyncratic risk, (2) strategic positioning in CDS products by institutional investors, and (3) post-crisis regulatory changes.
- The authors argue that, though post-crisis regulatory changes themselves are not the cause of credit basis widening, increased funding costs associated with tighter balance sheet constraints reduce the willingness of regulated institutions to enter spread-narrowing trades.
- Although some of the underlying factors driving deviations in credit spreads may be transitory, increased funding costs are likely to be more persistent and may point to potentially "new normal" levels for both the CDS-bond and the CDX-CDS bases.

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, corporate issuance costs increase, leading to higher overall funding costs. In this article, we examine two credit market basis trades: the cash bond-credit default swap (CDS) basis and the single-name CDS-index CDS (CDX) basis, evaluating potential explanations proposed for the widening in both bases that occurred in the second half of 2015 and first quarter of 2016.

The prolonged dislocation between the cash bond and CDS markets, and between segments of the CDS market, surprised market participants. In the past, participants executed basis trades anticipating that the spreads between the cash and derivative markets would retrace to more normal levels. This type of trading activity serves to link valuations in the two markets and helps correct price differences associated with transient or technical factors. However, the persistence and magnitude of dislocations during the first quarter of 2016 suggest that limits to arbitrage in these markets have become more significant than in the past.

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We examine three potential sources of the persistent dislocation: (1) increased idiosyncratic risk, which makes the CDX-CDS spread trade less attractive; (2) strategic positioning in CDS products by institutional investors, which makes the CDS market more liquid than the cash market; and (3) 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 incentives to enter into these trades. We lay out trade mechanisms in some detail and create a stylized example, which enables us to quantify the impact that capital and derivatives trading regulation has on incentives to engage in arbitrage trades. The numbers and exact version of the trade laid out in this article are illustrative because there is no standardized arbitrage trade. The exact terms vary depending on the dealer, investor, and cash securities used.

Many market participants, including dealer strategists and buy-side investors, cite balance sheet constraints as an underlying factor contributing to the unusual price dislocations. In particular, market participants believe that balance sheet constraints affect prices through multiple channels, such as liquidity in the cash markets and willingness to facilitate arbitrage trades between the cash and derivatives markets in ways that narrow the pricing gap. 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, profitability is defined as the return per additional dollar of equity required by the trade. We vary assumptions regarding the targeted leverage ratio and target return on equity (ROE). Before the crisis, capital regulation implied that bank holding companies targeted leverage ratios of around 2 to 3 percent, while current leverage targets are 5 to 6 percent. In our stylized examples, this can result in ROEs that are two to three times lower, making previously attractive trades significantly less economical.

The rest of this article is organized as follows. Section 1 reviews the theoretical basis trades and the recent performance of these trades. We turn toward potential explanations for basis dislocations in Section 2. Section 3 explains the mechanics of the CDS-bond trade in detail and examines how post-crisis regulation affects incentives to engage in this trade. We draw policy conclusions in Section 4.

1. Recent Trends

We focus on two particular credit basis trades: the CDS-cash bond basis trade and the index CDS-single-name CDS (CDX-CDS) basis trade. We begin with a brief description of the current structure of CDS and CDX contracts, and then discuss each of the basis trades in turn.

1.1 CDS Contracts

A credit default swap is a bilateral over-the-counter contract in which the buyer of protection agrees to pay a fixed spread to the seller of protection until the contract expires or the reference obligation underlying the contract experiences a credit event before contract expiration. A single-name CDS contract insures the buyer of protection against credit events experienced by either a single corporation, a sovereign, or a municipality. A CDS index (called CDX for North American reference entities) is a portfolio of single-name CDS and thus insures the protection buyer against credit events experienced by a basket of corporations or sovereign entities. The composition of the basket is determined when the index is rolled to the market. Once index composition is determined, the constituents of the series remain unchanged throughout the lifetime of the contract unless a credit event occurs for a constituent, in which case the defaulting constituent is removed without replacement and settled separately. In this case, a new version of the index series is published, which assigns zero weight to the defaulted constituent and has a reduced notional amount. A new (on-the-run) index series is introduced twice each year in March and September, with renewed maturity and an updated constituent list. Entities no longer qualifying for inclusion in the index based on either credit rating or liquidity are removed and new entities are added to keep the number of reference entities in the index constant, but the majority of the constituents remain unchanged.[1] Trading in previous (off-the-run) series continues after index rolls, though the liquidity in these series is diminished relative to the on-the-run series.

Since April 2009, both single-name and index CDS have been traded with a standardized fixed coupon (100 or 500 basis points for North American reference entities) and an upfront payment from the buyer to the seller, or vice versa. The upfront payment makes the expected present value of the protection bought equal to the expected present value of protection sold, conditional on the fixed spread chosen and common assumptions of the recovery rate in case of a credit event.[2] For both single-name and index CDS, the fixed coupon payments from the protection buyer to the protection seller are made on a quarterly basis, using 360 days per year as the convention.[3] (Boyarchenko et al. [2016] provides more details on the current structure and historical evolution of the CDS market.)

Example: Upfront and the Running CDS Spread

Consider a CDS contract with T years to maturity and fixed spread s. To compute the required upfront payment F, denote by $h(t)$ the (risk-neutral) default intensity—the probability of the reference entity defaulting in the next instant conditional on surviving to date t—and by $D(t)$, the risk-free discount factor applied to cash flows earned in t periods. Then the expected present value of protection bought is

$$V_{\text{float}} = \int_0^T \left[1 - \left(1 + A(t)\right)R\right] h(t) e^{-\int_0^t h(\tau)d\tau} D(t)dt,$$

where $A(t)$ is the accrued interest on the insured bond and R is the expected recovery rate on the bond in case of default. The expected present value of payments made by the buyer of protection is given by

$$V_{\text{fixed}} = s \sum_{i=1}^{N} e^{-\int_0^{t_i} h(\tau)d\tau} D(t_i) + F,$$

where $\{t_i\}$ are the N quarterly payment dates. Thus, given a fixed spread s, and assumptions about the discount rate, default rate, and recovery rate, the upfront payment is calculated as

$$F = \int_0^T \left[1 - \left(1 + A(t)\right)R\right] h(t) e^{-\int_0^t h(\tau)d\tau} D(t)dt - s\sum_{i=1}^N e^{-\int_0^{t_i} h(\tau)d\tau} D(t_i).$$

The equivalent running CDS spread is the spread $\hat{s}$ that equates the value of the fixed leg with the value of the floating leg of the swap for 0 upfront, so that

$$\hat{s} = \frac{\int_0^T \left[1 - \left(1 + A(t)\right)R\right] h(t) e^{-\int_0^t h(\tau)d\tau} D(t)dt}{\sum_{i=1}^N e^{-\int_0^{t_i} h(\tau)d\tau} D(t_i)}.$$

1.2 CDS-Cash Bond Basis Trade

The first basis trade we consider, and the main focus of this article, 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. The CDS bond-basis is then computed as the difference between the running spread ($\hat{s}$ above) on the CDS and the theoretical (par-equivalent) CDS spread implied by the yield on the cash bond. When this basis is negative, the return on the trade is earned by purchasing the cash bond and purchasing protection in the CDS market.[4] Ignoring the funding costs of this trade, a market participant receives the bond coupons, makes or receives the one-time upfront payment, and pays the CDS fixed spread.

Example: Par-equivalent CDS Spread

We now extend the above example to compute the bond-yield-implied par-equivalent CDS spread. Let P_{bond} be the price of a bond written on the same reference entity that pays quarterly coupon payments c and has T years until maturity. The market price P_{bond} implies a default hazard rate curve $\hat{h}(\tau)$ that correctly prices the cash bond, given the risk-free discount curve $D(t)$ and an expected recovery rate R. In particular, $\hat{h}(\tau)$ solves

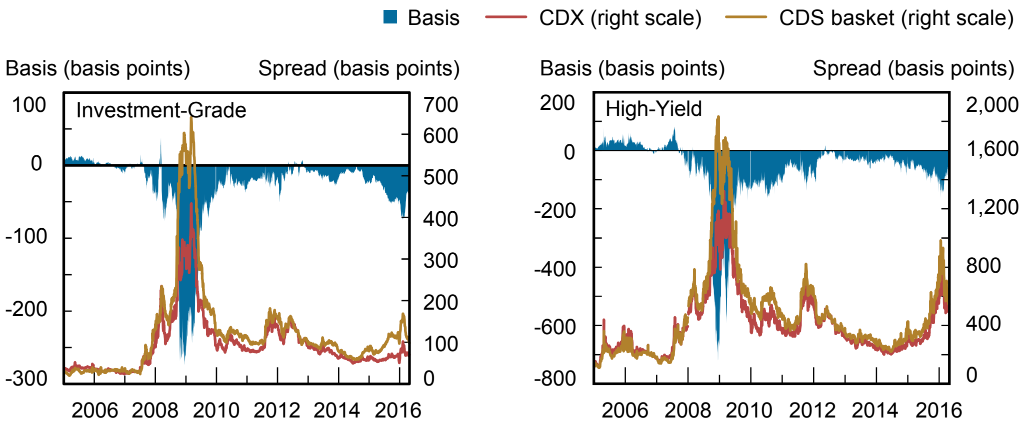
$$P_{\text{bond}} = c\sum_{i=1}^N e^{-\int_0^{t_i} \hat{h}(\tau)d\tau} D(t_i) + 100e^{-\int_0^T \hat{h}(\tau)d\tau} D(T) + R\int_0^T \hat{h}(t) e^{-\int_0^t \hat{h}(\tau)d\tau} D(t)\,dt.$$

The par-equivalent CDS spread, s_{bond}, is then the running spread computed using h as the default intensity

$$s_{\text{bond}} = \frac{\int_0^T \left[1 - \left(1 + A(t)\right)R\right] \hat{h}(t) e^{-\int_0^t \hat{h}(\tau)d\tau} D(t)dt}{\sum_{i=1}^N e^{-\int_0^{t_i} \hat{h}(\tau)d\tau} D(t_i)}.$$

The CDS-bond basis is then given by the difference between the running spread $\hat{s}$ and the par-equivalent CDS spread s_{bond}.

Chart 1
Historical Evolution of the CDS-Bond Basis



Source: JPMorgan Chase.

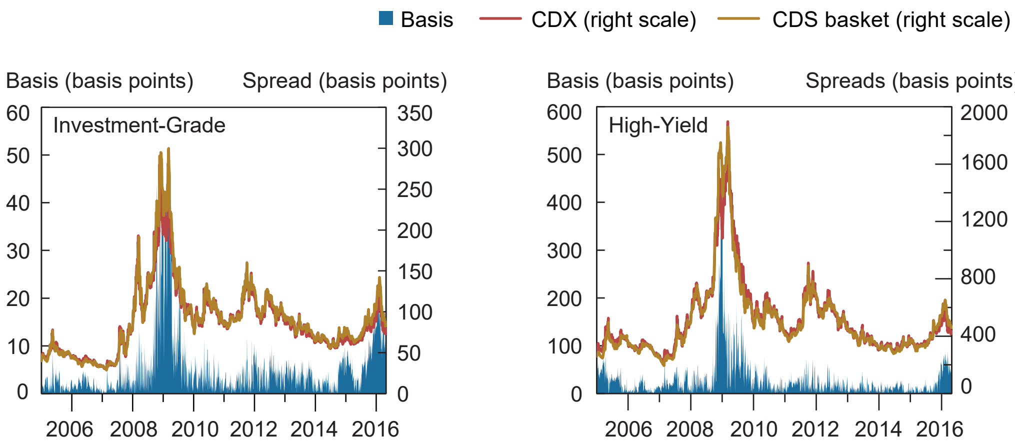
Notes: The chart shows the time series of the CDS-bond spread, the CDS spread, and the bond-implied CDS spread.

In practice, the CDS-bond basis has historically deviated from zero and has varied over time (see Chart 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 than the cash market. Thus, to transact in the more-liquid market, investors are willing to accept a lower spread.

Although there is no consensus about a single driver that explains the disparity between the market CDS spread and the bond-implied CDS spread, 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 also concludes that credit basis trade profitability is affected by the dealer's risk of exiting the CDS position before default or maturity. Choi and Shachar (2014) use data on corporate bond and CDS holdings of individual institutions during the financial crisis. They find that basis widening was precipitated by the unwinding of pre-crisis basis trades by hedge funds. At the same time, limited capital prevented dealers from taking the opposite side of the unwind trade, prolonging the duration of the dislocation. Similarly, Oehmke and Zawadowski (2016) show that, when the CDS-bond basis is more negative, the total net notional value in the corresponding CDS is higher. 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, severely restricting their ability to maintain similar prices of similar assets.

Nonetheless, market participants were still surprised by how large and persistent the gap between CDS and cash bond spreads had been because, during normal times when the CDS-bond basis became more negative, market participants—such as dealers, hedge funds,

Chart 2
Historical Evolution of the CDX-CDS Basis



Source: Markit.

Notes: The chart shows the time series of the CDX spread, the individual CDS-implied spread (CDS basket), and the CDX-CDS spread.

sophisticated asset managers, and pension funds—executed CDS-cash bond trades that helped reduce dislocation. Chart 1 plots the evolution of the CDS-bond basis for investment grade (left panel) and high-yield (right panel) bond indexes since January 2005. The CDS-bond basis has been increasing since January 2015 for investment grade bonds and the middle of 2015 for high-yield bonds.

1.3 CDX-CDS Basis Trade

For the CDX-CDS basis trade, on the other hand, an investor buys (sells) protection on a CDX index and sells (buys) protection on a portfolio of single-name CDS contracts that replicates the index. Similar to the CDS-bond basis trade, this trade is considered to be free of default risk because 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 contracts. 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 percent of CDS returns on average. In this trade, ignoring funding costs, the arbitrageur receives the difference between the index spread and the equal-weighted spreads on the underlying single-name CDS.

Chart 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 indexes. Similarly to the CDS-bond basis, the CDX-CDS basis has been increasing since the beginning of 2015, suggesting that, while liquidity

Table 1
Historical Credit Basis Changes

A. CDS-Bond Basis

	One-Month Change (Basis Points)	Percentile	Six-Month Change (Basis Points)	Percentile
Investment-grade	-13.181	10	-24.301	15
High-yield	-19.2	15	-46.859	15

B. CDX-CDS Basis

	One-Month Change (Basis Points)	Percentile	Six-Month Change (Basis Points)	Percentile
Investment-grade	3.357	95	12.312	95
High-Yield	13.756	90	50.271	95

Sources: JPMorgan Chase; Markit; authors' calculations.

Note: The table presents changes up to January 28, 2016, and the percentile of the historical distribution represented by the changes.

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 February 2016, the CDX-CDS basis reached levels not seen since the financial crisis, rising to a third of the crisis peak.

1.4 Historical Context

These credit bases moves were abnormal relative to historical experience. Table 1 shows that both the one-month and 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 indexes. 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 high-yield indexes.

Turning to the relationship between basis and investor transactions, we estimate the relationship between changes in the CDS-bond basis and the unfilled open interest in single-name CDS contracts

$$\Delta \text{CDS} - \text{bond basis}_{it} = \alpha_i + \beta_i \Delta SN \text{ Unfilled Interest}_{it} + \varepsilon_{it},$$

where ΔSN Unfilled Interest_{it} is the growth rate in the difference between the open interest and transaction volume cleared through the Intercontinental Exchange (ICE) for the single-name

Table 2
Basis and Unfilled Interest

	CDS-Bond, Investment-Grade	CDS-Bond, High-Yield	CDX-CDS, Investment-Grade	CDX-CDS, High-Yield
Constant	-0.023	0.320	-0.027	0.163
	(0.309)	(0.699)	(0.101)	(0.410)
Single-name unfilled interest	-0.451***	-0.096***	0.163***	0.004
	(0.061)	(0.005)	(0.015)	(0.005)
Index unfilled interest			-0.209	-2.018***
			(0.289)	(0.691)
Observations	148.0	148.0	148.0	148.0
R-squared	0.03	0.01	0.01	0.02
Adjusted R-squared	0.02	0.01	0.00	0.00

Sources: JPMorgan Chase; Markit; ICE; authors' calculations.

Notes: The table shows the relationship of changes in the CDS-bond basis and the absolute CDX-CDS basis with the growth rate of unfilled interest in index and single-name contracts. Unfilled interest means the difference between the open interest and transaction volume cleared through ICE for the on-the-run index with the five-year tenor (index unfilled interest) and the single-name constituents of the on-the-run five-year index (single-name unfilled interest). Standard errors in parentheses are calculated over time using Newey-West (five lags).

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

constituents of the on-the-run CDX index with five-year tenor, and the relationship between the absolute value of the CDX-CDS index and the unfilled open interest in single-name and index CDS contracts

$$\Delta|\text{CDX} - \text{CDS basis}|_{it} = \alpha_i + \beta_{i,1}\Delta SN \text{ Unfilled Interest}_{it} + \beta_{i,2}\Delta\text{CDX Unfilled Interest} + \varepsilon_{it}.$$

Table 2 reports the estimated coefficients and standard errors for these regressions. ICE reports open interest and transaction volume from the standpoint of net buyers in the market. When there is more unfilled interest in the single-name CDS market, the CDS-bond basis becomes less negative, consistent with investors taking more aggressive buy positions in the single-name CDS market that close the CDS-bond basis. Similarly, the CDX-CDS basis decreases when investors take more aggressive sell positions in the index contract and increases when investors take more aggressive buy positions in the single-name replicating basket.

Table 3
Measures of Idiosyncratic Risk as of the Fourth Quarter of 2015

	Upgrades/ Downgrades	Percentile	Percent Changed Every Roll	Percentile	Idiosyncratic Equity Volatility (Percent)	Percentile
Investment-grade	1.04	45	2.4	10	6.75	40
High-yield	0.53	30	15.0	100	11.43	45

Sources: JPMorgan Chase; Markit; Center for Research in Security Prices; authors' calculations.

Notes: The ratio of upgrades relative to downgrades is reported as a fraction—1 corresponds to an equal number of firms downgraded as upgraded and numbers less than 1 correspond to a larger number of downgraded than upgraded firms.

2. Potential Explanations

The explanations offered by market participant for these changes in early 2016 can be grouped into three categories: (1) greater idiosyncratic risk, which makes the CDX index a less attractive instrument for hedging individual exposures; (2) strategic positioning by asset managers; and (3) regulatory constraints, which reduce the attractiveness of basis trades. In this section, we describe the first two explanations. In Section 3, we examine the impact of regulatory constraints.

2.1 Idiosyncratic Risk

Table 3 shows three measures of idiosyncratic risk for investment grade and high-yield firms as of the fourth quarter of 2015, the fraction of names changed every CDX index roll,[5] the number of upgraded firms relative to the number of downgraded 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 index, implying higher idiosyncratic credit or liquidity risk. The number of firms within each broad rating category that get downgraded relative to the number that get upgraded illustrates 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 we average stock variance within a month credit rating category,[6] rather than within a month, to obtain an estimate of idiosyncratic volatility at the level of credit rating.

The credit-market-based measures, that is, the fraction of names changed every index roll and the number of upgraded relative to downgraded firms, suggest that idiosyncratic risk in the high-yield index was relatively high in the fourth quarter of 2015. By contrast, the idiosyncratic risk in the investment-grade index was in line with historical averages. This suggests that idiosyncratic risk may have contributed to the basis widening for lower-quality firms, but the basis for investment grade firms widened for other reasons. Finally, Table 3 shows that idiosyncratic equity return volatility for both investment grade and high-yield firms was slightly below the median in the second half of 2015, lending credence to the idea that idiosyncratic risk was not a main driver of basis widening.

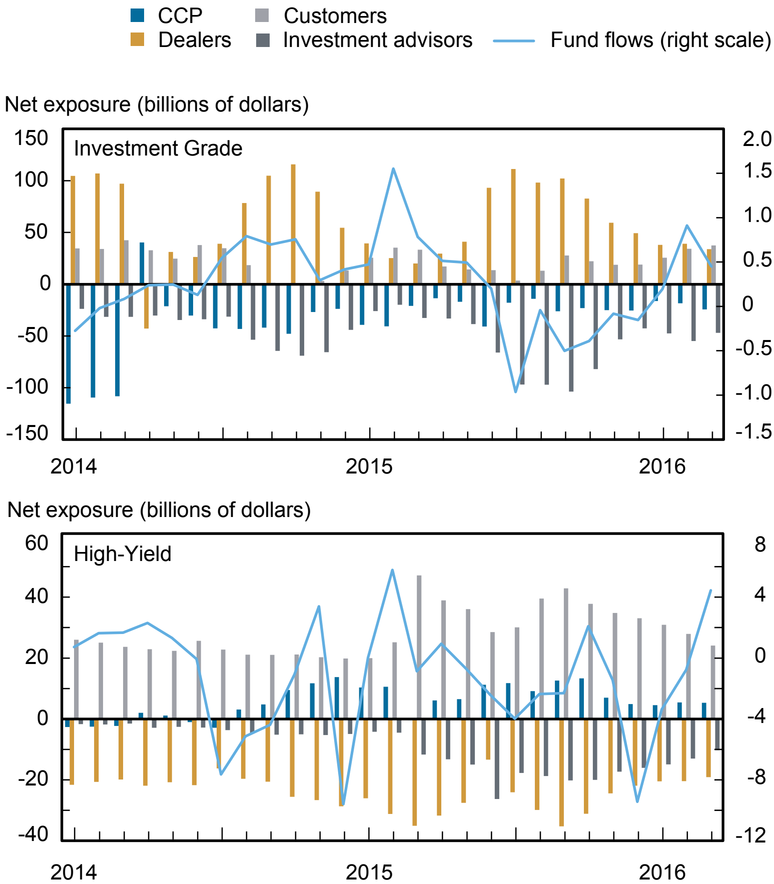
2.2 Strategic Positioning

Some market participants have suggested that, in the second half of 2015, mutual funds specializing in credit strategies may have taken on corporate credit risk by selling protection in the CDS market rather than buying corporate bonds. This strategy has the dual advantage of keeping fund asset allocations in more liquid instruments while allowing mutual funds to retain cash that would have otherwise been used to buy corporate bonds. Thus, using single-name CDS or index contracts instead of bonds to take on exposure to corporate credit risk may provide mutual funds an efficient tool for managing asset liquidity in anticipation of potential 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, that is, the net position between CDX indexes and the constituent single-name CDS for a given index. DTCC provides weekly snapshots of positions and transactions for contracts that involve either an institution supervised by the FRB as one of the counterparties to the trade or that reference a supervised institution. In particular, the largest dealer banks in the United States (Bank of America, Citibank, Goldman Sachs, JPMorgan Chase, and Morgan Stanley) are supervised by the FRB. Boyarchenko et al. (2016) show that this positions data covers 75 percent of trades reported to DTCC's Trade Information Warehouse in a median week.[7]

Using the weekly position snapshots, we construct net positions for each CDS market participant and aggregate by institution type, including central clearing counterparty (CCP), DTCC dealer, noninvestment advisor DTCC client, and investment advisor. We identify investment advisors by matching participant names to Compustat firms and using the assigned two-digit SIC. Chart 3 shows the net positions in the CDX-CDS basis trade in the investment grade (left panel) and high-yield (right panel) index by type of institution together with monthly net inflows into bond asset managers specializing in investment grade and high-yield bonds, respectively. As suggested by market participants, investment advisors have been increasing their long positions, that is, selling more protection, in the CDX indexes over the past year. Although 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 fund outflows, investment advisors seeking credit risk exposure may choose to sell more liquid CDS, taking on negative net exposure in the CDX-CDS trade, rather than buying relatively less liquid corporate bonds. Indeed, increased use of derivative products does seem to precede the increased outflows from both investment grade and high-yield funds. This further decreases the liquidity in the bond market relative to the CDS market and thereby contributes to the widening of the CDS-bond basis. Increased investment advisor CDX index exposure also leads to increased liquidity concentration, along with less frequent CDS rolls every six months,[8] making basis trades costlier to enter and exit because it is harder to match CDS and bond maturities.

Chart 3
Net Exposure to CDX Indexes by Institution Type



Sources: Depository Trust and Clearing Corporation; authors' calculations; Morningstar.

Notes: The chart shows the Net exposure (CDX position net of the position in the replicating portfolio of single name CDS) for investment-grade North American CDX indexes, together with monthly net flows into mutual funds specializing in investment-grade bonds (upper panel) and in high-yield bonds (lower panel). CCP is central clearing counterparty.

3. CDS-Bond Trade in Practice

In this section, we discuss how basis trades are implemented in practice, including capital charges and funding cost for both legs of the trade. In particular, this section approaches basis deviations from the viewpoint of a confluence of intermediary asset pricing and margin asset pricing. In intermediary asset pricing theory (see, for example, He and Krishnamurthy [2013]; Brunnermeier and Sannikov [2014]; and Adrian and Boyarchenko [2012]), binding capital and liquidity regulation increases the effective risk aversion of intermediaries, which 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 basis trades from being executed. At the same time, since the CDS leg of the CDS-bond basis trade requires posted margin, the margin capital asset pricing model 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.

3.1 Mechanics of the Trade

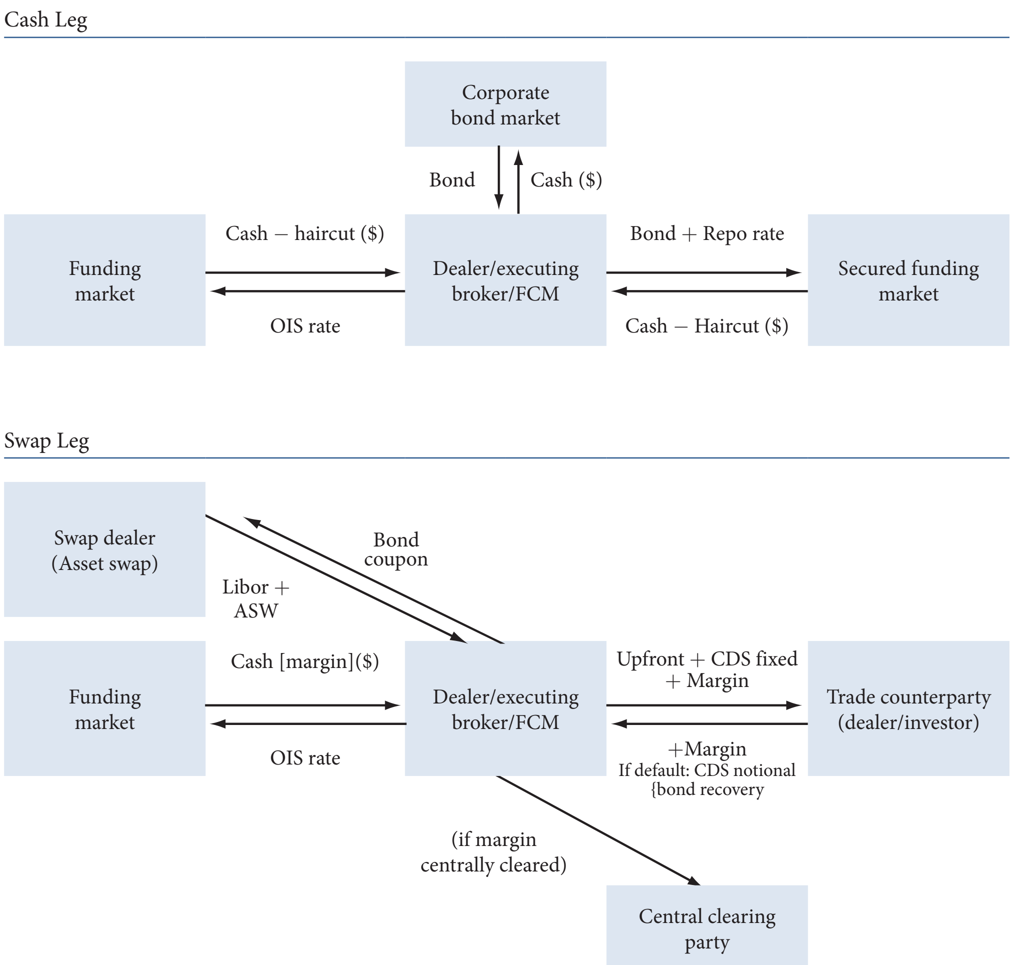
Exhibit 1, page 27, illustrates the different transactions required to complete the CDS-bond trade from the perspective of a dealer executing it for its own book. A key assumption in this example, which we also make when we discuss the balance sheet impact of the trade, is that the dealer uses repo financing to purchase the cash instrument (Exhibit 1, upper panel). The dealer buys a corporate bond and uses the cash bond as collateral to borrow in the tri-party repo market. The dealer pays the repo interest rate for each day that secured funding is used (which we assume to be 0.48 percent in the balance sheet example in Section 3.2) and receives the market value of the corporate bond used as collateral less the haircut on the bond (assumed to be 5 percent). The remainder of the purchase value of the corporate bond is financed in short-term unsecured funding markets with 0.5 percent interest rate and one-year maturity.[9]

The lower panel of Exhibit 1 illustrates the derivative leg of the trade. The dealer buys a CDS that provides protection from default on the corporate bond.[10] 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 a contract is cleared on a voluntary basis, another dealer, or a nondealer customer when entering into a 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 value of the CDS and may receive or pay an upfront amount. That payment reflects the fact that 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 from the funding market, paying the interest rate of the one-year overnight indexed swap (OIS). If the values of the swap and/or CDS change over time, the dealer must 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 counterparty default before a default of the reference entity.

3.2 Balance Sheet Impact

Table 4, page 28, illustrates how a credit basis trade affects 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 position, and whether the CDS is centrally cleared, which determines the potential future exposure (PFE) cost.

EXHIBIT 1
Mechanics of the Bond-CDS Trade



Notes: ASW is asset-swap spread, GC is general collateral, and FCM is futures commission merchant.

Consider first the balance sheet impact of the long corporate bond leg of the negative basis trade, illustrated in Panel A of Table 4. Assume a $10 million trade in which 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 unsecured funding markets at a 0.5 percent interest rate, increasing its short-term debt.

Panel B of Table 4 illustrates the balance sheet impact when the dealer buys CDS protection, paying a standard fixed rate of 100 or 500 basis points. At inception of the trade, if the market rate

Table 4
Balance Sheet Impact and Cost to Trade of a CDS-Bond Trade
U.S. Dollars

Panel A

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	9,500,000
Derivatives with a positive fair value		Derivatives with a negative fair value	
Receivables		Payables	
Total assets	10,000,000	Total liabilities	10,000,000

Panel B

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	9,500,000
Derivatives with a positive fair value	166,385	Derivatives with a negative fair value	
Receivables	200,000	Payables	166,385
Total assets	10,366,385	Total liabilities	10,366,385

(continued)

Table 4 (continued)

Balance Sheet Impact and Cost to Trade of a CDS-Bond Trade

U.S. Dollars

Panel C

Single-name CDS trade	
Trade size	
Notional	10,000,000
Initial margin received (payable)	400,000
Initial margin posted (receivable)	(200,000)
Upfront for fixed premium (with accrual)	166,385
CDS costs	
Initial margin funding cost ~ one-year OIS	(1,000)
CDS running premium	
CDS trade spread (effective)	(65,500)
CDS fixed premium (actual with upfront)	(100,000)
Subtotal CDS payment	(66,500)
Corporate bond in repo	
Trade size	
Corporate bond	10,000,000
Haircut ~ 5 percent	500,000
Costs	
Corporate bond repo ~ 0.48 percent	(45,600)
Haircut ~ one-year OIS	(2,500)
Subtotal corporate cash bond cost	(48,100)
Net return from carry	
CDS payment	(65,500)
CDS cost	(1,000)
Corporate bond cost	(48,100)
Total before spread	(114,600)
(CDS-cash basis) * bond notional	134,000
Total after spread	19,400

Source: Authors' calculations.

Notes: This table presents a stylized example of the balance sheet impact and the cost-to-trade a five-year CDS-cash basis trade on Time Warner Cable February 2021, from a dealer's perspective. The following assumptions were made: 5 percent haircut in the cash bond-collateralized repo trade, with a 0.48 percent interest rate; 0.5 percent interest rate charged in the overnight interest rate swap market; 4 percent initial margin from the seller of the CDS; 2 percent initial margin from the buyer of the CDS; and 1 percent fixed spread on the CDS.

of the CDS contract differs from the standard rate paid, the fair value of the CDS will not be zero as with an interest rate swap. If the CDS market rate, that is, the implied fixed rate on the contract that would result in an initial fair value of zero, is higher than the fixed rate actually paid, the dealer will pay an upfront premium in addition to the standard fixed rate and vice versa. However, in the example in Table 4, 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 basis points) and the market rate (65 basis points) over the life of the contract.[11]

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 of the balance sheet or an increase in the "derivatives with a negative fair value" line on the liabilities side. Purchasing the CDS requires an initial 2 percent margin,[12] reflected as an increase in receivables. The dealer borrows the initial margin in short-term funding markets at a 0.5 percent interest rate, increasing its short-term debt issuance. In addition, the dealer computes its potential future exposure (PFE) for the CDS, which increases its off-balance-sheet assets. 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.[13] In this example, for a five-year investment grade non-cleared CDS, the applicable conversion factor in the PFE calculation is 5 percent.

When the dealer carries out 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. In addition, if the dealer executes the CDS leg of the trade by buying CDS protection from its client to face the CCP, the dealer's PFE to the overall trade increases. Finally, if the dealer provides funding to its client, the value of loans on the asset side of the balance sheet increases, further expanding the dealer's balance sheet.

Table 4, Panel C illustrates the cash flows received 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 CDS buyer to post an initial margin for the trade ($200,000). The dealer also requires the CDS seller to post an initial margin ($400,000) to ensure the dealer from seller counterparty risk. The dealer borrows this initial margin from short-term funding markets, paying a rate based on the overnight indexed swap on the loan ($1,000 per year). 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 payment ($166,385) from the seller of protection.

In addition to the swap, the dealer holds a cash position in a bond deliverable into the CDS contract in case a credit event occurs. Purchase of this bond is financed through repo markets. 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 48 basis points and represents a funding cost to the dealer. In addition, the repurchase agreement requires a 5 percent haircut, which the dealer also borrows in the short-term funding markets, similar to the initial margin, increasing the overall funding cost of the bond position. Thus, the total cost of funding the long bond position is the corporate bond repo interest ($45,600) plus the haircut financing charge ($2,500), totaling $48,100 for the $10 million position.

Table 5
Equity Charges for Bond-CDS Trade
U.S. Dollars, except as noted

	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(F-V; 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)	19,400	19,400	19,400	19,400	19,400	19,400
Return on Equity (percent)	17	9	6	4	3	3

Source: Authors' calculations.

Note: The table shows the 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.

On the derivative side of the trade, the dealer pays the fixed spread and receives 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 the net carry (profit or income) on the trade, which equals $19,400 in this example. Thus, when the CDS becomes cheap relative to the value of the bond, the dealer earns positive carry.

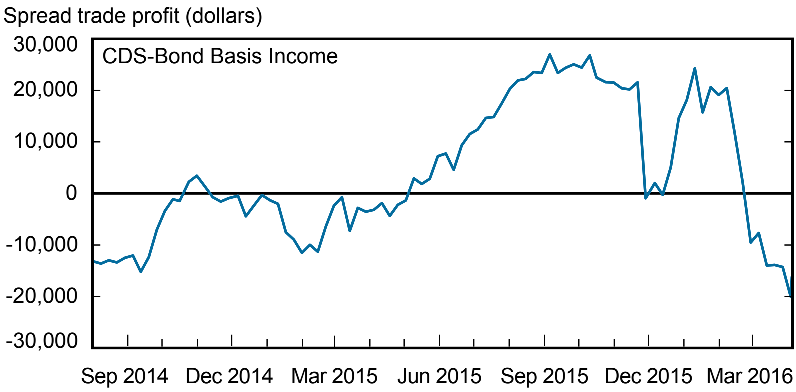
3.3 Profitability of the Trade

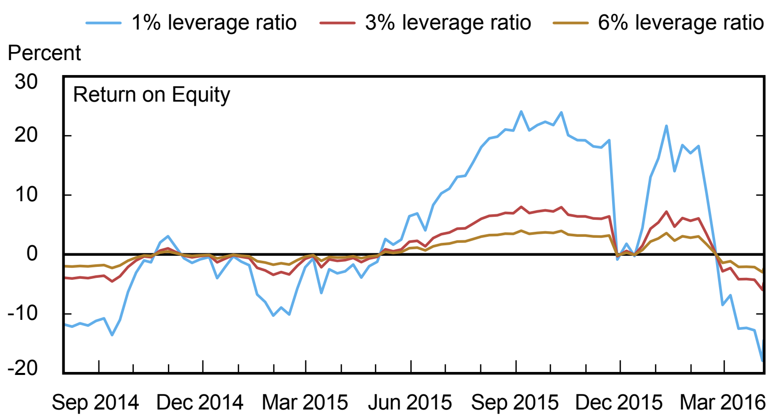
The costs of CDS positions have changed since enactment of mandatory clearing rules for index trades in 2013 and voluntary clearing of some single-name trades. From the dealers' perspective, new capital regulation, in particular the Supplemental Leverage Ratio (SLR) rule finalized in September 2014,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

Capital Charges

The balance sheet changes described above lead to a capital charge for the dealer in the form of additional equity required. Specifically, to satisfy the SLR, the gross notional amount of repo financing, initial margin, repo haircut, and PFE of the derivative instrument all require the dealer to hold additional equity before entering into the trade. While each firm and each business unit

Chart 4
Profitability and Equity Cost of Investment Grade Bond-CDS Trade over Time





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

Notes: The following assumptions were made: 5 percent haircut in the cash bond-collateralized repo trade, 4 percent initial margin from the seller of the CDS, and 2 percent initial margin from the buyer of the CDS.

within the firm may have its own approach for appraising how much additional equity should be raised, Table 5 computes representative capital charges associated with different levels of the target leverage ratio. As the table shows, the largest capital charge stems from the cash bond leg of the trade, since the capital charged is based on the entire notional amount financed rather than net repo liability. However, for higher leverage ratios, 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.

Anecdotal evidence suggests that dealers have increasingly been viewing their activity through the lens of the return on equity (ROE) generated by a given trade, which has declined across the board because of higher leverage (that is, stricter capital) requirements. Table 5 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. Indeed, the ROE declines from 17 percent to 9 percent when the

Table 6
Bond-CDS 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	-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

Source: Authors' calculations.

Notes: Spreads are reported in basis points. The table shows the maximum bond-CDS spread that generates different ROE levels for disparate assumptions on the leverage ratio of the dealer.

assumed leverage ratio increases from 1 percent to 2 percent, and then declines a further 3 percentage points when the leverage ratio increases from 2 percent to 3 percent. At around a 6 percent leverage ratio, corresponding to the SLR for the largest U.S. banks in 2015, the ROE for the CDS-bond trade is 3 percent at most, well below the 15 percent ROE reportedly targeted by dealers.

Compare this with the ROE that would have been earned historically on the investment grade bond-CDS trade. Chart 4 plots the time series evolution of the profit from the bond-CDS trade and the total equity cost under different leverage ratio assumptions. As the CDS-bond basis and the OIS spread fluctuate over time, the income earned on the swap spread trade fluctuates as well (Chart 4, top panel). When the regulatory minimum leverage level is low, say 1 percent, this translates into the implied ROE fluctuating between -10 percent and +20 percent (Chart 4, lower panel). However, for higher required leverage levels, the fluctuations are much more modest, with the implied ROE never reaching above 5 percent for the 6 percent minimum leverage requirement.

Breakeven Basis

While new regulations may have increased dealer CDS-bond trade costs, there should still be a CDS-bond basis level at which the trade generates an attractive ROE. Table 6 conducts a sensitivity analysis of the breakeven CDS-bond basis needed to achieve a given ROE target for different leverage ratio levels. In the past, at low regulatory leverage levels, a dealer could have earned a 15 percent ROE when the CDS-bond basis was below negative 134 basis points simply through carry. Now, at a 6 percent leverage ratio, the basis needs to be negative 218 basis points to achieve the same ROE target. While this calculation is subject to many assumptions, it illustrates the costs faced by dealers and helps explain their possible reluctance to enter into basis trades.

3.4 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 must be financed via leverage. At the same time, each individual CDS contract requires a margin to be posted with the counterparty to the contract. The CDX-CDS basis trade is further complicated by differences in the clearing requirements for single-name and index contracts. In particular, under current regulation, index CDS contracts are required to be centrally cleared. Single-name CDS, on the other hand, are not required to be centrally cleared. Thus, the margin requirements for the long and the short sides of the CDX-CDS trades cannot be offset against each other. For example, to put on the CDX-CDS basis trade for the investment grade index (CDX.NA.IG), a market participant must post margin with the CCP clearing the index (ICE) and with the CCPs clearing the eligible single-name contracts (ICE, CME, LCH). In addition, since all the CDS contracts trade on a standardized basis, all contracts necessary for this trade will have non-zero upfront payments, further increasing the cost of entering into the trade.

4. 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. Although some of these factors may be transitory—for example, as the outlook for energy companies stabilized, idiosyncratic risk of high-yield companies decreased—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 appears that executing credit-basis 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, rather than the derivatives portion. As a result, while current CDS-cash basis levels may have been attractive to trade in the past, which would have lessened the dislocations, our analyses suggest that these spreads must still reach more negative levels to produce adequate returns on equity for dealers, given the balance sheet costs. Although this may represent a shift in the levels considered attractive to trade, it suggests there may be a "new normal" level at which dealers may be incentivized to enter into these spread and basis trades, which eventually should narrow the dislocations. Indeed, the CDS-cash basis became less negative in the spring of 2016, though this appears to have resulted from an increase in demand for corporate bond products following alleviation of macro risks, not from dealer arbitrage activity.

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

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[1] The North American Corporate Investment Grade (CDX.NA.IG) has 125 constituents and the North American Corporate High Yield Index (CDX.NA.HY) has 100 constituents.

[2] The rapid growth of the CDS market in the early 2000s was reflected not only in enormous levels of gross notional amount outstanding, but also in operational backlog. Therefore, the CDS contract and its trading conventions were changed on April 2009 as part of the Big Bang Protocol to create a more standardized contract intended to eliminate offsetting trades and facilitate centralized clearing.

[3] CDX.EM, the emerging market CDS index, is an exception with semiannual payments.

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

[5] 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 indexes. These changes did not affect the inclusion criteria for the investment grade index.

[6] That is, each month, we average the stock variance of all firms with an investment-grade credit rating to create the idiosyncratic equity volatility for investment grade firms; similarly, we average the stock variance of all firms with a high-yield credit rating to create the idiosyncratic equity volatility for high-yield firms.

[7] 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 Trade Information Warehouse universe of transactions.

[8] Prior to the crisis, CDS were rolled on a quarterly basis.

[9] These assumptions are based on interest rates prevailing in fall 2015. 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 in which the periodic floating payment is based on a return calculated from a daily compound interest investment and the reference rate is an overnight rate.

[10] Market participants may also execute a third leg, which is an asset swap that hedges 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 swap spread.

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

[12] If the CDS is cleared, the investor purchasing it posts half the initial margin required by the clearing member for selling CDS protection. In this example, the clearing member requires 4 percent initial margin from a counterparty selling CDS, and 50 percent times 4 percent equals a 2 percent initial margin for a counterparty buying CDS protection.

[13] Our example assumes that the single-name CDS is not cleared and that bilateral netting is not applicable. If netting were applicable, it could be used to offset up to 60 percent of the effective notional value.

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