STEP 3

Risk SWAPPING

BY ALAN WHITE

Understanding and using CDSs and CDOs

There have been tremendous developments in the credit markets over the last decade. Our understanding of credit risk has become much clearer and, along with that understanding, has come a set of new financial products that can be traded to either control credit risk or allow investors to generate returns by taking on some credit risk. In this article we provide an overview of the development of the market and the main instruments that are now traded.

Credit Default Swaps

The first generation of credit derivative products were Credit Default Swaps (CDSs). Although the name does not suggest this, CDSs are insurance contracts. They insure against losses due to default on a bond and are structured in almost the same way as a term life insurance policy. You make periodic payments to the insurer and, in return, you are compensated for your loss if the insured event happens during the life of the insurance contract. In the case of a CDS the insurer is called the seller of protection and the insured is the buyer of protection.

CDSs are over-the-counter contracts so it is possible to negotiate almost any terms, but the most common contracts have a five-year life. They provide protection on $5 or $10 million face value of senior unsecured bonds issued by a particular borrower. The periodic payments are usually made quarterly and the size of the payments is based on a quoted spread times the face value amount insured. This face value amount is known as the notional of the contract. In the event of default, the compensation is determined in one of two ways. In a physical settlement contract the buyer of protection delivers bonds with the correct face value to the seller of protection and receives the face value in cash. In a cash-settled transaction, the market price of the bonds 30 days after the default event is determined based on quotes from a number of market makers, and a cash payment equal to the difference between the face value and this market price is made from the seller of protection to the buyer.

This general structure involving how the payments are calculated and made and how losses are determined is repeated in almost all synthetic credit derivatives. As you will see, the difference between contracts lies in what type of credit risk is being insured. Almost all the more complex structures that we will encounter later are cash settled using the rules described.

It is easy to estimate the spread that a seller of protection will charge in a CDS. Suppose that you buy a credit risky bond that yields 7% and buy protection on this bond. Since you have insured against default risk, the package is a low-risk investment and, as a result, should earn a return similar to an investment in bonds that have little or no credit risk. The actual return that you earn is the 7% bond yield less the CDS spread. Since we rarely encounter free lunches in the capital markets we can expect the CDS spread to be about equal to 7% less the yield on our no-credit-risk bond. Experience has shown that, for the purposes of estimating the CDS spread, it is best to use something close to the swap rate as the no-credit-risk bond-yield. If the 5-year risky bond yield is 7% and the 5-year swap rate is 5%, the spread on a 5-year CDS on the bond will be about 2%.

Collateralized Debt Obligation

The second generation of credit derivatives is the

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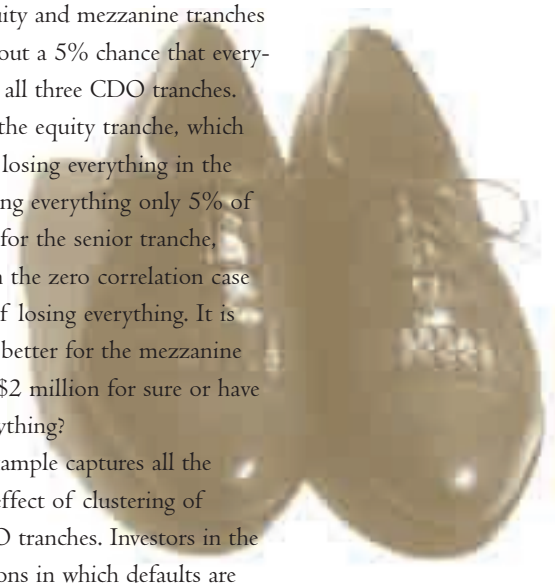
Collateralized Debt Obligation (CDO). The first CDOs were cash CDOs. They are a form of securitization. A portfolio of debt instruments, often bonds or loans, is put into a trust or special purpose vehicle (SPV) and new securities are issued against the assets in the portfolio. The classes of securities issued, known as tranches, differ primarily in how much default risk the tranche bears.

For example, we might put $100 million of debt instruments into an SPV and issue three classes or tranches of securities secured by the pool. The most risky tranche, known as the equity tranche, has a principal amount of $3 million. This principal is reduced by all losses due to defaults until it is completely gone. As a result, the equity tranche absorbs all losses due to default up to a maximum of $3 million. The next most risky tranche, known as the mezzanine tranche, has a principal amount of $17 million and is responsible for losses due to defaults in excess of $3 million, up to a total loss due to default of $20 million. The most secure tranche, known as a senior tranche, has a principal of $80 million and is responsible for all losses due to default in excess of $20 million. The senior tranche apparently bears virtually no default risk and is typically rated AAA. The mezzanine tranche bears a moderate amount of default risk and might have a BBB rating. The equity tranche bears a great deal of default risk and is usually unrated. The promised returns for investment in each tranche are commensurate with the tranche rating.

While it may appear that the primary risk in investing in a CDO tranche is the default risk of the underlying portfolio, this is not the case. The overall level of default risk does play a role, but it is secondary. The main risk for an investor in a mezzanine or senior tranche is what is known as default correlation. This is the tendency of defaults to cluster together in time. To see this, consider the following rather extreme example. Suppose that our CDO has a life of five years, the pool of assets in our CDO is one hundred $1 million bonds, and that, in the event of default, there is no recovery, so each default costs $1 million. Let us also assume that defaults occur at a rate of 1% per year so that on average we see one default per year from the pool of bonds.

If there is zero default correlation, that is no clustering of defaults, there will be about one default per year. Over the life of the CDO there will be about five defaults causing $5 million in losses. The equity tranche will be wiped out by the first $3 million of losses, which should occur in the first three years of the CDO. The mezzanine tranche will then absorb $2 million in losses and the senior tranche will suffer no loss.

Now consider the 100% correlation case. This is the ultimate case of clustering in which, if one firm defaults, everyone defaults. We still observe about one default per year on average but the pattern of defaults is quite different. In 99 years out of 100 there are no defaults, but in one year in one hundred everyone defaults, resulting in 100 defaults. What does this mean for our CDO tranches? There is about a 95% chance that there will be no defaults in the five-year life of the CDO, in which case the equity and mezzanine tranches suffer no losses. There is about a 5% chance that everyone will default, wiping out all three CDO tranches.



This is clearly better for the equity tranche, which goes from being assured of losing everything in the zero correlation case to losing everything only 5% of the time. It is clearly worse for the senior tranche, which never suffers a loss in the zero correlation case but now has a 5% chance of losing everything. It is not clear which situation is better for the mezzanine tranche. Is it better to lose $2 million for sure or have a 5% chance of losing everything?

Although extreme, this example captures all the important elements of the effect of clustering of defaults on the various CDO tranches. Investors in the equity tranche prefer situations in which defaults are highly correlated. This is likely to occur if the portfolio of bonds is highly concentrated in a small number of industries. The senior tranche investors prefer low correlation situations, cases in which the bond portfolio is widely diversified. The relative unimportance of the average default rate is revealed by the fact that the results would be similar if we were to double or halve the average default rate for the bond portfolio.

A second risk factor that investors in cash CDOs should be aware of is what is referred to as the waterfall. This is the set of rules that defines how the cash flows generated by the debt portfolio underlying the CDO will be distributed to the various tranches of the CDO. Some early CDOs had a waterfall that allowed the equity tranche investors to withdraw much of their earnings in cash early in the life of the CDO. This left the more senior tranches with reduced collateral. A few years ago investors in mezzanine and senior tranches received some unpleasant surprise losses. This was a result of an adverse economic situation coupled with excessive default correlation in the CDO portfolio and a waterfall that allowed the equity tranche to withdraw cash early. The structure of

most cash CDOs was changed as a result of these events so that there have been no similar problems recently.

Synthetic CDOs

In the last few years, as an alternative to a cash CDO, investment banks introduced synthetic CDOs. The structure of the synthetic CDO is similar to that of a CDS. The CDS insures against losses due to default by a particular issuer; the synthetic CDO insures against losses due to default on a portfolio. However, unlike the CDS the synthetic CDO does not insure against all losses due to default but only a portion of the losses. It does this by adopting a tranche structure similar to that of a cash-CDO. The synthetic CDO can be considered to be a CDO where the underlying portfolio is a portfolio of CDSs rather than debt instruments.

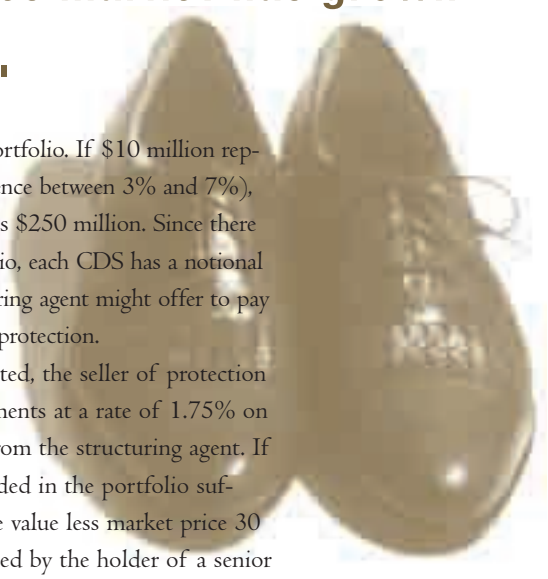
The synthetic CDO is similar to a cash-CDO with a few important differences. First, since there is no debt in the underlying portfolio, the tranche investors do not have to make an initial investment to finance the bond portfolio. In our cash CDO example, the mezzanine tranche holders made an initial investment of $17 million in the tranche. In a synthetic CDO, the mezzanine tranche investors would merely enter into a contract under which they would agree to pay for all losses between $3 and $20 million on the CDS portfolio. Usually they would be required to post collateral to ensure that they could be able to cover these potential losses. Although there is no initial investment, in the event of a default in the CDS portfolio the tranche that is responsible for that loss would be required to make a payment equal to the loss.

The second difference in the synthetic CDO is in the payments to the tranche investors. In a cash-CDO, the promised payment is similar to a bond coupon payment and the yield will be commensurate with the rating of the tranche. In our example, the mezzanine tranche was rated BBB and might yield about 6.75%. In a synthetic CDO, since there is no initial investment, the payment is similar to the payment on a CDS; it is roughly equal to the credit spread for the tranche. For a BBB-rated issue, this might be about 1.75%.

Synthetic CDOs have evolved into what are called single tranche or bespoke tranche CDOs. In these structures, the customer gets to have input into the contents of the portfolio of CDSs underlying the CDO, the portion of the loss for which they would like to be responsible, and the notional size of the underlying portfolio.

For example, the customer (the seller of protection) would provide the structuring agent, usually an investment bank (the buyer of protection), with a list of, say, 100 corporations that they would like to include in the portfolio of CDSs. They would indicate that they would like to cover between 3% and 7% of the total losses and that they are willing to bear up to $10 million of losses. This becomes the notional for the CDO tranche. The range of losses that they cover and the total loss they bear define the size of the portfolio. If $10 million represents a 4% loss (the difference between 3% and 7%), then the total portfolio size is $250 million. Since there are 100 names in the portfolio, each CDS has a notional of $2.5 million. The structuring agent might offer to pay a rate of, say, 1.75% for the protection.

The credit derivatives market has grown to about $12 trillion.



Once the CDO was initiated, the seller of protection would receive quarterly payments at a rate of 1.75% on a notional of $10 million from the structuring agent. If one of the 100 names included in the portfolio suffered a default, the loss (face value less market price 30 days after the default) suffered by the holder of a senior unsecured bond with a face value of $2.5 million issued by that corporation would be determined and the seller of protection would be required to pay that amount to the buyer of protection. The notional amount on which the regular payments are based would then be reduced by the amount of the loss.

Suppose that the CDO has a life of five years and that, in the event of a default, the loss is $1.5 million, 60% of the value. For illustration purposes let us suppose that one firm in the pool defaults at the end of each six months. The seller of protection is responsible for all losses between 3% and 7% of the total $250 million, that is, losses between $7.5 million and $17.5 million. Since losses accumulate at a rate of $1.5 million every six months, after two and one-half years (10 quarters) the accumulated losses on the portfolio amount to $7.5 million and the seller of mezzanine protection is exposed to any further losses. The next loss occurs at the end of the third year and costs the seller $1.5 million.

CDO CASH FLOWS — TABLE 1

The cash flows for a seller of protection who agrees to cover all losses between $10 million and $17.5 million on a portfolio in exchange for payments at a rate of 1.75% per year or 0.4375% per quarter. Payment income is based on this rate times the notional at the end of the previous quarter. Net cash is the payment income less the tranche loss. All numbers are in millions

Quarter	Default Loss	Cum. Loss	Tranche Loss	Cum. Tranche Loss	Notional Income	Payment Income	Net Cash
0					10.0		
1		0.0	0.0	0.0	10.0	0.04375	0.044
2	1.5	1.5	0.0	0.0	10.0	0.04375	0.044
3		1.5	0.0	0.0	10.0	0.04375	0.044
4	1.5	3.0	0.0	0.0	10.0	0.04375	0.044
5		3.0	0.0	0.0	10.0	0.04375	0.044
6	1.5	4.5	0.0	0.0	10.0	0.04375	0.044
7		4.5	0.0	0.0	10.0	0.04375	0.044
8	1.5	6.0	0.0	0.0	10.0	0.04375	0.044
9		6.0	0.0	0.0	10.0	0.04375	0.044
10	1.5	7.5	0.0	0.0	10.0	0.04375	0.044
11		7.5	0.0	0.0	10.0	0.04375	0.044
12	1.5	9.0	1.5	1.5	8.5	0.04375	-1.456
13		9.0	0.0	1.5	8.5	0.03719	0.037
14	1.5	10.5	1.5	3.0	7.0	0.03719	-1.463
15		10.5	0.0	3.0	7.0	0.03063	0.031
16	1.5	12.0	1.5	4.5	5.5	0.03063	-1.469
17		12.0	0.0	4.5	5.5	0.02406	0.024
18	1.5	13.5	1.5	6.0	4.0	0.02406	-1.476
19		13.5	0.0	6.0	4.0	0.01750	0.018
20	1.5	15.0	1.5	7.5	2.5	0.01750	-1.483

To summarize, at the end of each three months for the first three years, the seller of protection receives $43,750, one-quarter of 1.75% of $10 million. At the end of the third year the seller must pay $1.5 million, so the net income at the end of the 12th quarter is -$1.456 million. At this point the seller's notional is reduced to $8.5 million, so the payment at the end of the 13th quarter is $37,188, one-quarter of 1.75% of $8.5 million. The resulting cash flows for this example are shown in Table 1. As this table shows, this was not a particularly attractive investment for the seller of protection. If there were no defaults, total income over the five-year period would be $875,000. Each default in excess of five defaults costs $1.5 million. In order for this to be an attractive investment to the seller of protection, the chance of having six or more defaults in five years must be low.

The attraction of the single tranche CDO to the structuring agent is that they can respond to individual client needs and do not need to assemble a structure that is attractive to a wide set of investors. This allows a quicker response to client requests. In practice, the investment bank structuring a single tranche CDO may not assemble an actual specific portfolio of the named CDSs. Rather it will delta hedge the risk of the position in much the same way that it delta hedges its option positions. One of the advantages of the single tranche CDO to the customer is that it is possible for the customer to either buy or sell protection.

Index Products

One of the weaknesses in the CDO market has been the lack of standardization of products. Every CDO was in some sense unique. Further, investors were concerned that the structuring agents, the investments banks, probably had superior information about the credit quality of some of the names included in the portfolio and could take advantage of this information. To address these issues, Dow Jones launched a set of standardized credit indexes. The most popular of these are the DJ iTraxx and the DJ CDX IG indexes. The iTraxx index is an equally weighted portfolio of 125 investment-grade European corporations and the CDX IG is a similar equally weighted portfolio of 125 investment-grade North American corporations. The contents of these portfolios are selected by an independent committee that regularly adjusts the portfolio contents to reflect changing credit conditions.[1]

There are six standard contracts written on each of these indexes. The first is an index CDS. This is similar

Quotes for CDX IG and iTraxx Tranches on December 1, 2005 **TABLE 2**

	CDX IG Tranches					
	0% to 3%	3% to 7%	7% to 10%	10% to 15%	15% to 30%	Index
5-year Quotes	32.5	196	71	26	9	47
10-year Quotes	54.0	507	177	86	33	67
	iTraxx Tranches					
	0% to 3%	3% to 6%	6% to 9%	9% to 12%	12% to 22%	Index
5-year Quotes	23.0	131	44	26.5	14	36.0
10-year Quotes	45.5	367	152	87.5	43	53.3

to a portfolio of 125 CDSs, one for each name in the portfolio. The distinction between the index CDS and a portfolio of 125 individual CDSs is that if you were to buy 125 individual CDSs, each one would have a spread that reflected the default risk of that particular issuer. In the index CDS, all the CDSs have the same spread. This spread is close to but slightly lower than the average of all the individual CDS spreads.[2]

The remaining five contracts are all tranches of a synthetic CDO. The tranches are defined by what are known as the attachment and detachment points. These define the range of losses for which the tranche is responsible. For iTraxx, the tranche attachment and detachment points are 0 to 3%, 3 to 6%, 6 to 9%, 9 to 12% and 12 to 22%. For the CDX IG they are 0 to 3%, 3 to 7%, 7 to 10%, 10 to 15% and 15 to 30%. In both cases the first tranche is called the equity tranche, the second the mezzanine tranche and the remaining tranches are referred to as senior tranches. Dealers quote prices for all six of these standardized products and are willing to make a two-way market in all of them. As a result, investors can either buy or sell protection on the index or any of the CDO tranches. The prices quoted are spreads given in basis points (bps) per year. The only exception to this is for the equity tranche, in which case the quote is an upfront payment in percentage points. In addition to this, the buyer of equity tranche protection also pays a spread of 500 bps (5%) per year.

Quotes for five and 10-year contracts as of December 1, 2005 are shown in Table 2. This table shows that, if you wanted to buy protection for five years on the equity tranche of the CDX with a notional of $10 million on this date, you would pay $3.25 million immediately and then make payments at a rate of 5% per year. This would result in quarterly payments of $125,000 until the notional was reduced by losses due to default. The losses would be calculated based on an assumed portfolio size of $333.3 million.[3]

Similarly, if you want to sell protection for five years on $10 million notional of the CDX mezzanine tranche you would receive payments at a rate of 196 bps (1.96%). This results in quarterly payments of $49,000 as long as the notional is not reduced by losses due to default. Since the mezzanine tranche is responsible for 4% of losses (7% less 3%) and the amount of loss to be covered is $10 million, the losses would be calculated on the basis of an assumed portfolio size of $250 million. The first 3% of $250 million, $7.5 million, of losses on the portfolio would be absorbed by the equity tranche and the mezzanine tranche would be responsible for all losses between

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3% and 7%, $7.5 million and $17.5 million.

These standardized credit products can be used for either risk management purposes or for more speculative investment purposes. For example, a Canadian bank with a well-diversified portfolio of investment-grade loans can reduce the credit risk of the loan portfolio by buying the CDX index CDS. Although the names in the two portfolios are not likely to overlap too much, circumstances that lead to many loan losses are likely to lead to defaults in the CDX portfolio. The default payments on the purchased protection will then offset the loan losses.

As an investment product, most investors note that the spreads paid for protection seem very high relative to historic default experience. As a result these products appear to offer a very good return to the seller of protection. It should be noted, however, that when a proper analysis is carried out, the index and CDO tranche spreads turn out to be consistent with the yield spreads that are observed on bonds. These spreads are also high relative to historic losses due to default.

A popular trade among hedge funds was to sell protection on the equity tranche while buying protection on the mezzanine tranche. This is similar to a yield curve carry trade in which we lend long-term at high rates of interest and finance short-term at low rates. The mezzanine tranche purchased protection was designed to hedge the fund against changes in default correlation, our measure of clustering of defaults. This clustering affects all tranches of a CDO. The trade was very popular until the downgrading to non-investment grade of Ford and General Motors, both members of the CDX index at that time, in May of 2005. This event caused the mezzanine hedge that worked in normal times to break down, resulting in large losses for many hedge funds.

Conclusions

The credit derivatives described here are the main credit-related products that are traded. From a standing start about 10 years ago, the credit derivatives market has grown to about $12 trillion notional outstanding in mid-2005, according to ISDA estimates. About half of the outstanding notional is single-name CDSs. To put this in perspective, this is about the same size as the U.S. economy or about twice as large as the total principal amount of U.S. corporate debt outstanding in 2005.

As the market has developed, other more exotic credit derivative products have also emerged. These include options on credit spreads and other credit-related options, as well as something called a CDO-squared, a form of synthetic CDO where the underlying portfolio consists of CDO tranches. Most of these more exotic products are designed to provide more leverage, that is, a higher return on investment. However, as is always the case, while more leverage produces higher rates of return, it also produces much higher risk. Further, just as it is the clustering of defaults rather than the frequency of defaults that primarily determines the values of CDO tranches, the prime determinants of the value of these levered products are often different from what the investor might imagine. As a result, these products should be approached with caution. ∎

Endnotes

1. When you enter into a contract involving one of these indexes, the portfolio underlying your contract remains the same over the life of the contract. It is not affected by subsequent revisions of the index.
2. The reason that it is slightly lower than the average is that CDSs with high spreads represent cases in which there is a good chance that a default will occur and you will stop receiving the spread payments early in the life of the contract. Thus when we are averaging the spreads we should downplay the importance of these spreads a little, lowering the effective average.
3. The equity tranche is responsible for the first 3% of losses on the portfolio. Three percent of $333.3 million is $10 million, the tranche notional.