

# Chapter 5

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## CREDIT DERIVATIVES

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### Abstract

*Credit derivatives are instruments used to measure, manage, and transfer credit risk. Recently, there has been an explosive growth in the use of these instruments in the financial markets. This article reviews the structure and use of some credit derivative instruments that are popular in practice.*

**Keywords:** credit derivatives; credit risk; default risk; credit spreads; asset swaps; default swaps; credit default swaps; total return swaps; basket default swaps; credit spread options

### 5.1. Introduction

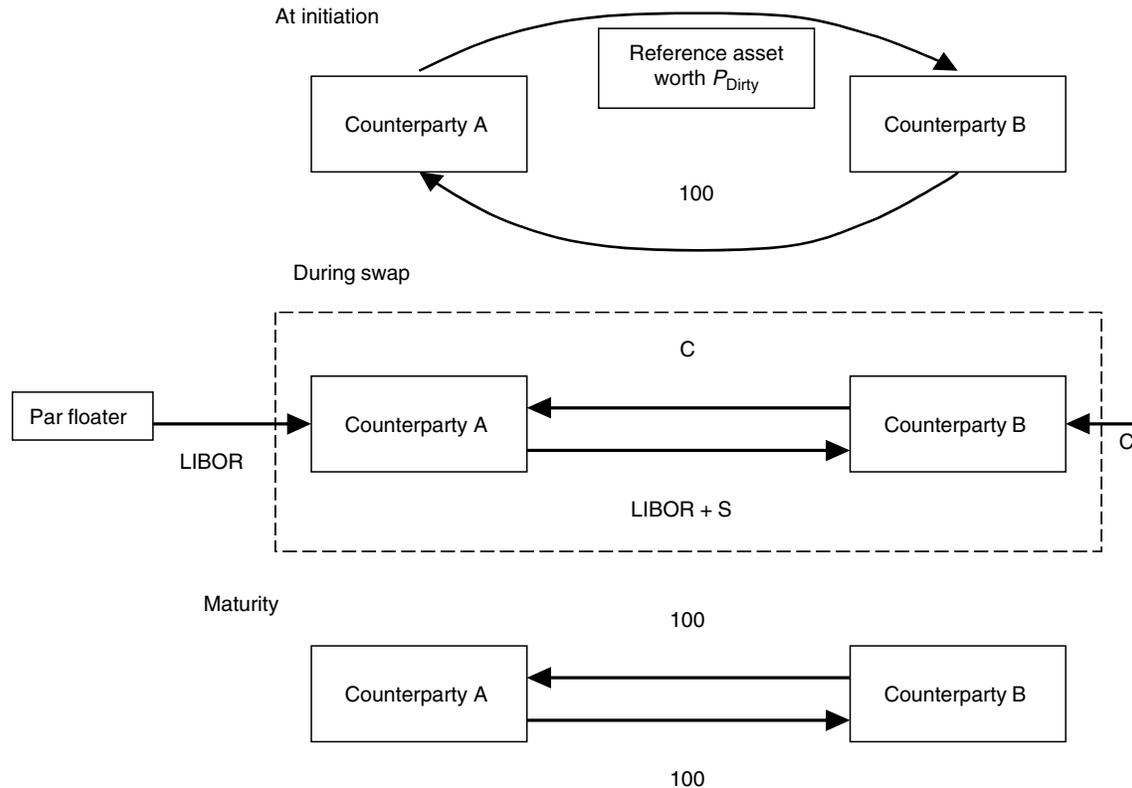
Recent years have seen a dramatic expansion in the use of credit derivatives in the financial industry. Credit derivatives are used in the diversification and transfer of credit risk, the ability to leverage, and the creation of new asset classes providing yield enhancement. This growth is likely to continue as institutional investors, broker-dealers, hedge funds, and insurance companies all realize the advantages that these instruments have over the traditional alternatives. In the following, we present an overview of the main credit derivatives such as default swaps, total return swaps, and credit spread options.

### 5.2. Asset Swaps

The most basic building block in the credit world is perhaps the asset swap. An asset swap is a simple

structure that enables a counterparty receiving fixed payments on a security to exchange the fixed coupon for a floating rate payment at a fixed spread to London Interbank Offered Rate (LIBOR). Historically, banks have used asset swaps to match their long-term fixed-rate assets with their short-term liabilities, i.e. mortgage loans against depositor accounts. In a par asset swap, one party delivers a risky asset to the other in return for par. They then receive the cash flows of a risky bond in return for regular payments of LIBOR plus a fixed spread (or minus a fixed spread if the asset is better quality than LIBOR, e.g. a U.S. Treasury security). The mechanics of this structure are shown in Figure 5.1.

This fixed spread is known as the Asset Swap Spread. The key point concerning asset swaps is that the fixed coupons being paid are *effectively* guaranteed by the counterparty even if the underlying risky asset defaults. As a result, the payer of the fixed coupon has a credit exposure to the issuer of the defaulting bond. The asset swap spread is therefore the additional return required by the payer of the fixed coupon to compensate for the credit risk incurred and to repay any difference in price if the bond is trading away from par. The par amount paid up front can be used to purchase a par floater. The overall result for counterparty A has been to take fixed cash flows from a risky asset and exchange them for the same cash flows paid by a LIBOR quality counterparty. These fixed coupons can then be exchanged for floating rate payments in another standard interest rate swap.



**Figure 5.1.** Mechanics of a par floater asset swap

The asset swap is an important measure of default risk as it represents the additional spread that can be locked-in by taking on the risk of an issuer in a fixed-for-floating rate par swap.

### 5.3. Default Swaps

A default swap is a bilateral contract that allows an investor to buy protection against the risk of default of a specified *reference credit*. The fee may be paid up front, but more often is paid in a “swapped” form as a regular, accruing cash flow.

As a default swap is a negotiated contract, there are several important features that need to be agreed between the counterparties and clearly defined in the contract documentation. First and foremost is the definition of the credit event itself. This is obviously closely linked to the choice of the reference credit and will include such events as bankruptcy, insolvency, receivership, restructuring of debt, and a material change in the credit spread.

This last *materiality* clause ensures that the triggering event has indeed affected the price of the reference asset. It is generally defined in spread terms since a fall in the price of the reference asset could also be due to an increase in the level of interest rates.

Many default swaps define the triggering of a credit event using a *reference asset*. However, in many cases, the importance of the reference asset is secondary as the credit event may also be defined with respect to a class of debt issued by a *reference entity*. In this case, the importance of the reference asset arises solely from its use in the determination of the *recovery price* used to calculate the payment following the credit event.

The contract must specify what happens if the credit event occurs. Typically, the protection buyer will usually agree to do one of the following:

- Deliver the defaulted security to the protection seller in return for par in cash. Note that the contract usually specifies a basket of securities

that are ranked *pari passu*, which may be delivered in place of the reference asset. In effect, the protection seller is long a “cheapest to deliver” option.

- Receive par minus the default price of the reference asset settled in cash. The price of the defaulted asset is typically determined via a dealer poll conducted within a few weeks to months of the credit event, the purpose of the delay being to let the recovery price stabilize.

These choices are shown in Figure 5.2. It is often in the interest of the protection seller to choose physical delivery of the asset since the seller may have the view that either by waiting or by entering into negotiations with the issuer of the reference asset, he may be able to receive more than the default price.

For those familiar with option terminology, it may help to think of a default swap as a knock-in option contingent on the credit event. Until the credit event occurs, the default swap is always out-of-the-money. Even a large deterioration in the credit of the reference asset of a default swap that just stops short of the credit event will not be covered by the default swap.

Some default swaps have a different payoff from the standard par minus recovery price. The main alternative is to have a fixed pre-determined

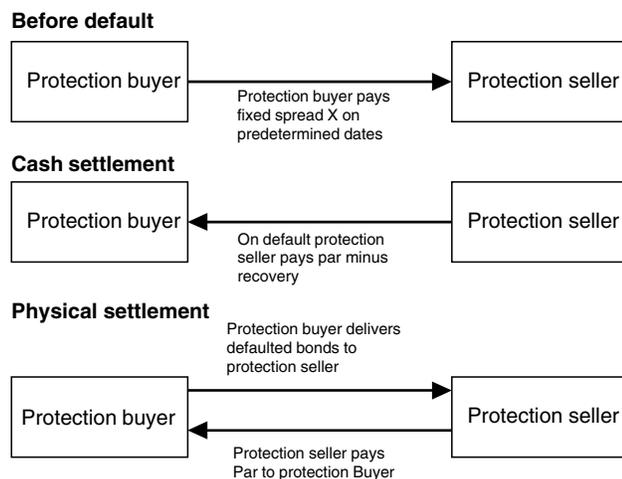
amount that is paid out immediately after the credit event. This is known as a binary default swap. In other cases, where the reference asset is trading at a significant premium or discount to par, the payoff may be tailored to be the difference between the initial price of the reference asset and the recovery price.

The protection buyer automatically stops paying the premium once the credit event has occurred, and this property has to be factored into the cost of the swap payments. It has the benefit of enabling both parties to close out their positions soon after the credit event and so eliminates the ongoing administrative costs that would otherwise occur.

A default swap can be viewed as a form of insurance with one important advantage – efficiency. Provided the credit event in the default swap documentation is defined clearly, the payment due from the triggering of the credit event will be made quickly. Contrast this with the potentially long and drawn out process of investigation and negotiation that may occur with traditional insurance.

In approximate order of importance, the main factors that will determine the cost of the default swap are the shape of the reference asset credit spread curve, the maturity of the protection, the default price of the reference asset, the shape of the LIBOR curve, the credit worthiness of the protection seller, and the correlation of the credit worthiness of the protection seller to the reference asset; default protection bought on the debt of a bank from another closely related bank is probably worthless.

However, it is possible to get a very good idea of the price of the default swap using a simple “static replication” argument. This involves recognizing that buying a default swap on a risky par floating rate asset that only defaults on coupon dates is exactly equivalent to going along a default-free floating rate note and short a risky floating rate note of the same credit quality (see Table 5.1). If no default occurs, the holder of the position makes a net payment equal to the asset swap spread of the



**Figure 5.2.** Mechanics of a default swap

**Table 5.1.** Static replication of a default swap on a par floater that can default on coupon dates only

Event	Long riskless FRN	Short risky FRN via asset swap	Default swap
Coupon Payments	+LIBOR	-(LIBOR + ASS)	-ASS
Credit Event occurs on Coupon Date	+100 at Default	-R at Default	(100 - R) at Default
No Credit Event	+100 at Maturity	-100 at Maturity	0

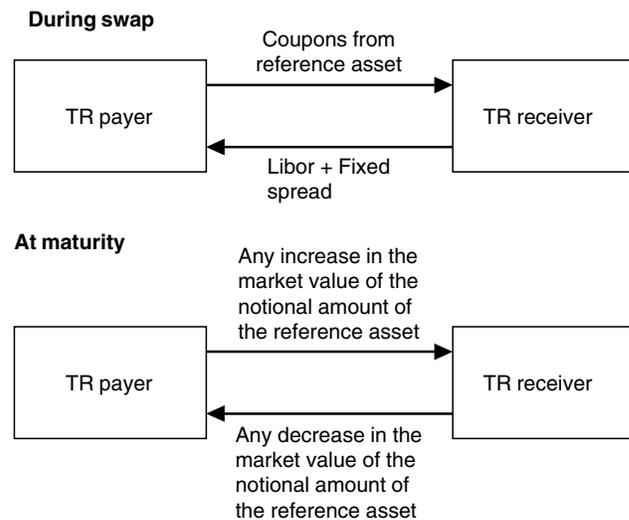
asset on each coupon date until maturity. This spread represents the credit quality of the risky floater at issuance. If default does occur, and we assume that it can only occur on coupon payment dates, the position can be closed out by buying back the defaulted asset in return for the recovery rate and selling the par floater. The net value of the position is equal to the payoff from the default swap.

This argument implies that we would expect the price of the default swap on a par floater to be close to the asset swap spread with the credit quality of the reference credit and the same maturity as the default swap. It also shows that par floaters are a perfect hedge for default swaps.

#### 5.4. Total Return Swaps

A total return swap is a contract that allows an investor to receive all of the cash flow benefits of owning a reference asset without actually possessing the asset itself. The mechanics of this structure are shown in Figure 5.3.

At trade inception, one party, the total return receiver, agrees to make payments of LIBOR plus a fixed spread to the other party, the total return payer, in return for the coupons paid by some specified asset. At the end of the term of the total return swap, the total return receiver must then pay the difference between the final market price of the asset and the initial price of the asset. If default occurs, this means that the total return receiver must shoulder the loss by paying the difference between the initial value of the reference asset and the default value of the reference asset. Standard practice is for cash settlement.

**Figure 5.3.** Mechanics of a total return swap

It is important to understand that a total return swap has a default swap embedded within it – the payer of the total return has insured himself against the default risk of the asset. Furthermore, he is also protected from the price risk of the asset.

Determination of the fixed spread to LIBOR payable by the total return receiver depends on several factors including the spread curve of the reference asset, the LIBOR curve, the financing cost to the payer of holding the asset on balance sheet, the expected default price of the asset, and counterparty credit quality. In certain circumstances, the price will be close to that of the corresponding default swap.

There are several reasons why an investor would wish to use such a structure. First and foremost is leverage. Using a total return swap, an investor can gain the return of an asset without paying the full price of the asset. The investor only has to make

the coupon payments that are paid net. Indeed, if there is no actual transfer of the reference asset, then the limit on the size of the notional depends solely on the amount of risk that the two parties wish to assume.

Another motivation is that it enables investors to obtain off balance sheet exposure to assets that they might otherwise be precluded for tax, political or other reasons. This is especially useful to banks with lower credit ratings and higher funding costs in certain markets. Furthermore, total return swaps are often treated as derivatives and so incur a lower regulatory capital charge.

Total return swaps make it possible to short an asset without actually selling the asset. This may be useful from a point of view of temporarily hedging the risk of the credit, deferring a payment of capital gains tax, or simply gaining confidentiality regarding investment decisions.

As the maturity of the total return swap is not necessarily the same as the maturity of the reference asset, a total return swap effectively creates a new synthetic asset with the required maturity. Credit gaps in a portfolio may therefore be filled.

### 5.5. Principal Protection

Many loans to developing countries are like investing junk bonds, subject to high default risk. Banks that provide loans to developing countries are fully aware of the high default risk. Buying default swaps would be a natural way to hedge the risk but default swaps of these countries are usually very expensive and will wipe out all the incentive to provide loan to these countries. Furthermore, most banks that provide loan to these countries normally do so due to political and not economic considerations. Hence, protecting the principal and not the interest is the main concern for the lending banks.

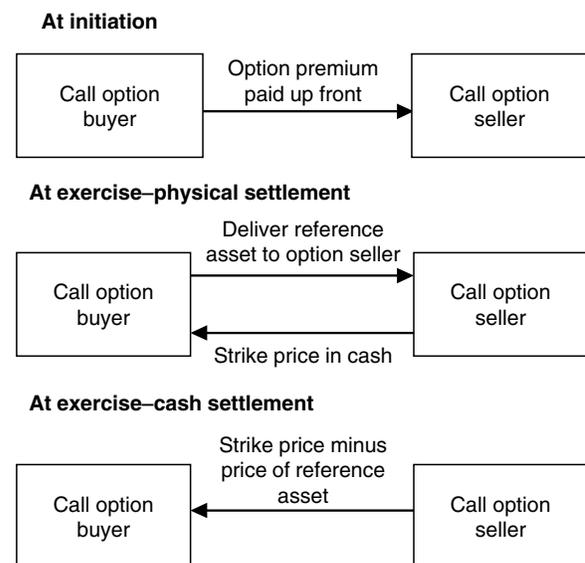
A principal protected note (PPN) is developed for this purpose. PPN is similar to a risky floater except that the principal is guaranteed upon default and is similar to a risk-free floater except that the coupons are not guaranteed. As a result, we can value any PPN by either one of the following:

- Risky floater + Principal protection
- Risk-free floater – Risk-free coupons + Risky coupons
- Risk-free zero + Risky coupons

Since the default swaps hedge away coupon risks and the principal is risk-free, a PPN and the default swaps add up to a risk-free floater.

### 5.6. Credit Spread Options

A spread option is a contract whose payout depends on the credit spread of a reference asset. This reference asset may be either a floating rate note or an asset swap. As with standard options, one must specify whether the option is a call or put, the expiry date of the option, the strike price, and the type of optionality, i.e. American style (exercise at any time), European style (exercise at expiry only), or Bermudan style (exercise on one of several dates). It is also important to define what happens in the event that the underlying asset defaults – one may not want to pay for the right to exercise upon default. On exercise, the option may be settled through cash or physical delivery.



**Figure 5.4.** Mechanics of a call option on reference asset

Credit spread options are usually quoted in terms of the price of the reference asset. To see how an option on prices translates to an option on spreads, consider the case of a put option on a floating rate note paying LIBOR plus 150 basis points where the strike price is par. As the credit spread of the floating rate note widens, its price falls. If the market asset swap spread widens from 150 basis points to 160 basis points, the price of the floating rate bond falls below par and the put option is now in the money. The sensitivity of the price of the reference asset to changes in the asset swap spread is given by the spread duration. We can therefore view the put option on the price of the reference asset as a call option on the asset swap spread of the reference asset with an effective notional proportional to the spread duration.

A more complicated version of this is the option on an asset swap shown in Figure 5.5. In this case, the purchaser of a call option pays premium to the option seller to have the right to buy a specific reference asset and enter into a par flat asset swap.

As the asset swap spread of the reference asset widens, the value of the underlying asset swap falls and the buyer is less likely to exercise the call option. Equally, as the value of the underlying asset swap spread rises, the buyer is more likely to exercise the call option. Therefore, the call

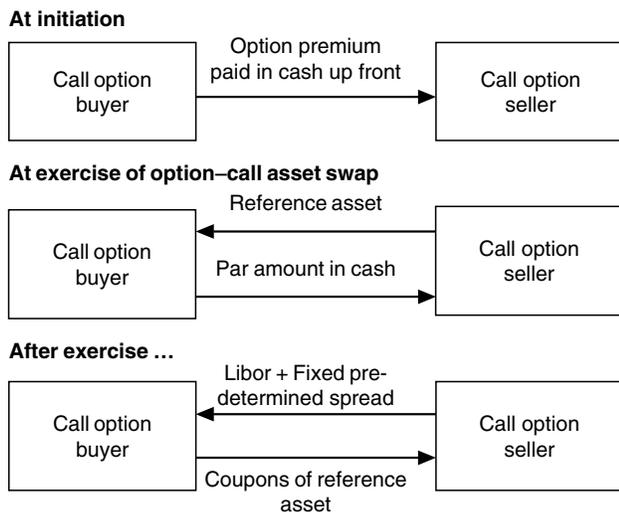
option on the asset swap translates into a put option on the asset swap spread and vice versa.

For all practical purposes, default swaps and credit spread options are the same. Indeed the payoff from a credit spread put option (a call on the asset swap spread) struck at par is the same as the payoff from a default swap, which pays par minus the default price. However, there are some differences. First of all, the value of a credit spread option depends on the credit spread volatility. The more volatile the credit spread, the more time-value the option will have and the more the option will be worth. Secondly, the payoff of credit spread option is sensitive to large increases in spread that may not actually constitute formal default. They therefore provide a hedge against price risk as well as default risk. Lastly, they allow the purchaser the right to choose when to exercise.

### 5.7. Basket Default Swaps

A basket default swap is like a default swap, but the only exception is that it is linked to the default of more than one credit. In the particular case of a first-to-default basket, it is the first asset in a basket whose credit event triggers a payment to the protection buyer. As in the case of a default swap, this payment may involve either cash payment of par minus the default price of the defaulted asset, or physical delivery of the defaulted asset in return for par. In return for protection against the first-to-default, the protection buyer pays a fee to the protection seller as a set of regular accruing cash flows.

To see clearly the mechanics of the structure, consider a deal in which an investor buys first-to-default protection to hedge a \$50M notional of each of three credits A, B, and C. Although the total notional amount covered is \$150M, it is imperative to note that if one of the credits is defaulted, only the notional size of that credit in the basket gets paid. For example, if credit B defaults, then we receive a payout equal in value to the difference between par and its default price on



**Figure 5.5.** Mechanics of a call option on asset swap

a notional of \$50M. See Figure 5.6. The default basket terminates and remaining credits A and C are then left unhedged.

Since there is no simple portfolios that can statically replicate this structure, determining the value of the fixed spread is not an easy task. However, we can easily impose lower and upper limits on the price. Since the structure provides less protection than buying default swaps against *each* of the reference credits individually, it has to be less than this total cost. For a lower bound, we note that the cost of the basket has to be greater than the price of a default swap on the lowest credit quality asset in the basket. The problem is that these bounds may be quite far apart so that in practice we will need a model to get a more accurate price.

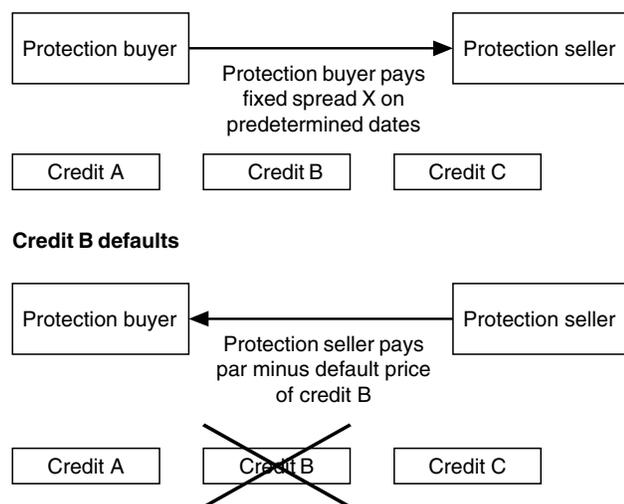
The motivation for doing a basket default swap is that it is a cheaper way to buy protection on a group of credits than buying protection individually on each credit. It is therefore an efficient way to reduce credit concentrations at an attractive cost. For the protection seller, the main motivation is that it provides a way to earn a high yield on high-quality securities.

There may also be a regulatory capital advantage to selling protection. For example, an investor may be able to sell protection against five assets, earning a high yield in the process, but only be

required to pay the regulatory capital charge against one of the assets in the basket. However, as there is as yet no standard treatment for default baskets, the benefit of this advantage may vary depending upon regulatory framework.

It is important to understand that default baskets are correlation trades. However, there are two types of correlations to think about. First, there is the correlation between the changes in the spreads of the assets in the basket. This captures the fact that as one asset becomes more likely to default, another asset may also become more likely to default. The second type of correlation is the default correlation. This captures the knock-on effect that the default of one asset has on the default of another asset.

This is a subtle issue. To see it more clearly, consider the example of a default basket on two issuers within the same industry sector. We would expect to find a strong positive correlation between the credit spread changes of both issuers. However, if one issuer were to actually default and this was due to idiosyncratic reasons, it has a beneficial effect on the other issuer due to effects such as creating more market share and reducing labor costs. The upshot is that we have positive spread correlation but negative default correlation. A major difficulty is the sheer lack of data available for estimating these correlations. In practice, the credits in most baskets are chosen in such a way that they have low probabilities of default and low correlations with each other.



**Figure 5.6.** A basket default swap on credits A, B and C

## 5.8. Convertible Bonds

Convertible bonds are traditionally regarded as an equity play, i.e. the buyers of convertibles are after potentially high equity value. Some convertible bonds with less likelihood of significant equity appreciation try to attract buyers who try to enhance investment returns. Nowadays, convertibles have become a major credit derivative contract. Institutional investors discover that the credit risk in convertible bonds is significantly mispriced and hence start to arbitrage on high-yield convertibles.

A typical credit play of convertibles is to buy an underpriced convertible, engage in an interest rate swap to hedge away the interest rate risk, sell an equity put option to compensate the conversion value paid for, and enjoy the underpriced credit spread. This credit spread can be monetized by selling a spread option, or engaging in a forward asset swap, or buying a default swap.

### 5.9. Conclusions

What we have presented here constitute the main types of credit derivative instruments. Many of the more exotic structures that are now being traded in the market are simply variations and extensions of these basic building blocks. For example, credit-linked notes may consist simply of a standard bullet bond that has an embedded default swap – the investor receives a coupon plus a spread and loses part of the redemption value if the reference credit defaults.

One important issue in the use of credit derivatives, which is not the focus of this review, is how

to price and hedge these instruments. See, for example, Caouette et al. (1998), Saunders and Allen (2002), Duffie and Singleton (2003), and Anson et al. (2004).

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