Credit Derivatives and Quantitative Research
New York, London
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Credit Derivatives: A Primer

About this primer

This primer introduces credit derivatives to new users and explains how to value and trade them. The supporting graphs, exhibits, footnotes, and appendices further aid the reader in learning about credit derivatives.

JPMorgan publishes daily reports that analyze the credit derivative markets. To receive electronic copies of these reports, please contact a Credit Derivatives research professional or your salesperson. These reports are also available on www.morganmarkets.com.

1. Introduction

A credit derivative is a financial contract that allows one to take or reduce default exposure, generally on bonds or loans, of a sovereign or corporate entity. The contract is between two parties and does not directly involve the issuer itself. Credit derivatives are primarily used to:

1) reduce risk arising from ownership of bonds or loans

2) take exposure to an entity, as one would do by buying a bond or loan, and

3) express a positive or negative credit view on a single entity or a group of entities, independent of any other exposures to the entity one might have.

Since its introduction in the mid-1990s, the growth of the credit derivative market has been dramatic:

- The notional amount of credit derivative contracts outstanding at the end of 2003 stood at $3.5 trillion, up 82% from 2002[1]. At the end of 2004, outstanding contracts are estimated to be $5 trillion.
- The tremendous growth in the credit derivatives market has been driven by the diversification of participants, the standardization of documentation, and the growth of product applications.
- Credit derivatives have become mainstream and are integrated with credit trading and risk management at many firms.
- We estimate that single-name credit default swaps represent about 60% of the total volume of credit derivatives traded, while credit derivative index products (see Section 6) represent about 25%. Options, first-to-default baskets, synthetic CDOs, and tranched credit products (see Section 7)

1. British Bankers' Association estimates.

The certifying analyst(s) is indicated by a superscript AC. See last page of the report for analyst certification and important legal and regulatory disclosures.

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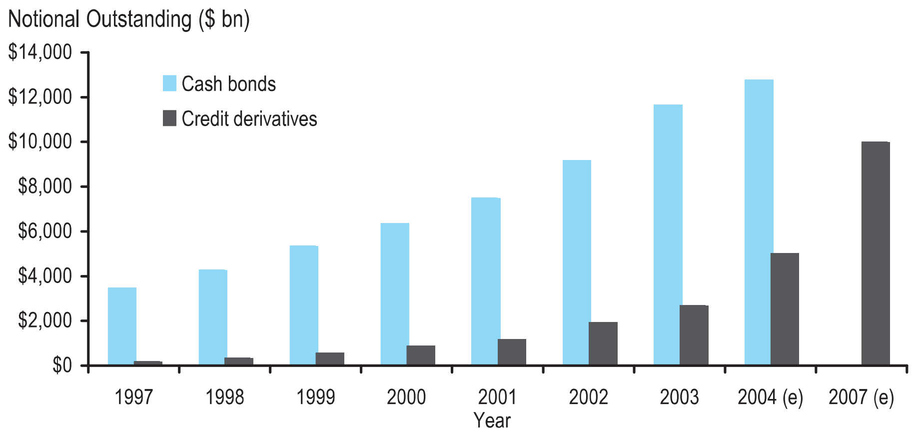
account for the remaining 15% of the credit derivatives market. We expect this segment to grow.

- The variety of products is growing along with the sophistication of users. Recent additions to the credit derivatives product suite allow for the trading of spread volatility, correlation, and spread curves, as well as specific components of credit risk such as recovery rates.

Exhibit 1: Credit derivative volumes continue to grow rapidly and are an increasing portion of total debt outstanding.



Sources: British Bankers' Association, Bank for International Settlements.

2. The credit default swap

The credit default swap (CDS) is the cornerstone of the credit derivatives market. A credit default swap is an agreement between two parties to exchange the credit risk of an issuer (reference entity). The buyer of the credit default swap is said to buy protection. The buyer usually pays a periodic fee and profits if the reference entity has a credit event, or if the credit worsens while the swap is outstanding. A credit event includes bankruptcy, failing to pay outstanding debt obligations, or in some CDS contracts, a restructuring of a bond or loan[2]. Buying protection has a similar credit risk position to selling a bond short, or "going short risk."

The seller of the credit default swap is said to sell protection. The seller collects the periodic fee and profits if the credit of the reference entity remains stable or improves while the swap is outstanding. Selling protection has a similar credit risk position to owning a bond or loan, or "going long risk."

As shown in exhibit 2, Investor B, the buyer of protection, pays Investor S, the seller of protection, a periodic fee (usually on the 20th of March, June, September, and December) for a specified time frame. To calculate this fee on an annualized basis, the two parties multiply the notional amount of the swap, or the dollar amount of risk being exchanged, by the market price of the credit default swap (the market price of a CDS is also called the spread or fixed rate). CDS market prices are quoted in basis points (bp), and are a measure of the reference entity's credit risk. (Section 3 discusses how credit default swaps are valued.)

2. See the appendix for an in-depth description of credit events

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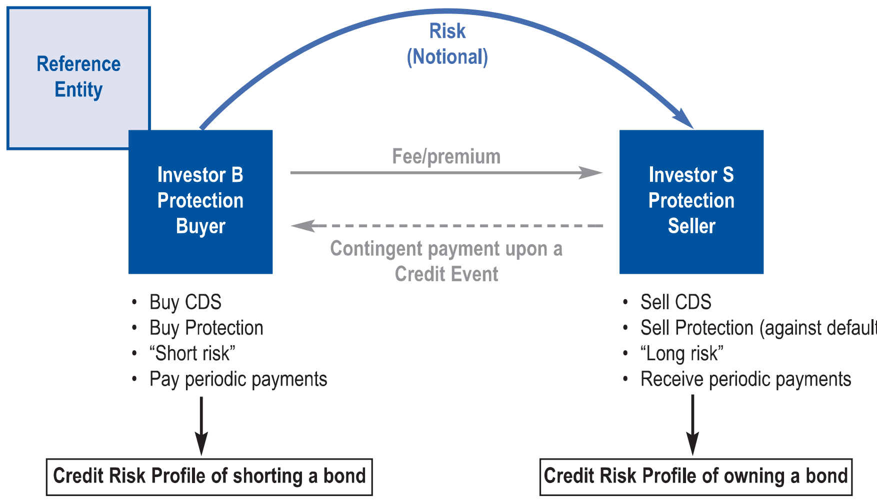
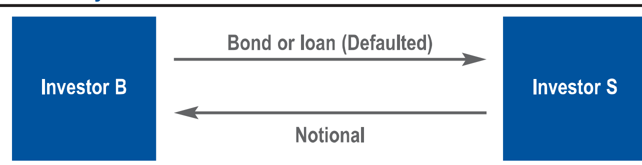
Exhibit 2: Single name credit default swaps



Definition: A credit default swap is an agreement in which one party buys protection against losses occurring due to a credit event of a reference entity up to the maturity date of the swap. The protection buyer pays a periodic fee for this protection up to the maturity date, unless a credit event triggers the contingent payment. If such trigger happens, the buyer of protection only needs to pay the accrued fee up to the day of the credit event (standard credit default swap), and deliver an obligation of the reference credit in exchange for the protection payout.

Source: JPMorgan.

Exhibit 3: If the Reference Entity has a credit event, the CDS Buyer delivers a bond or loan issued by the reference entity to the Seller. The Seller then delivers the Notional value of the CDS contract to the Buyer.



Source: JPMorgan.

Following a credit event, the buyer of protection delivers to the seller of protection defaulted bonds and/or loans with a face amount equal to the notional amount of the credit default swap contract. The seller of protection then delivers the notional amount on the CDS contract in cash to the buyer of protection. The buyer can deliver any bond meeting certain criteria issued by the reference entity that is pari passu, or of the same level of seniority, as the specific bond referenced in the contract. This is called "physical settlement," as the "physical" bonds are delivered. Alternatively, because the CDS contract is a bilateral agreement, the buyer and seller can agree to unwind the trade based on the market price of the defaulted bond, for example $40 per $100. The seller then pays the net amount owed to the protection buyer, or $100 - $40 = $60. This is called "cash settlement." It is important to note that the recovery rate ($40 in this example) is not fixed and is determined only after the credit event.

There does not need to be a credit event for credit default swap investors to capture gains or losses, however. Like bonds, credit default swap spreads widen when the market perceives credit risk has increased and tightens when the market perceives credit risk has improved. For example, if Investor B bought five years of protection (short risk) paying 50bp per year, the CDS spread could widen to 75bp after one year.

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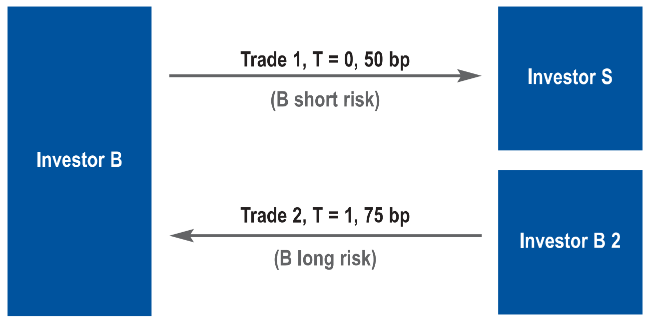
Investor B could collect profits and unwind the swap by selling four-year protection (long risk) at 75bp. Investor B would receive the present value of 75 – 50 = 25bp for the remaining four years on her contract multiplied by the notional amount of the swap (this is an approximation; Section 8 details the profit calculation).

Other notes about credit default swaps:

Exhibit 4: CDS investors can capture gains and losses before the contract matures.



Note that Investor B may directly unwind Trade 1 with Investor S, or instead with Investor B2 (presumably for a better price). If she chooses to do the unwind trade with Investor B2, she tells Investor B2 that she is assigning her original trade with S to Investor B2. Investor S and Investor B2 then have offsetting trades with each other. In either case her profit is the same. She would receive the present value of (75 - 50 = 25 bp) * (4, approximate duration of contract) * (notional amount of the swap). Thus, Investor B finishes with cash equal to the profit on the trade and no outstanding positions.
Source: JPMorgan.

- The most commonly traded and therefore the most liquid tenors, or maturity lengths, for credit default swap contracts are five and ten years, though liquidity across the maturity curve continues to develop.
- Standard trading sizes vary depending on the reference entity. For example, in the US, $10 - 20 million notional is typical for investment grade credits and $2-5 million notional is typical for high yield credits. In Europe, €10 million notional is typical for investment grade credits and €2 - 5 million notional is typical for high yield credits.

Credit default swaps and credit-linked notes

Credit default swaps are swap contracts where upfront cash is not exchanged at the time of the transaction but may be exchanged in the future based on market outcomes. The economics of the credit default swap can be captured in a funded security or a note. A credit linked note is a synthetic security, typically issued by a special purpose vehicle, that trades like a bond issued by the reference entity but with the economics of the credit default swap. For this security, the buyer of protection sells the note. As in the credit default swap, the protection buyer is still “going short risk.” The buyer of protection (note seller) will pay periodic payments and profit if the reference entity defaults. Unlike the swap, the buyer of protection in a credit-linked note will receive money at the time of transaction from the sale of the note, and will return this money at the contract’s maturity if no credit event occurs.

Conversely, the seller of protection purchases the note and is “long risk.” As with a credit default swap, the note purchaser (protection seller) receives periodic payments. Unlike the swap transaction, the protection seller must pay for the note at the time of the transaction and will collect this money at the contract’s maturity if no credit event occurs. Thus, the cash flows and risks of buying and selling credit-linked notes are similar to buying and selling bonds.

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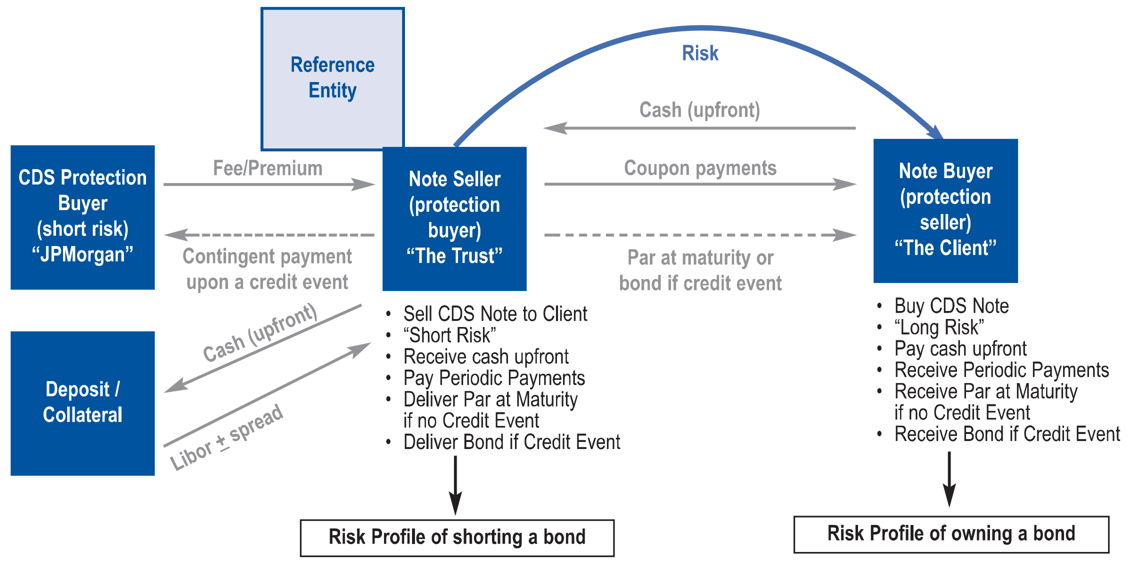
Recall that, in a credit default swap, if a reference entity has a credit event, the buyer of protection (short risk) delivers defaulted bonds or loans to the seller of protection (long risk), then receives the notional value of the credit default swap contract. In other words, the buyer of protection receives par minus the recovery value of the defaulted bond. When a reference entity of a credit linked note defaults, the economics are identical. In the case of default, the buyer of protection (short risk), or the investor who sold the note, delivers bonds and/or loans of the reference entity and keeps the cash she received at the trade's inception.

Exhibit 5: Credit-Linked Notes are a synthetic security that trades like a bond issued by the Reference Entity, but with the economics of a credit default swap.



Source: JPMorgan.

3. Valuation and relative value analysis of credit default swaps

Credit default swaps and bonds of the same credit will usually trade similarly, as both reflect the market's view of default risk. In order to compare credit default swaps with bonds, one needs to isolate the spread of the bond that compensates the holder for assuming the credit risk of the issuer.

Intuition behind credit default swap valuation

To make the comparison between credit default swaps and bonds, we assume that the yield on a typical fixed-rate corporate bond is intended to compensate the holder for the following:

- Risk-Free Rate: the bond holder could earn this yield in a default/risk-free investment (for example, the US Treasury rate).
- Funding Risk: This is the swap spread. The swap yield (swap spread plus the risk-free rate) is the hurdle rate for investment opportunities for many investors.
- Credit Risk: the risk that the investor might suffer a loss if the issuer defaults.

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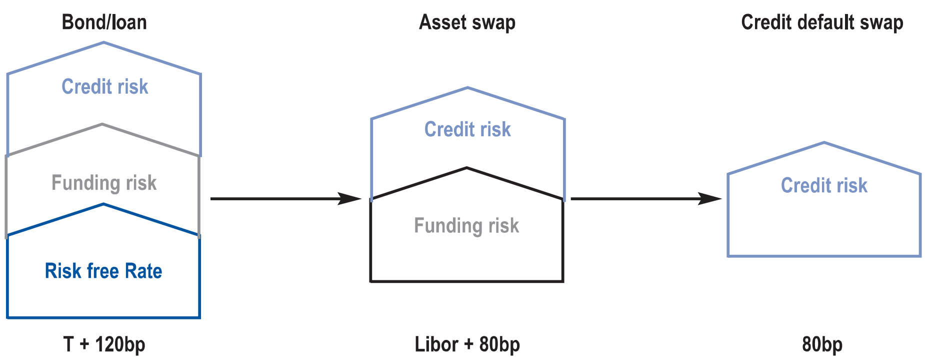
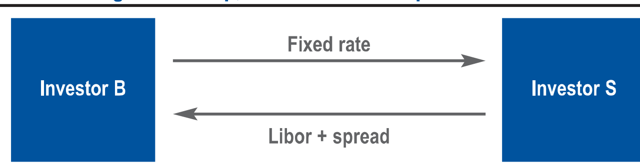
For example, assume that a bond is paying a yield of Treasury rates plus 120bp (Exhibit 6). To remove interest-rate risk from owning this bond, an investor can swap the fixed payments received from the bond for floating rate payments through an asset swap. In a fixed-to-floating asset swap, Investor B (Exhibit 7) agrees to make a series of fixed payments to Investor S, and Investor S makes floating payments to Investor B. Swaps are typically constructed so that the present value of the fixed payments equals the present value of the floating payments. In our example, the fixed rate is the bond's coupon, and we solve for the floating rate equivalent, Libor[3] + 80bp. As a result of the fixed-to-floating rate swap, Investor B will receive floating payments equal to Libor + 80bp. Thus, the value of Investor B's position is no longer very sensitive to changes in risk-free rates, as she will receive a higher coupon as rates increase and lower coupon as rates decrease.

Exhibit 6: Spreads of Credit Default Swaps can be compared to bond yields.



Source: JPMorgan.

Exhibit 7: Fixed to floating asset swap, or a "Vanilla" swap



Source: JPMorgan.

To isolate the credit risk, our investor must account for her funding costs, or the rate at which she borrows money needed to purchase the bonds. In our example, we assume that an investor can borrow money at a rate of Libor. Thus, if an investor purchased this bond, she would receive the yield on the bond less her borrowing costs, or (Libor + 80bp) – Libor = 80bp. The difference between the bond's yield and the swap yield curve (Libor) is called the Z-spread[4]. For bonds trading with

3. London interbank offer rate.

4. More specifically, the Z-spread is the value that solves the following equation (assuming a three period bond):

$$Bond\ Price = \frac{c_1}{(1+s_1+Z)^1} + \frac{c_2}{(1+s_2+Z)^2} + \frac{c_3+Face}{(1+s_3+Z)^3}$$

Where Bond Price = current market price, c_i = coupon at time *i*, s_i = swap rate at time *i*, Face = face value of bond.

The I-spread is also used in the valuation of bonds. It solves the equations (assuming a three period bond):

$$Bond\ Price = \frac{c_1}{(1+YTM)^1} + \frac{c_2}{(1+YTM)^2} + \frac{c_3+Face}{(1+YTM)^3}$$

I-spread = YTM - s_t

Where YTM = yield to maturity, s_t = swap rate to bond's maturity date.

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low Z-spreads and market prices close to par, or $100, it is usually valid to directly compare the Z-spread on a bond to the credit default swap spread. For example, if a bond has a Z-spread of 100bp and the CDS spread for the same credit and same maturity trades at 120bp, one could conclude that the CDS market was assigning a more bearish view compared to the bond market for this credit. In this case, there may be a relative value trading opportunity between the bonds and CDS. For bonds not trading close to par, investors should make adjustments to the Z-spread to more accurately compare it to the market-quoted credit default swap spread with the same maturity date.

Par equivalent credit default swap spread

If the bond's Z-spread is wide and/or the bond's price is not close to $100, the subtle differences between the Z-spread and the credit default swap spread become more important. We call the "perfect" bond spread to compare to a credit default swap spread a par equivalent credit default swap spread. In this calculation, we make adjustments to a bond's Z-spread so it is directly comparable to the CDS market. We emphasize, however, that for most investment-grade bonds, Z-spreads and par equivalent CDS spreads will be within a few basis points.

The reason that adjustments should be made to the bond's Z-spread, derived above, before comparing it to a credit default spread are:

Differences in cash prices between bonds and credit default swaps

For a given issuer, if a bond and a credit default swap have the same spread and the issuer does not default, the return on the bond and CDS will be the same. If a company defaults, however, the loss to the bond holder (long risk) and CDS seller (long risk) may not be the same.

For example, assume an investor is considering purchasing a bond with a price of $110.00, one year to maturity and a 3% spread over swaps. Assume that the one year CDS for this company also has a 3% spread. If the investor has $100 to spend (or to risk), she will buy $100 / $110 or 0.9091 bonds, or she will sell protection (take risk) for $100 notional in CDS. If there is no default, the investor will earn $3 in either case. If there is a credit event, however, the returns will not be the same. A bond investor will lose money equal to the price she paid for the bond less the recovery value she receives for selling the defaulted bond. In our example, if the defaulted bond's price falls to $40, the investor will have suffered a loss of: (price change) * (number of bonds), or ($110 - $40)*(.91) = $63.64. Alternatively, if the investor had sold $100 of default protection, her loss would be equal to the notional amount of CDS contract minus the recovery value of bonds delivered, or $100 – $40 = $60. A premium bond is thus more expensive, when compared to a credit default swap, than the Z-spread implies, because the bond has more risk in the case of default, while the same return on credit risk as a CDS if there is no default.

Exhibit 8: Although a bond and a CDS may have the same spread, they may have a different loss profile in the case of default.

Bond		Credit Default Swap	
Z-spread	3%	Market spread	3%
Cash at risk	$100	Cash at risk	$100
Bond price	$110		
No. of bonds purchased	0.9091		
Default recovery price	$40	Default recovery price	$40
Cash loss	(110-40)*0.909 = **$63.64**	Cash loss	100-40 = **$60**

Source: JPMorgan.

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In the par-equivalent CDS spread calculation, we adjust for the additional risk of default for bonds priced above par by making a downward adjustment to the Z-spread. In other words, we lower the bond Z-spread because a bond priced above par can be thought of as "more expensive" than the unadjusted Z-spread implies, for there will be a greater loss on default for a bond compared to a CDS. An upward adjustment to the Z-spread is made if the bonds are priced below par.

Convention with coupon payments
The coupon payments for US corporate bonds are paid semi-annually and accrue using a 30/360 day count convention (30-day month and 360-day year). The coupon, or fee payments, for a credit default swap are paid quarterly and accrue using an actual/360 convention. The par equivalent CDS spread adjusts for this by converting the bond's coupon payments to the credit default swap convention.

Treatment of coupons in the event of default
If an issuer defaults in between scheduled coupon payments, the bond investor does not receive money for the coupon payment. Rather, the missed accrued payment is a claim on the company's assets. On the other hand, if an issuer defaults in between scheduled credit default swap coupon payments, the seller of protection (long risk) receives the accrued coupon payment up to the date of default. This payment will be settled when the buyer and seller of protection close the transaction.

The potential cost to unwind a swap
As described in Exhibit 6, the yield on a bond can be divided into the swap yield plus a credit spread. When an issuer defaults, both the swap part of the bond coupon payments and the credit part of the coupon payments stop. For a credit default swap investor to replicate a long bond position, she would sell protection (long risk) and invest in swaps (paying floating, receiving fixed). But for the CDS investor, the swap coupon will continue to pay until maturity if the issuer defaults. To make the swap plus credit default swap investment equivalent to a bond, we must adjust for the potential cost to unwind the swap position before maturity. This cost, multiplied by the probability of default, discounted to present value terms, is another adjustment made to calculate the par equivalent CDS spread. (Please see the appendix for more detail on par equivalent CDS spread calculations.)

The difference between bonds and credit default swap spreads
Basis refers to the difference, in basis points, between a credit default swap spread and a bond's par equivalent CDS spread with the same maturity dates. Basis is either zero, positive or negative.

Negative basis
If the basis is negative, then the credit default swap spread is lower than the bond's spread. This occurs when there is excess protection selling (investors looking to go long risk and receive periodic payments), reducing the CDS coupon. Excess protection selling may come from structured credit issuers (or CDO issuers, discussed in Section 7), for example, who sell protection in order to fund coupon payments to the buyers of structured credit products. Protection selling may also come from investors who lend at rates above Libor. For these investors, it may be more economical to sell protection (long risk) and invest at spreads above Libor, rather than borrow money and purchase a bond.

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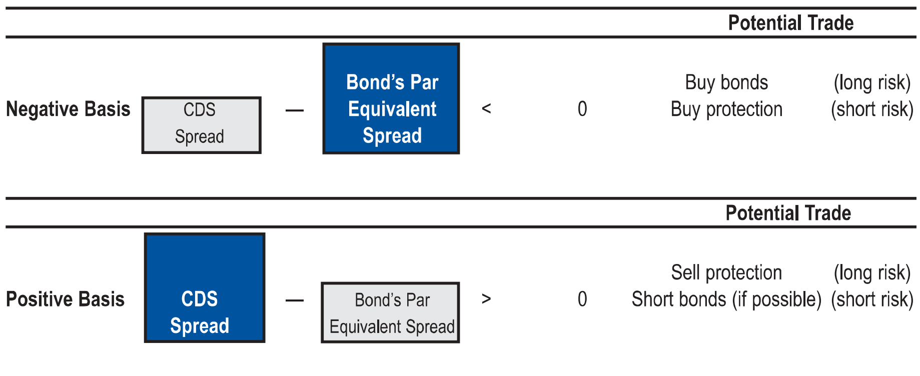
An investor could buy the bond (long risk) then buy protection (short risk), to capture this pricing discrepancy. In this trade, an investor is not exposed to default risk, yet still receives a spread. This is, therefore, a potential arbitrage opportunity[5]. Trading desks at investment banks and other investors who can fund long bond positions cheaply (borrowing at or near Libor) will typically enter into this position when the negative basis exceeds 10–25bp. Such arbitrage opportunities are increasingly rare.

Exhibit 9: Basis is the basis point difference between a credit default swap spread and a bond's par equivalent credit default swap spread with the same maturity dates. Basis is either positive or negative.



Source: JPMorgan.

Positive basis

If the basis is positive, then the credit default spread is greater than the bond's spread. Positive basis occurs for technical and fundemental reasons. The technical reasons are primarily due to imperfections in the repo[6] market for borrowing bonds. Specifically, if cash bonds could be borrowed for extended periods of time at fixed costs, then there would not be a reason for bonds to trade "expensive" relative to credit default swaps. If a positive basis situation arises, investors would borrow the bonds and sell them short, eliminating the spread discrepancy. In practice, there are significant costs and uncertainties in borrowing bonds. Therefore, if the market becomes more bearish on a credit, rather than selling bonds short, investors may buy default protection (short risk). This may cause credit default swap spreads to widen compared with bond spreads.

Another technical factor that causes positive basis is that there is, to some degree, a segmented market between bonds and credit default swaps. Regulatory, legal and other factors prevent some holders of bonds from switching between the bond and credit default swap markets. These investors are unable to sell a bond and then sell protection (long risk) when the credit default swap market offers better value. Along this vein of segmented markets, sometimes there are market participants, particularly coming from the convertible bond market, who wish to short a credit (buy default swap protection) because it makes another transaction profitable[7]. These investors may pay more for the protection than investors who

5. The trade does have mark-to-market and counterparty risk.
6. A repurchase (repo) trade is when an investor borrows money to purchase a bond, posts the bond as collateral to the lender, and pays an interest rate on the money borrowed. The interest rate is called the repo rate. Most repo transactions are done on an overnight basis or for a few weeks at most. To sell a bond short, an investor must find an owner of the bond, borrow the bond from the owner in return for a fee (repo rate), then sell the bond to another investor for cash. This is difficult to do at a fixed repo cost for extended periods of time.
7. Investors may purchase convertible bonds and purchase default protection in the CDS market, thus isolating the equity option embedded in the convertible.

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are comparing the bonds and credit default swap markets. This is another manifestation of the undeveloped repo market.

A fundemental factor that creates positive basis is the cheapest-to-deliver option. A short CDS position (long risk) is short the cheapest-to-deliver option. If there is a credit event, the protection buyer (short risk) is contractually allowed to choose which bond to deliver in exchange for the notional amount. This investor will generally deliver the cheapest bond in the market. When there is a credit event, bonds at the same level of the capital structure generally trade at the same price (except for potential differences in accrued interest) as they will be treated similarly in a restructuring. Still, there is the potential for price disparity. Thus, protection sellers (long risk) may expect to receive additional spread compared to bonds for bearing this risk. This would lead to CDS spreads trading wider than bond spreads and therefore contribute to positive basis.

4. The importance of credit derivatives

Credit derivatives have been widely adopted by credit market participants as a tool for managing exposure to, or investing in, credit. The rapid growth of this market is largely attributable to the following features of credit derivatives:

Credit derivatives allow the disaggregation of credit risk from other risks inherent in traditional credit instruments.
A corporate bond represents a bundle of risks including interest rate, currency (potentially), and credit risk (constituting both the risk of default and the risk of volatility in credit spreads). Before the advent of credit default swaps, the primary way for a bond investor to adjust his credit risk position was to buy or sell that bond, consequently affecting his positions across the entire bundle of risks. Credit derivatives provide the ability to independently manage default risk and interest rate risk.

Credit derivatives provide an efficient way to short a credit.
While it can be difficult to borrow corporate bonds on a term basis or enter into a short sale of a bank loan, a short position can be easily achieved by purchasing credit protection. Consequently, risk managers can short specific credits or a broad index of credits, either as a hedge of existing exposures or to profit from a negative credit view.

Credit derivatives create a market for “pure” credit risk that allows the market to transfer credit risk to the most efficient holder of risk.
Credit default swaps represent the cost to assume “pure” credit risk, as discussed in the Valuation section on page 5. Bond, loan, equity, and equity-linked market participants may transact in the credit default swap market. Because of this central position, the credit default swap market will often react faster than the bond or loan markets to news affecting credit prices. For example, investors buying newly issued convertible debt are exposed to the credit risk in the bond component of the convertible instrument, and may seek to hedge this risk using credit default swaps. As buyers of the convertible bond purchase protection, spreads in the CDS market widen. This spread change may occur before the pricing implications of the convertible debt are reflected in bond market spreads. However, the change in CDS spreads may cause bond spreads to widen as investors seek to maintain the value relationship between bonds and CDS. Thus, the CDS market can serve as a link between structurally separate markets. This has led to more awareness of and participation from different types of investors.

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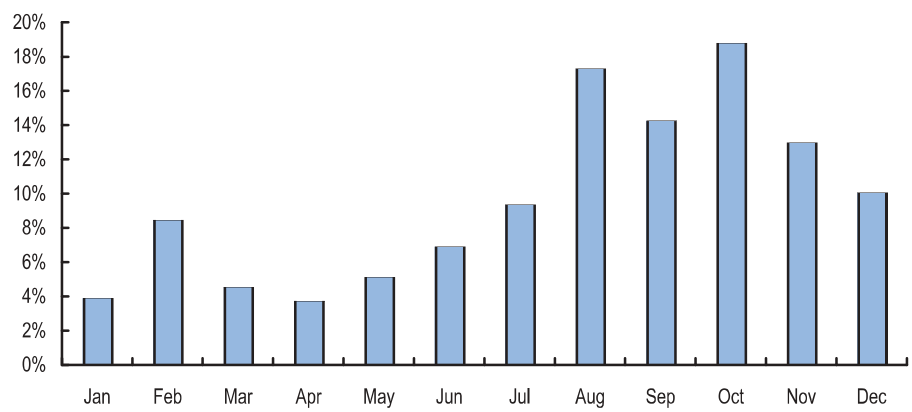
Credit derivatives provide liquidity in times of turbulence in the credit markets. The credit derivative market is able to provide liquidity during periods of market distress (high default rates). Before the credit default swap market, a holder of a distressed or defaulted bond often had difficulty selling the bond–even at reduced prices. This is because cash bond desks are typically long risk as they own an inventory of bonds. As a result, they are often unwilling to purchase bonds and assume more risk in times of market stress. In contrast, credit derivative desks typically hold an inventory of protection (short risk), having bought protection through credit default swaps. In distressed markets, investors can reduce long risk positions by purchasing protection from credit derivative desks, which may be better positioned to sell protection (long risk) and change their inventory position from short risk to neutral. Furthermore, the CDS market creates natural buyers of defaulted bonds, as protection holders (short risk) buy bonds to deliver to the protection sellers (long risk). CDS markets have, therefore, led to increased liquidity across many credit markets.

As the exhibit below illustrates, CDS volumes as a percentage of cash volumes increased steadily during the distressed spring and summer of 2002 in the face of credit-spread volatility and corporate defaults.

Exhibit 10: The CDS market remained liquid during the turbulent second half of 2002.

US High Yield CDS volumes as a % of High Yield cash volumes: 2002



Source: JPMorgan.

Credit derivatives provide ways to tailor credit investments and hedges. Credit derivatives provide users with various options to customize their risk profiles. Through the CDS market, investors may assume exposure to credits that do not actively trade in the cash market, customize tenor or currency exposure, or benefit from relative value transactions between credit derivatives and other asset classes. With credit derivatives, investors have access to a variety of structures, such as baskets and tranches that can be used to tailor investments to suit the investor's desired risk/return profile.

Credit derivative transactions are confidential. As with the trading of a bond in the secondary market, the reference entity whose credit risk is being transferred is neither a party to a credit derivative transaction, nor is even aware of it. This confidentiality enables risk managers to isolate and transfer credit risk discreetly, without affecting business relationships. In contrast, a loan

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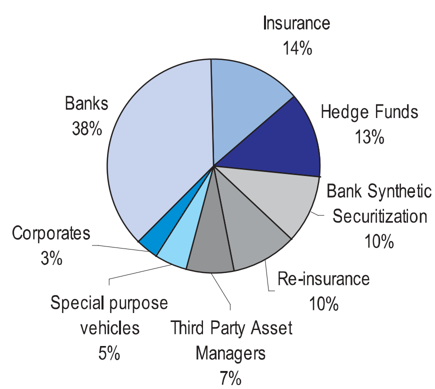
assignment through the secondary loan market may require borrower notification, and may require the participating bank to assume as much credit risk to the selling bank as to the borrower itself. Since the reference entity is not a party to the negotiation, the terms of the credit derivative transaction (tenor, seniority, and compensation structure) can be customized to meet the needs of the buyer and seller, rather than the particular liquidity or term needs of a borrower.

5. Market participants

Over the last 10 years, participants' profiles have evolved and diversified along with the credit derivatives market itself. While banks and hedge funds remain important players in the credit derivatives market, trends indicate that asset managers should be the principal drivers of future growth.

Exhibit 11: Diversity of CDS market participants



Source: Risk magazine: February 2003.

The following is a brief summary of strategies employed by the key players in the credit derivatives market:

Banks and loan portfolio managers
Banks were once the primary players in the credit derivatives market. They developed the CDS market in order to reduce their risk exposure to companies to whom they lent money, thus reducing the amount of capital needed to satisfy regulatory requirements. Banks continue to use credit derivatives for hedging both single-name and broad market credit exposure.

Market makers
In the past, market markers in the credit markets were constrained in their ability to provide liquidity because of limits on the amount of credit exposure they could have on one company or sector. The use of more efficient hedging strategies, including credit derivatives, has helped market makers trade more efficiently while employing less capital. Credit derivatives allow market makers to hold their inventory of bonds during a downturn in the credit cycle while remaining neutral in terms of credit risk. To this end, JPMorgan and some other dealers have integrated their CDS trading and cash trading businesses.

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Hedge funds

Since their early participation in the credit derivatives market, hedge funds have continued to increase their presence and have helped to increase the variety of trading strategies in the market. While hedge fund activity was once primarily driven by convertible bond arbitrage, many funds now use credit default swaps as the most effecient method to buy and sell credit risk. Additionally, hedge funds have been the primary users of relative value trading opportunities and new products that facilitate the trading of credit spread volatility, correlation, and recovery rates.

Asset managers

Asset managers have significantly increased their participation in the credit derivatives market in recent years. Asset managers are typically end users of risk that use the CDS market as a relative value tool, or to provide a structural feature they cannot find in the bond market, such as a particular maturity. Also, the ability to use the CDS market to express a bearish view is an attractive proposition for many asset managers. Prior to the availability of CDS, an asset manager would generally be flat or underweight in a credit they did not like, as most were unable to short bonds in their portfolios. Now, many asset managers may also buy credit protection as a way to take a short-term neutral stance on a credit while taking a bullish longer term view. For example, an asset manager might purchase three-year protection to hedge a ten-year bond position on an entity where the credit is under stress but is expected to perform well if it survives the next three years. Finally, the emergence of a liquid CDS index market has provided asset managers with a vehicle to efficiently express macro views on the credit markets.

Insurance companies

The participation of insurance companies in the credit default swap market can be separated into two distinct groups: 1) life insurance and property & casualty companies and 2) monolines and reinsurers. Life insurance and P&C companies typically use credit default swaps to sell protection (long risk) to enhance the return on their asset portfolio either through Replication (Synthetic Asset) Transactions ("RSATs", or the regulatory framework that allows some insurance companies to enter into credit default swaps) or credit-linked notes. Monolines and reinsurers often sell protection (long risk) as a source of additional premium and to diversify their portfolios to include credit risk.

Corporations

Corporations are recent entrants to the credit derivatives market and promise to be an area of growth. Most corporations focus on the use of credit derivatives for risk management purposes, though some invest in CDS indices and structured credit products as a way to increase returns on pension assets or balance sheet cash positions.

Recent default experiences have made corporate risk managers more aware of the amount of credit exposure they have to third parties and have caused many to explore alternatives for managing this risk. Many corporate treasury and credit officers find the use of CDS appealing as an alternative to credit insurance or factoring arrangements due to the greater liquidity, transparency of pricing and structural flexibility afforded by the CDS market. Corporations are also focused on managing funding costs; to this end, many corporate treasurers monitor their own CDS spreads as a benchmark for pricing new bank and bond deals and are exploring how the CDS market can be used to hedge future issuance.

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6. Credit default swap index products

Credit default swap indices provide investors with a single, liquid vehicle through which to take diversified long or short exposure to a specific credit market or market segment. The first index product was the High Yield Debt Index (HYDI), created by JPMorgan in 2001. Like the S&P 500 and other market benchmarks, the credit default indices reflect the performance of a basket of credits, namely, a basket of single-name credit default swaps (credit default swaps on individual credits). CDS indicies exist for the US investment-grade and high-yield markets, the European investment-grade and high-yield markets, the Asian markets, and global emerging markets.

Unlike a perpetual index like the S&P 500, CDS indices have a fixed composition and fixed maturities. New indices with an updated basket of underlying credits are launched periodically, usually twice a year. New indices are launched in order reflect changes in the credit market and to give the index more consistent duration and liquidity. When a new index is launched, dubbed the “on-the-run index,” the existing indices continue to trade (as “off-the-run”), and will continue to trade until maturity. The on-the-run indices tend to be more liquid than the off-the-run indices.

Mechanics of the indices
JPMorgan has worked with other dealers and the Dow Jones Company to create a global family of highly liquid, standardized CDS indices. The results of this effort are the Dow Jones CDX indices for North America, and the Emerging Markets and the Dow Jones iTraxx indices for Europe, Japan and Asia (two collective ventures within the global credit derivatives dealer community). There is a rules-based portfolio selection process used to create the indices. Credits that are prominent in the market and have liquid single-name credit default swaps are prime candidates for inclusion. Some of the indices have sub-indices based on ratings, industry groups, or geographic region.

The indices pay a fixed coupon that is determined by the consortium at the time of launch such that the market spread of the index will be near to its coupon. As the index trades, the market spread of the index changes while the coupon payment does not. For example, assume that an index has a coupon of 50bp (annual rate) that is paid quarterly. If the market spread of the index is different from the coupon, which is generally the case, there will be an upfront exchange of money to account for this difference. For example, if the market spread of the index is 60bp, the seller of protection (long risk, the investor who receives the coupon) will receive an upfront payment of (60bp minus 50bp)* duration*notional. The upfront payment plus the 50bp coupon is equivalent to receiving a 60bp coupon. Duration is used to calculate the present dollar value of the future spread payments, adjusting for default risk and time value. These calculations can computed using the credit default swap calculator on Bloomberg, discussed in Section 8. Details about duration are found in the appendix.

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Exhibit 12: The global credit derivative indices: DJ iTraxx and DJ CDX

Index	Tenors (yr)	No. of credits underlying index	Options traded?	Tranches traded?
European Investment Grade				
DJ iTraxx Europe Investment Grade	5, 10			
Europe		125	Yes	Yes
Non Financial		100	Yes	
HiVol		30	Yes	
TMT (Telecom, Media, Technology)		20	Yes	
Energy		20		
Auto		10		
Industrial		20		
Consumer		30		
Financial Senior		25		
Financial Sub		25		
European Crossover				
DJ iTraxx Europe Crossover	5, 10	30	Yes	
U.S. Investment Grade				
DJ CDX.NA.IG	1,2,3,4,5,7,10	125	Yes	Yes
High Vol		30	Yes	
U.S. High Yield				
DJ CDX.NA.HY (Swaps)	5			
100		100	Yes	Yes
BB		43		
B		44		
High Beta		30		
DJ CDX.NA.HY (Notes)	5			
100 (rated B3)		100	Yes	
BB (rated Ba3)		43		
B (rated B3)		44		
High Beta (not rated)		30		
Japan				
DJ iTraxx CJ	5, 10	50	Yes	Yes
Financials		10		
Technology		10		
Capital Goods and others		9		
HiVol		10		
Non-Japan Asia				
DJ iTraxx Asia ex Japan	5	30	Yes	Yes
Korea		8		
Greater China		9		
Rest of Asia		13		
Australia				
DJ iTraxx Australia	5	25	Yes	Yes
Emerging Markets				
DJ CDX.EM	5	14	Yes	

Source: JPMorgan.

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Exhibit 13: If the market price of the index is different from the coupon, there will be an upfront exchange of money to account for this difference.

If the market spread of the index =	60bp	Payment to Seller of Protection: (60bp – 50bp) * Duration
Index pays a fixed coupon of:	50bp	
If the market spread of the index =	40bp	Payment to Buyer of Protection: (50bp – 40bp) * Duration

Source: JPMorgan.

The credit default swaps in the index are equally weighted in terms of default protection; if there is a credit event in one credit, the notional value of an investor's CDS contract will fall by 1/100, if there are 100 credits in the index. After a credit event, in this example, the index will be comprised of 99 credits. Consider Investor B who buys $100 of protection (short risk) on an index with a coupon of 50 bp. Assume a credit event occurs in one credit whose bonds fall to $0.40 per $1 face. Investor B will deliver one bond, purchased for $0.40 in the marketplace, with a $1 face (notional * 1/100), to Investor S and receive $1 in cash. Investor B will continue paying 50 bp annually, but on the new notional value of $99.

The market spread of an index may change if there is a credit event in an underlying credit. Continuing our example, assume that, before the credit event, 99 of the credits underlying the index have a spread of 50 and one credit has a spread of 1,000. Also assume that the index is trading at its theoretical value (discussed next). The market spread of the index will be approximately 60 bp. If the credit with a spread of 1,000 defaults, the credit is removed from the index, and the market spread of the index will now be 50 bp, the average of the remaining 99 credits (Exhibit 14). An investor who is long protection (short risk) will therefore lose money when the index spread rallies, but receive money on the credit event ($0.60 in our example). If the credit event was widely anticipated, these two factors will likely offset one another for no significant net impact on her profit and loss statement.

Exhibit 14: After a credit event in an underlying credit, the credit drops out of the index, and the spread of the index should adjust to a tighter level.

	Number of underlying credits	Spread on each credit	Sum of spreads	Average spread	
	99	50	4,950	50	(market spread after credit event)
	1	1,000	1,000	1,000	
Total	**100**		**5,950**	**60**	(market spread before credit event)

Source: JPMorgan.

Theoretical value calculation

A credit default swap index spread is not directly based on the value of the underlying credit default swaps, but is set by the supply and demand of the market. This is analogous to the pricing of a closed-end mutual fund, where the traded price is based on the buying and selling of the index, not directly on the net asset value of the underlying securities.

To compute the theoretical value of the index, we perform the following calculations:

- Observe the current market levels of the single-name CDS that have the same maturity date as the index.

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- Convert the spreads into prices. Do this by assuming that each single-name CDS has a coupon equal to the index coupon and is being valued against its own CDS curve. For example, if the index has a coupon of 50 bp and the actual market spread of the first credit in the index was 75 bp, one would calculate its approximate price as par - (spread difference)* duration. If we assume duration is 4, the result is 1.00 - (0.0075 - 0.0050)*4 = $0.99.
- Mark-to-market: once the prices for all of the underlying credits are calculated, take a simple average. This is the theoretical value of the index in price terms. Then convert this price to a spread using the index duration.
- The market quoted index spread less the theoretical spread is the basis to theoretical.

If the quoted spread of the index is greater than this theoretical value, then basis to theoretical is positive. If the opposite is true, then basis to theoretical is negative. The terminology is different for the US High Yield CDX indices as they trade on price rather than spread terms. When the HY CDX indices trade at a higher price than the theoretical price implied by the underlying credits, we say the index is trading with a positive basis to theoretical value. For individual credits, investors attempt to arbitrage this relationship by buying the cheap security and selling the expensive security. This is also possible to do with the indices, however, the transaction costs involved with trading a basket of single name CDS against the index need to be considered.

In a rapidly changing market, the index tends to move more quickly than the underlying credits. This is because, in buying and selling the index, investors can express positive and negative views about the credit market in a single trade. This creates greater liquidity in the indices compared to the individual credits. As a result, the basis to theoretical for the indices tends to increase in magnitude in volatile markets.

Exhibit 15: The basis to theoretical of an index is the difference between the spread of the index and the theoretical spread of the index implied by the underlying CDS spreads.

Negative Basis to theoretical	Index Spread	—	**Theoretical Value of Underlying CDS**	<	0
Positive Basis to theoretical	**Index Spread**	—	Theoretical Value of Underlying CDS	>	0

Source: JPMorgan.

Comparing the CDS index to cash bonds

Comparing the credit default swap indices to cash bonds is a two-step process of first comparing the index to the levels of the individual credit default swaps that make up the index, and second, comparing the single names credit default swap levels to bonds. The second step is an average of the basis between a representative bond for each credit and the CDS curve for that credit. In order to do this calculation perfectly, one would need a liquid bond for each credit with the exact maturity date of each index. As such bonds do not exist, investors often choose the most liquid bond for each credit that is nearest to the maturity date of the index. If no such bond exists, credits are often excluded from the basis calculation. The result is therefore an approximation of the relative expensiveness or cheapness of the index to the cash bond market for a similar list of credits.

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Note that this calculation incorporates the comparison of the index to the underlying CDS. This is because, if the basis between each bond and its CDS curve averaged to zero but the index was trading 5bp expensive to the CDS market (i.e., expensive to theoretical), then the index would also be trading 5bp expensive to cash bonds.

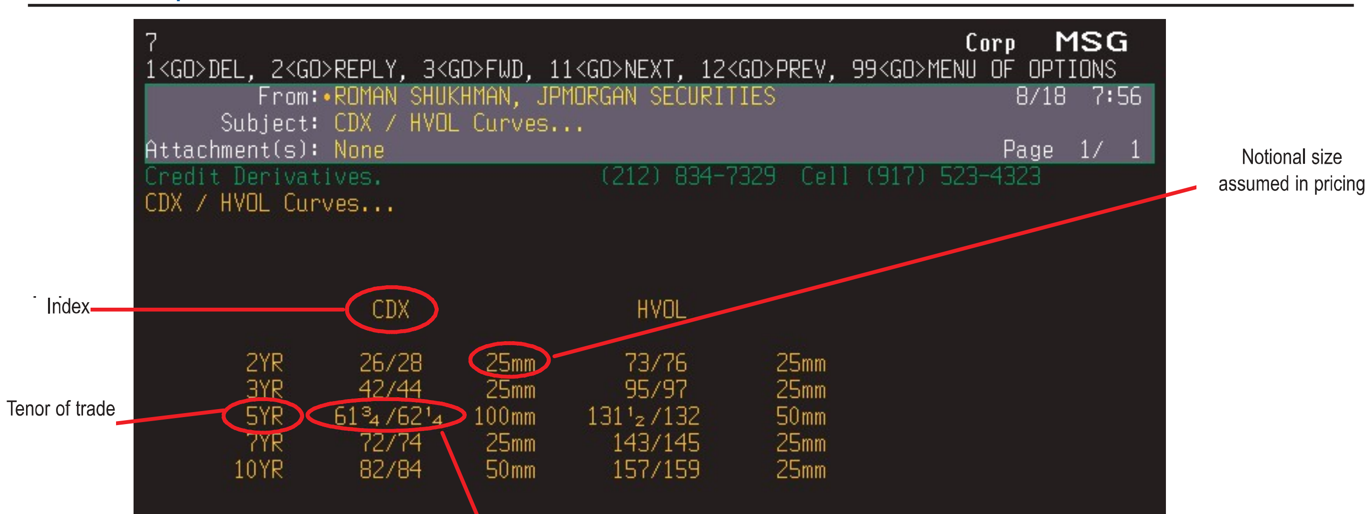
Other index points:

- The most liquid credit default swap maturity is the five-year tenor, followed by the ten-year tenor.
- Standard trade sizes are US$100-50 million, or its equivalent, for the main US and European indices, and US$10-25 million for subindices.
- Single-name North American high-grade credits typically include Modified Restructuring as a credit event, while single-name North American high-yield credits typically do not. Both the US high grade and high yield indices trade with no restructuring, however. Modified Restructuring is discussed in Section 8.
- European investment-grade credits and the indices typically trade with Modified Modified Restructuring as a credit event.

Notes versus swaps

The US high-yield indices have funded securities in addition to the swap indices. The funded index is similar to the swap index in that it tracks the returns of the same basket of single-name credit default swaps. It differs in that it is priced and trades like a bond, with transfers of cash at the time of purchase in addition to coupon payments. (Like the credit-linked note in exhibit 5.) If an underlying credit defaults, in percentage terms, the coupon level remains constant. However in dollar terms, it is lowered because the face value of the note is reduced by 1/100, assuming there are 100 credits in the index.

Exhibit 16: Sample CDX Index Run



The spread at which the index is trading. In this example, an investor can sell protection (long risk) in 5 year CDX and receive 61.75bp (accrues on an Act/360 basis). Alternatively, she can buy protection (short risk) and pay 62.25bp annually. Credit derivative indices such as the CDX have a fixed coupon; the 5 yr in this example has a 60bp coupon. The market spread is usually above or below that rate, just as a bond may trade at a different spread than its coupon. If an investor sold protection (long risk), she would receive the PV(61.75bp – 60bp) upfront.

Source: Bloomberg.

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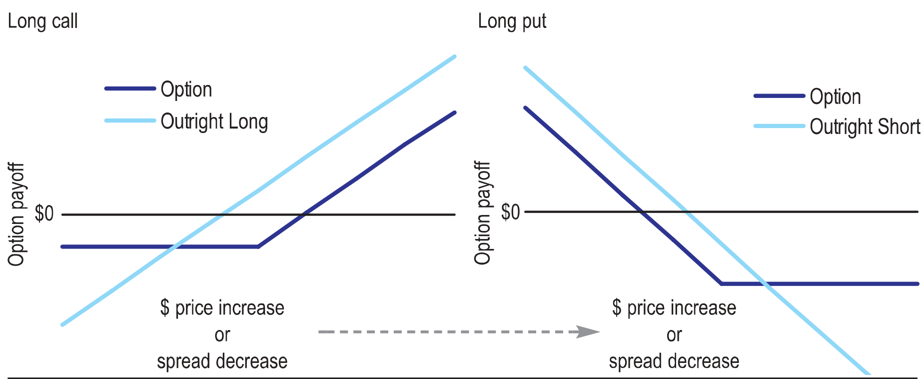
7. Other credit default swap products

Second generation credit derivative products are creating new economic opportunities. Below, we review several products based on single name credit default swaps that allow investors to express views on credit volatility, curve shape, and recovery rates. For each section, more extensive research is available.

Credit default swap options (CSO)[8]
A credit default swap option is an option to buy or sell CDS protection on a specified reference entity at a fixed spread on a future date. Offered on CDS indices and on many single-name CDS, the call option (receiver option) provides investors with the right to sell protection (the right to go long risk and receive the CDS coupon, i.e., the investor expects credit to strengthen), whereas the put option (payer option) provides investors with the right to buy protection (the right to go short risk and pay the CDS coupon, i.e., the investor expects credit to worsen). These options provide an instrument through which investors can trade credit market volatility or tailor their risk profile.

Exhibit 17: Call and Put Option payoffs



Source: JPMorgan.

Digital default swaps (DDS) and recovery swaps[9]
A digital default swap is a credit default swap where the payment to the buyer of protection following a credit event, normally 100% - recovery rate (the recovery rate is determined after the credit event), is instead fixed at the trade's inception. These structures are also known as fixed recovery CDS because the payout is based on a fixed assumption about recovery following default rather than on market recovery rates. This instrument may be used to hedge specific exposures where the loss upon default is a known amount.

A recovery swap is a combination of credit default swap and digital default swap contracts used to take isolated views on recovery rates. In a recovery swap, an investor goes long or short protection using a digital default swap and takes an offsetting default position using standard credit default swaps. The net of these two positions is typically structured to have zero carry, or in other words, cash inflows equal cash outflows except during a credit event. Following a credit event, the

8. For more information on options, see "Credit Volatility–A Primer," by Lee McGinty, published July 7, 2003.
9. For more information on DDS, see "Trading Recovery Rates-Digital Default Swaps and Recovery Swaps," by Jacob Due, published May 19, 2004.

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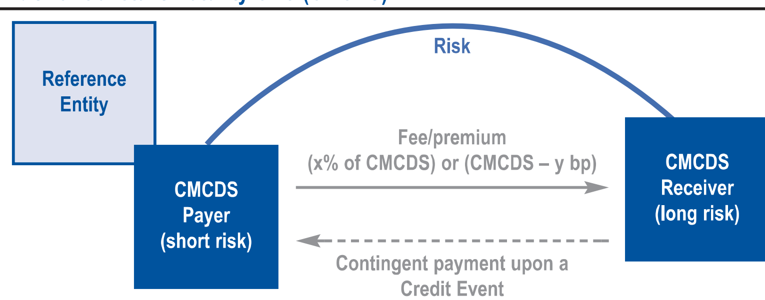
digital default swap protection buyer receives a fixed payout (1 - fixed recovery rate) from the seller, and the pays the seller an amount equal to the payout on a standard CDS contract (1 - market recovery rate). The DDS buyer benefits if market recovery rates are higher than the fixed recovery rate assumed in the DDS.

Constant maturity credit default swaps (CMCDS) and credit spread swaps (CSS)[10]
Constant maturity credit default swaps are CDS contracts where the spread is reset periodically, for example every six months, based on changes in the market spread for a benchmark CDS tenor. The benchmark CDS can be a single name or an index product. The buyer of protection (short risk) pays a fraction (called the participation rate, a rate negotiated at the initiation of the contract that remains constant) of the then current credit default swap spread of the relevant maturity (called the reference rate). For example, the buyer of protection could pay 70% of the current five-year credit default swap spread on Company X, which is 100bp initially, but expected to increase over time. If the five-year CDS spread on Company X six months later is 125bp, the buyer of the constant maturity credit default swap would now pay 70% * 125bp. This continues for the duration of the contract. If there is a credit event during the life of the contract, the contract terminates with a settlement procedure identical to the credit default swap procedure, namely, the buyer of protection (short risk) delivers the notional amount of defaulted bonds to the seller of protection (long risk), who then pays the notional amount to the buyer.

The buyer of protection in this example is taking the view that the spread on the credit will increase by less than the spread implied by existing forward rates. At the beginning of the contract, she is paying less for protection than if she had entered into a standard CDS contract. If the spread on the credit remains low, then she will continue to pay a low rate at each fixing, while if market spreads increase significantly, she will be obliged to pay much higher rates in the future. The initial participation rate reflects this risk - it will generally be a lower number for steep credit curves (i.e. perhaps 60%) and a higher number for flatter curves (i.e. 80%).

In a credit spread swap (CSS), an investor buys or sells protection using a CMCDS contract and enters into an offsetting default risk position using standard CDS. This structure allows investors to take curve and directional spread exposure to a reference entity without default risk.

Exhibit 18: Constant Maturity CDS (CMCDS)



Source: JPMorgan.

10. For more information CMCDS, see "Introduction to constant maturity CDS and CDO's" by Jacob Due and Rishad Ahluwalia, published October 21, 2004.

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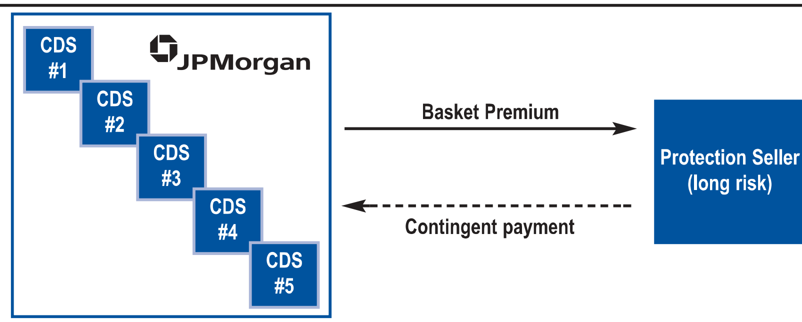
First-to-default baskets[11]

In a first-to-default (FTD) basket, an investor chooses a basket of credits, typically five names, instead of taking exposure to an individual credit default swap. If there are no credit events, the basket pays a fixed coupon throughout the life of the trade. Upon a credit event in one of the basket names, the swap terminates, and the protection buyer delivers the notional amount of the FTD basket in bonds or loans of the defaulted entity to the protection seller. The protection seller then pays the buyer the notional amount of the trade in cash. It is as if the protection seller (long risk) had written a contract on only the defaulted name.

A first-to-default basket is a leveraged position in a basket of credit default swaps. It is a leveraged position because an investor is exposed to the risk of default on the entire basket rather than on a single name. However, the investor's loss is limited to the notional value of the trade. Because the basket has a higher probability of default than an individual credit, the seller of protection receives a spread greater than the widest individual spread in the basket. Typically, the basket pays a spread of 60-80% of the sum of the spreads in the basket. For example, Exhibit 20 is an insurance company FTD basket that pays the seller of protection (long risk) 505 bp, which is 71% of the aggregate spread. The value drivers in this product are the number of basket components (the greater the number of names, the greater the likelihood of one name defaulting, the greater the premium paid), absolute spread levels (clustered spreads provide the greatest value), and correlation (or similarity of assumed default probability between credits, the less similar the correlation, the higher the default risk, therefore the greater the premium paid).

Exhibit 19: First-to-default baskets



Source: JPMorgan.

Exhibit 20: Sample High Yield FTD Basket

FTD Basket

Reference Credits	5yr Bid (bp)	S&P Industry
ACE LIMITED	125	Insurance
AIG CORP	27	Insurance
AON CORP	245	Insurance
MARSH & MCLENNAN	250	Insurance
HARTFORD FIN. GROUP	62	Insurance
AGGREGATE SPREAD	709	
5YR First to Default Spread over LIBOR	505	
5YR First to Default % of Aggregate Spread	71%	

Source: JPMorgan.

11. For more information on First-to-default baskets, see "First-to-Default Baskets: A Primer," by Rishad Ahluwalia, published October 24, 2003.

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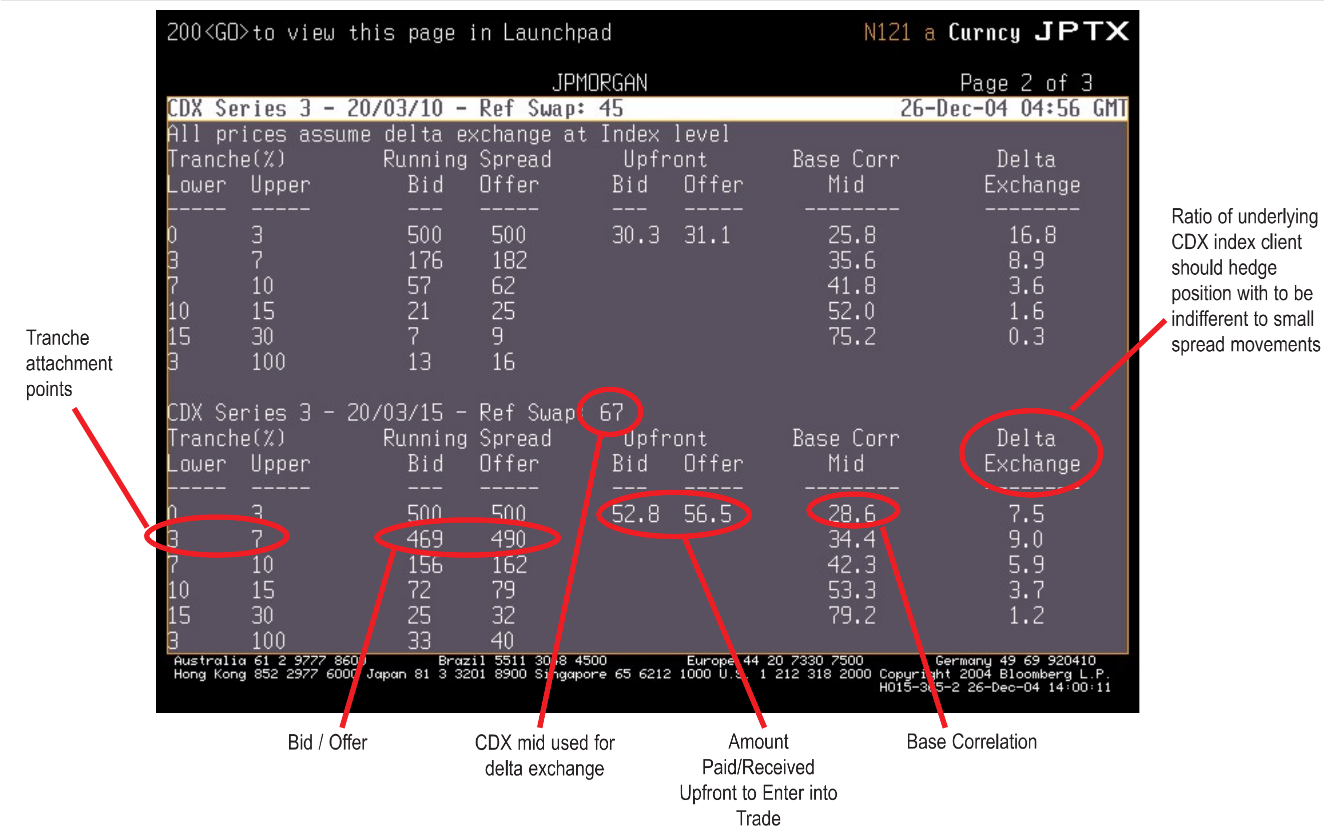
Synthetic collateralized debt obligations (CDO)[12] and tranched indices[13]

A synthetic collateralized debt obligation (also called a collateralized swap obligation, or CSO) is a transaction in which a basket of credit default swaps is created and the default risk of the basket of reference entities is pooled and divided into tranches. The most junior tranche (one that has no subordination) is often called the equity tranche. It will absorb the first credit losses on the portfolio, for example, it might absorb the first 3% of losses. When loss amounts exceed the notional of the most junior tranche, the next tranche absorbs losses. Investors are paid a coupon that reflects the risk of loss in their tranche. Tranched credit structures increase market efficiency by reallocating the risk of credit losses on an underlying portfolio into tailored investments that satisfy an investor's desired risk/return profile.

Synthetic CDOs have historically been bespoke or customized in nature, meaning that the end investor selects the underlying portfolio, amount of subordination, and tranche size. Currently, there are standardized synthetic collateralized debt obligations using the credits in the Dow Jones CDX and iTraxx indices. These tranched index products create a standardized, liquid, and transparent instrument to trade tranched credit risk. It also introduces the ability to hedge other CDO structures or take a view on market-implied correlation, a key value driver in the tranched credit market.

Exhibit 21: Sample Tranched Index Pricing Page



200<GO>to view this page in Launchpad N121 a Curncy JPTX

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CDX Series 3 - 20/03/10 - Ref Swap: 45 26-Dec-04 04:56 GMT

All prices assume delta exchange at Index level

Tranche(%) Lower	Upper	Running Spread Bid	Offer	Upfront Bid	Offer	Base Corr Mid	Delta Exchange
0	3	500	500	30.3	31.1	25.8	16.8
3	7	176	182			35.6	8.9
7	10	57	62			41.8	3.6
10	15	21	25			52.0	1.6
15	30	7	9			75.2	0.3
3	100	13	16				

CDX Series 3 - 20/03/15 - Ref Swap: 67

Tranche(%) Lower	Upper	Running Spread Bid	Offer	Upfront Bid	Offer	Base Corr Mid	Delta Exchange
0	3	500	500	52.8	56.5	28.6	7.5
3	7	469	490			34.4	9.0
7	10	156	162			42.3	5.9
10	15	72	79			53.3	3.7
15	30	25	32			79.2	1.2
3	100	33	40				

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 920410
Hong Kong 852 2977 6000 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2004 Bloomberg L.P.
26-Dec-04 14:00:11

Source: Bloomberg.

12. For more information on synthetic CDOs, see "CDOs 101," published August 12, 2003, and "Innovations in the Synthetic CDO Market: Tranche-only CDOs," published January 22, 2003, by Chris Flanagan.
13. For more information on index tranches, see "Introducing Dow Jones Tranched TRAC-X," by Lee McGinty, published November 26, 2003.

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8. Logistics of trading credit default swaps

Accounting and marking to market

Under relevant US and international accounting standards, credit default swaps and related products are generally considered derivatives, though exceptions may apply. US and international accounting rules generally require derivatives to be reflected on the books and records of the parties at fair value (i.e., the mark-to-market value) with changes in fair value recorded in earnings at the end of each reporting period. Under certain circumstances, it is possible to designate derivatives as hedges of existing assets or liabilities. Investors should consult with their accounting advisors to determine the appropriate accounting treatment for any contemplated credit derivative transaction.

Marking a credit default swap contract to market

Investors mark credit default swaps to market, or calculate the current value of an existing contract, for two primary reasons: financial reporting and monetizing existing contracts. We find the value of a CDS contract using the same methodology as other securities; we discount future cash flows to the present. In summary, the mark-to-market on a CDS contract is approximately equal to the notional amount of the contract multiplied by the difference between the contract spread and the market spread (in basis points per annum) and the risk-adjusted duration of the contract.

To illustrate this concept, assume a 5-year CDS contract has a coupon of 500bp. If the market rallies to 400bp, the seller of the original contract will have a significant profit. If we assume a notional size of $10 million, the profit is the present value of (500bp - 400bp) * $10,000,000 or $100,000 per year for the 5 years. If there were no risk to the cash flows, one would discount these cash flows by the risk free rate to determine the present value today, which would be something slightly below $500,000. These contracts have credit risk, however, so the value is lower than the calculation described above.

Assume that, for example, the original seller of the contract at 500bp choose to enter into an offsetting contract at 400bp. This investor now has the original contract on which she is receiving $500,000 per year and another contract on which she is paying $400,000 per year. The net cash flow is $100,000 per year, assuming there is no default. If there is a default, however, the contracts cancel each other (so the investor has no immediate gain or loss) but she looses the remaining annual $100,000 income stream. The higher the likelihood of a credit event, the more likely that she stops receiving the $100,000 payments, so the value of the combined short plus long risk position is reduced. We therefore discount the $100,000 payments by the probability of survival (1 - probability of default) to recognize that the value is less than that of a risk-free cash flow stream.

The calculation for the probability of default (and survival) is detailed in the appendix. In summary, the default probability is equal to *spread / (1 - Recovery Rate)*. If we assume that recovery rate = 0, then the spread equals the default probability. If the recovery rate is greater than zero, then the default probability is greater than the spread. To calculate the market-to-market on a CDS contract (or the profit or loss of an unwind), we discount the net cash flows by both the risk free rate and the survival probability. See the appendix for a more complete example of the calculations described above.

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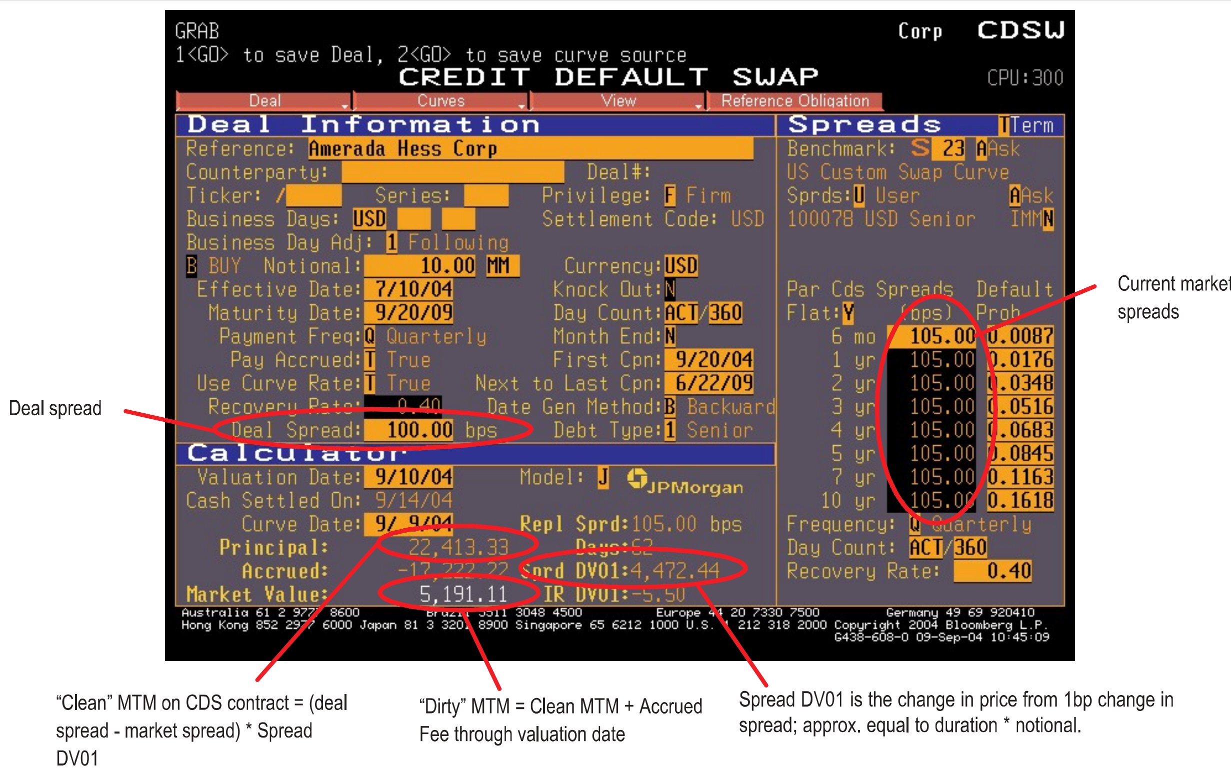
The JPMorgan CDSW model is a user friendly market standard tool on Bloomberg that calculates the mark-to-market on a credit default swap contract. Users enter the details of their trade in the Deal Information section, input credit spreads and a recovery rate assumption in the Spreads section, and the model calculates both a "dirty" (with accrued fee) and "clean" (without accrued fee) mark-to-market value on the CDS contract (set model in "Calculator" section to 'J'). Valuation is from the perspective of the buyer of protection:

- Positive clean mark-to-market value means that spreads have widened (seller pays buyer to unwind)
- Negative clean mark-to-market value means that spreads have tightened (buyer pays seller to unwind)

To access this model, select a bond of the issuer and type "CDSW<Go>."

Exhibit 22: The CDSW model on Bloomberg calculates mark-to-market values for CDS contracts



Source: Bloomberg.

Standardized documentation

The standardization of documentation from the International Swaps and Derivatives Association (ISDA) has been an enormous growth driver for the CDS market.

ISDA produced its first version of a standardized CDS contract in 1999. Today, CDS are usually transacted under a standardized short-form letter confirmation, which incorporates the 2003 ISDA Credit Derivatives Definitions, and is transacted

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under the umbrella of an ISDA Master Agreement[14]. Combined, these agreements address:

- Which issuers, if they default, trigger the CDS
- The universe of obligations that are covered under the contract
- The notional amount of the default protection
- What events trigger a credit event
- Procedures for settlement of a credit event

Standardized confirmation and market conventions mean that the parties involved need only to specify the terms of the transaction that inherently differ from trade to trade (e.g., reference entity, maturity date, spread, notional). Transactional ease is increased because CDS participants can unwind a trade or enter an equivalent offsetting contract with a different counterparty from whom they initially traded. As is true with other derivatives, CDS that are transacted with standard ISDA documentation may be easily assigned to other parties. In addition, single-name CDS contracts mature on standard quarterly end dates. These two features have helped promote liquidity and, thereby, stimulate growth in the CDS market.

ISDA's standard contract has been put to the test and proven effective in the face of significant credit market stress. When WorldCom filed for bankruptcy in July 2002, according to our estimates, there were 600 CDS contracts outstanding in the marketplace, accounting for over $7 billion in notional terms. More recently, when Parmalat SPA defaulted in December 2003, we estimate that there were approximately 4,000 CDS contracts and €10 billion outstanding in the marketplace. Additionally, Parmalat was a component of the original Trac-x Series 1 credit index. In December 2003, trading volumes in Trac-x increased 3 to 4 times after the Parmalat default, and over 550 Trac-x contracts settled. In all situations, contracts were settled without mechanical settlement problems, disputes or litigation.

Counterparty considerations

Recall that in a credit event, the buyer of protection (short risk) delivers bonds of the defaulted reference entity and receives par from the seller (long risk). Therefore, an additional risk to the protection buyer is that the protection seller may not be able to pay the full par amount upon default. This risk, referred to as counterparty credit risk, is a maximum of par less the recovery rate, in the event that both the reference entity and the counterparty default. While the likelihood of suffering this loss is remote, the magnitude of the loss given default can be material. When trading with JPMorgan, counterparty credit risk is typically mitigated through the posting of collateral (as defined in a collateral support annex (CSA) to the ISDA Master Agreement between the counterparty and JPMorgan), rather than through the adjustment of the price of protection.

14. For more information on the ISDA standard definitions, see 'The 2003 ISDA Credit Derivatives Definitions' note published on June 13, 2003 by Jonathan Adams and Tom Benison.

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Conclusion

The use of credit derivatives has grown exponentially since the beginning of the decade. Transaction volumes have picked up from the occasional tens of millions of dollars to regular weekly volumes measured in billions of dollars. The end-user base is broadening rapidly to include a wide range of banks, broker-dealers, institutional investors, asset managers, corporations, hedge funds, insurers, and reinsurers. Growth in participation and market volume is likely to continue at its current rapid pace based on the contribution that credit derivatives are making to efficient risk management, rational credit pricing, and systemic liquidity. At this stage, as a mainstream and integrated market, the focus within the credit derivatives market is on second generation products and further innovation.

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9. Appendix I

Credit events and settlement procedures

A credit event is the occurrence of a significant event with respect to a reference entity that triggers a contingent payment on a credit default swap. Credit events are defined in the 2003 ISDA Credit Derivatives Definitions[15] and include the following:

- Bankruptcy: insolvency, appointment of administrators/liquidators, creditor arrangements, etc.
- Failure to pay: payment failure on one or more obligations after expiration of any applicable grace period; typically subject to a materiality threshold (e.g., US$1million for North American CDS contracts).
- Restructuring: refers to an agreement between the reference entity and the holders of an obligation (and such agreement was not previously provided for under the terms of that obligation) with respect to:
  - reduction of interest or principal
  - postponement of payment of interest or principal
  - change of currency (other than to a "Permitted Currency")
  - contractual subordination

Note that there are several versions of the restructuring credit event that are used in different markets.

- Repudiation/moratorium: authorized government authority (or reference entity) repudiates or imposes moratorium and failure to pay or restructuring occurs.
- Obligation acceleration: one or more obligations due and payable as a result of the occurrence of a default or other condition or event described, other than a failure to make any required payment.

For US high grade markets, bankruptcy, failure to pay, and modified restructuring are the standard credit events. Modified Restructuring is a version of the Restructuring credit event where the instruments eligible for delivery are restricted. European CDS contracts are usually drafted with Modified Modified Restructuring, which has further modifications to account for the structural differences between the US and European debt markets[16]. In the US high yield markets, only bankruptcy and failure to pay are standard. Of the above credit events, bankruptcy does not apply to sovereign reference entities. In addition, repudiation/moratorium and obligation acceleration are generally only used for emerging market reference entities.

Credit default swap contracts call for physical settlement. After a credit event, the buyer of protection typically delivers to the seller of protection defaulted bonds or loans with a notional amount equal to the notional amount of the credit default swap. In return, the seller of protection delivers the notional amount of the CDS contract in cash to the buyer. The deliverables are selected from a predefined category of deliverable obligations, and typically consist of any bonds or loans of the reference entity that are pari passu with the reference obligation. The buyer of protection chooses which bonds or loans to deliver; she can typically deliver a bond or loan of any maturity (generally up to 30 years, however more maturity restrictions apply if the credit event is caused by Restructuring) and in several specified currencies. Often the buyer and seller of protection will agree on the value of defaulted bonds in the market and choose to cash settle rather than exchanging cash for bonds.

15. Copies of the 2003 ISDA Credit Derivatives Definitions can be obtained by visiting the International Swaps and Derivatives Association website at http://www.isda.org.
16. For more information, see "The 2003 ISDA Credit Derivatives Definitions," by Jonathan Adams and Thomas Benison, published in June 2003.

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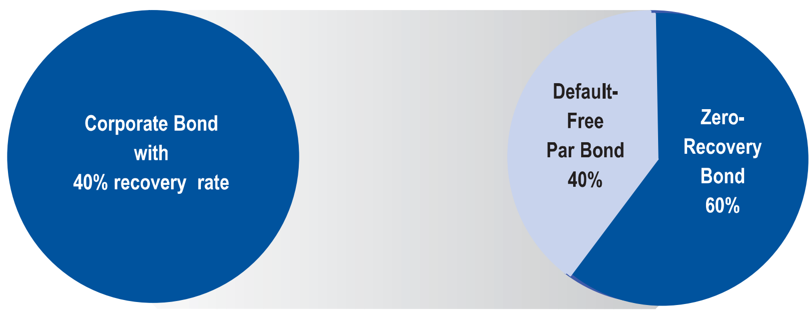
Appendix II

A five-step process to compare bonds to CDS[17]

Credit default swaps are par instruments whereas most bonds trade at a discount or a premium. The five-step valuation method presented here builds on the intuition provided earlier, and calculates an equivalent spread for a corporate bond so that like comparisons can be made with credit default swaps.

Step 1:

The first step is to estimate a recovery rate for the bond and then divide the bond into two parts based on that estimation. The recovery rate is the estimated price of a defaulted bond. It determines the default-free portion of the bond. As a default-free instrument, only the time value of money determines its value. A default-free bond is expected to recover the same amount at any point in time. We therefore price the default-free bond as a par instrument with a coupon of Libor to account for the time value of money.



Step 2:

Next we calculate the price and coupon for the zero recovery portion of the bond based on the actual corporate bond price and coupon, its recovery rate, and the price of the default-free bond of 100 and its coupon of Libor flat. The two formulas used are the following:

Bond Price = Default-Free Security + Risky Security

$$P_{corpbond} = [(R\% \text{ x } 100)] + [(1\text{-}R\%) \text{ x } P_{zero\ recovery}]$$

$$Cpn_{corpbond} = [(R\% \text{ x LIBOR})] + [(1\text{-}R\%) \text{ x } Cpn_{zero\ recovery}]$$

where,
R% is the recovery rate
$P_{corp\ bond}$ is corporate bond price
$P_{zero\ recovery}$ is zero recovery bond price

$Cpn_{corp\ bond}$ is corporate bond coupon
$Cpn_{zero\ recovery}$ is zero recovery bond coupon

17. For more information, see "A Simple and Robust Method to Compare Bonds to Credit Default Swaps" by Antonio Paras and Richard Stephenson, published in March 2003.

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Step 3:
The next step is to determine the yield to-maturity for the zero recovery bond based on the price and coupon derived from Step 2.

$$P_{zero\ \ recovery} = \sum \frac{Cpn_{zero\ \ recovery\ \ t} + Face_T}{(1+YTM)^t}$$

Step 4:
Most corporate bond coupons accrue on a semi-annual 30/360 basis whereas credit default swaps accrue quarterly actual/360, and upon a credit event, accrue up to the credit event determination date. After calculating the YTM for the zero recovery bond, we need to convert that semi-annual 30/360 rate to a continuously compounding rate to best capture the fact that credit default swaps pay accrued upon a credit event. This adjusted YTM from Step 3 minus Libor is the zero recovery bond's probability of default, also called the "clean spread."

Step 5:
The final step is to calculate the bond's par spread. It is this spread that is used to compare bonds to credit default swaps. The clean spread is the return paid to investors for assuming the risk that the issuer defaults. This spread is earned only on the zero recovery portion of the bond. By apportioning the clean spread calculated in Step 4 to the difference between one and the recovery rate, we are able to determine the par spread for the bond as a whole. The equation for this final step is the following:

$$\text{ParSpread} = \text{CleanSpread x (1 - RecoveryRate)}$$

When an investor purchases protection (short risk), she is protecting herself against the net loss on a bond, or (Par – Recovery Rate). Thus, the actual notional amount at risk on a credit default swap is the difference between par and the recovery rate. Intuitively, the par spread represents an expected payout whereby (1 – recovery rate) is the amount received and the clean spread is the likelihood of a credit event taking place. The end result is a bond equivalent par credit default swap spread that can be compared to credit default swaps[18].

See the following page for an example.

18. In reality, par bond spreads and par CDS spreads would differ slightly due to different coupon payment frequencies, day-count conventions, treatments of accruals, etc.

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Appendix II: A five-step process to compare bonds to CDS, an example

Bond information

Today's date	1-Jan-05		Bond price	$80
Maturity date	1-Jan-10		Coupon	6%
Years to bond maturity	5.00		Payments per year	2
Swap rate to bond maturity	3.50%	(the 5 yr swap rate)		

Step 1: Divide bond into a default free and a zero recovery bond

Estimated recovery rate 40%

Step 2: Calculate the implied price and coupon of the zero recovery bond

$P_{corp\ bond}$ = Default-free bond + Risky bond

$P_{corp\ bond} = (R\%*100) + [(1 - R\%)*P_{zero\ recovery}]$

$P_{zero\ recovery} = [P_{corp\ bond} - (R\%*100)] / (1 - R\%)$

$P_{zero\ recovery}$ = $66.67

$CPN_{corp\ bond}$ = Default-free coupon + Risky coupon

$CPN_{corp\ bond} = (R\%*Libor) + [(1-R\%)*CPN_{zero\ recovery}]$

$CPN_{zero\ recovery} = [CPN_{corp\ bond} - (R\%*Libor)] / (1-R\%)$

$CPN_{zero\ recovery}$ = 7.67%

Z-spread = $CPN_{zero\ recovery}$ - Libor

Z-spread = 4.17%

Step 3: Calculate the yield-to-maturity for the zero recovery bond

$P_{zero\ recovery}$ = $66.67

$CPN_{zero\ recovery}$ = 7.67%

Method 1 - use YTM excel function

YTM =yield() excel function 18.07%

Function inputs:

Settlement date	1-Jan-05
Maturity date	1-Jan-10
Percent coupon	7.67%
Price	$66.67
Redemption value	$100.00
Coupon frequency	2
Basis (30/360)	0

Method 2 - trial and error

YTM	**18.07%**
YTM / 2	9.04%

(calculate by trial and error, or use Solver in excel)

Period	Cash flows	Discount factor	PV
1	$3.83	0.9171	$3.52
2	$3.83	0.8411	$3.22
3	$3.83	0.7714	$2.96
4	$3.83	0.7075	$2.71
5	$3.83	0.6489	$2.49
6	$3.83	0.5951	$2.28
7	$3.83	0.5458	$2.09
8	$3.83	0.5006	$1.92
9	$3.83	0.4591	$1.76
10	$103.83	0.4210	$43.72
		Zero Recovery Bond Price:	**$66.67**

(adjust YTM so Price = $66.67)

Step 4: Calculate the Clean Spread

First, convert the YTM and swap rate from semi-annual 30/360 to continuous 30/360 rates

$e^{R_{continuous}} = (1 + R_m / m)^m$ where m is the number of times per year the rate compounds

$R_{continuous} = m*\ln(1 + R_m / m)$

In our case, m = 2, as the interest on the bond is compounded twice a year

$R_{continuous}$ = 2 * [ln (1 + Semi-annual rate / 2)]

Continuous $YTM_{zero\ recovery}$ =	17.30%
Continuous Swap rate to bond maturity =	3.47%
Continuous Z-$spread_{zero\ recovery}$ =	13.83%

Second, convert the Z-spread from continuous 30/360 to continuous actual/360

Clean Spread = Continuous Z-$spread_{zero\ recovery}$ * (360 / 365)

Clean Spread = 13.64%

The clean spread is the return paid to investors for assuming the risk the issuer defaults

Step 5: Calculate the Par Spread

Par Spread = Clean Spread * (1 - R%)

Par Spread = 8.18%

The par spread is the spread above Libor for a given bond assuming a $100 price.

Source: JPMorgan.

Appendix II: JPMorgan CDSW Example Calculations Model (for illustration of the general concepts only)

Notional value	10,000,000	Enter notional position amount
Initial contract sprea	5.00%	Enter the original contract coupon
Current at market S|	4.00%	Enter the current market spread
Recovery assumptic	40%	Enter the assumed Recovery Rate
Clean spread (probability of default)	6.667%	Equal to current market spread / (1 - Recovery Rate). It is the annual default probability. This is an approximation that is correct if one is doing the calculations assuming continuous possibility of default. It is slightly off when assuming default is only possible on the quarterly payment dates, as we do below.

Notional Value * Original Contract Spread / 4 (for quarterly payment)

Notional Value * Current Market Spread / 4 (for quarterly payments)

Difference between Column 2 and Column 3. This represents the cash flow which is being valued, i.e., the value of a CDS unwind is the discounted value of this cash flow stream.

Enter swap zero curve

Discount factors based on swap curve

1 Minus Column 8

Probability of no default. Calculated as 1/(1+ Clean Spread) ^ time in years. The concept is that the clean spread is the annual default probability. The probability of not having defaulted after two years (for example) is the probability of no default in year one time the probability of no default in year two.

Column 4 X Column 6 X Column 8.

The cash flows expected X the discount factor for time X the probability of receiving the cash flows.

Additional check of calculation

When a CDS is at par, it means that the expected value of the cash flows to be received (with no default) is equal to the expected value of the recovery value to be received (in case of default). These calculations are shown in columns 10 and 11 below. The columns generally will be a little off because the Clean Spread which is calculated as Current Market Spread / (1 - Recovery) is not quite right, because of continuous vs discrete compounding, as discussed.

Period	Cash Flow Earned on CDS	Premium Paid on offsetting CDS	Net Premium	Swap Curve	Discount Factor	Prob of Default	Survival Probability	PV of Expected Cash flows	Value of Current Coupon Flows	Value of loss if default
0.25	$125,000	$100,000	$25,000	2.000%	0.99502	0.0160	0.9840	$24,477	$97,910	$95,553
0.50	$125,000	$100,000	$25,000	2.000%	0.99007	0.0157	0.9682	$23,966	$95,864	$93,556
0.75	$125,000	$100,000	$25,000	2.000%	0.98515	0.0155	0.9527	$23,465	$93,860	$91,601
1.00	$125,000	$100,000	$25,000	2.000%	0.98025	0.0152	0.9375	$22,975	$91,898	$89,686
1.25	$125,000	$100,000	$25,000	2.000%	0.97537	0.0150	0.9225	$22,494	$89,977	$87,812
1.50	$125,000	$100,000	$25,000	2.000%	0.97052	0.0148	0.9077	$22,024	$88,097	$85,976
1.75	$125,000	$100,000	$25,000	2.000%	0.96569	0.0145	0.8932	$21,564	$86,256	$84,179
2.00	$125,000	$100,000	$25,000	2.000%	0.96089	0.0143	0.8789	$21,113	$84,453	$82,420
2.25	$125,000	$100,000	$25,000	2.000%	0.95610	0.0141	0.8648	$20,672	$82,688	$80,697
2.50	$125,000	$100,000	$25,000	2.000%	0.95135	0.0138	0.8510	$20,240	$80,959	$79,011
2.75	$125,000	$100,000	$25,000	2.000%	0.94661	0.0136	0.8374	$19,817	$79,267	$77,359
3.00	$125,000	$100,000	$25,000	2.000%	0.94191	0.0134	0.8240	$19,403	$77,611	$75,743
3.25	$125,000	$100,000	$25,000	2.000%	0.93722	0.0132	0.8108	$18,997	$75,988	$74,159
3.50	$125,000	$100,000	$25,000	2.000%	0.93722	0.0130	0.7978	$18,693	$74,772	$72,973
3.75	$125,000	$100,000	$25,000	2.000%	0.93722	0.0128	0.7850	$18,394	$73,576	$71,805
4.00	$125,000	$100,000	$25,000	2.000%	0.93722	0.0126	0.7725	$18,099	$72,398	$70,655
4.25	$125,000	$100,000	$25,000	2.000%	0.93722	0.0124	0.7601	$17,810	$71,239	$69,524
4.50	$125,000	$100,000	$25,000	2.000%	0.93722	0.0122	0.7479	$17,525	$70,099	$68,412
4.75	$125,000	$100,000	$25,000	2.000%	0.93722	0.0120	0.7360	$17,244	$68,977	$67,317
5.00	$125,000	$100,000	$25,000	2.000%	0.93722	0.0118	0.7242	$16,968	$67,873	$66,239
						Mark to market of CDS unwind		**$405,941**	**$1,623,762**	**$1,584,678**

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