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Credit Derivatives Strategy
J.P. Morgan Securities Ltd.
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Trading Recovery Rates - Digital Default Swaps and Recovery Swaps

- **Digital Default Swaps (DDS) are CDSs with a predetermined recovery rate**
- **Recovery Swaps can be constructed by combining a DDS with a standard CDS**
- **JPMorgan has begun to trade DDS on single name credits and also trades Credit derivative indices in North America and Europe with a fixed recovery rate**
- **The instruments can be used to take views on recovery rates, hedge recovery rate independent credit exposure, and to make capital efficient investments**

Credit Derivatives Strategy

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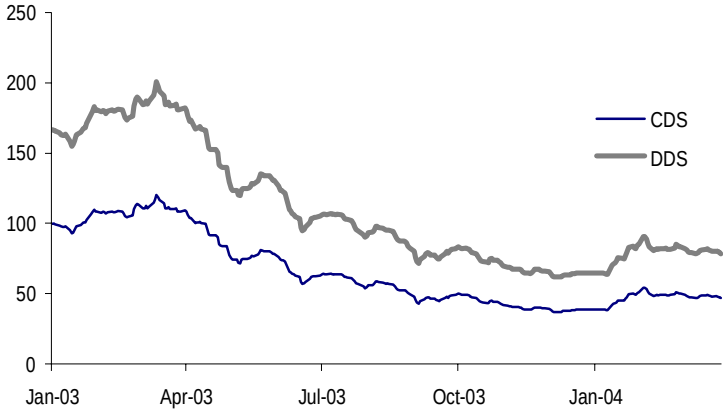
Chart 1: CDS Credit Derivative Index vs. DDS Credit Derivative Index
Simulated CDS Spread, 40% assumed implied recovery rate, bp



Source: JPMorgan

Introduction

With the continued success and still increasing volumes on CDS index products such as DJ TRAC-X Europe and DJ CDX.NA.IG, it is a natural extension of the product range from options, tranches, various maturities, and various formats to also include Digital Default Swaps (DDS) and Recovery Swaps. DDS is a simplified version of a CDS, resulting in a shorter settlement process, and serving a number of purposes for both fund managers, hedge funds, corporates and banks. A Recovery Swap is simply a CDS and a DDS bundled together allowing investors to isolate views on recovery rates. As liquidity in these index type products increases, trading in the underlying single name DDS is likely to pick up as well. In this short

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note, we describe the mechanics of DDS and Recovery Swaps and highlight their many uses.

How do Digital CDS work?

A Digital CDS, also called a Digital Default Swap (DDS), is a simplified version of a regular CDS. The only difference being that a DDS has a predetermined recovery rate (and hence payout) in case of a Credit Event occurring. The recovery rate in a DDS can be fixed at any level, whereas recovery rates on regular CDS depend on where the deliverable obligations trade following a Credit Event. In this research note we assume that the DDS is set at 0% recovery unless otherwise stated.

A 0% DDS will always trade at a higher spread than a regular CDS, except in the extreme scenario where the expected recovery rate on the company is 0% (implying identical expected payoffs for the CDS and the DDS). Intuitively this makes sense as the expected loss on a DDS is relatively higher. It is important to note that the default probability on a CDS and DDS contract is identical, and that the increased expected loss on a DDS is due entirely to different payouts following a Credit Event. Imagine a long protection position in a CDS trading with an expected recovery rate of 40% compared to a long protection DDS position. In case the reference entity experiences a Credit Event and the recovery rate turns out to be 40% the buyer of CDS protection will make (1-R) = (1-40%) = 60% of the notional, whereas the buyer of DDS protection will make (1-R) = (1-0%) = 100% (and vice versa for sellers of protection in CDS / DDS).

By comparing positions and expected payouts in DDS and CDS we can establish some simple, but essential, relationships between CDS, DDS, and implied recovery rates. Consider the following positions:

a) - Long CDS protection
- Notional: $10m
- Fee leg: 50bp
- Payout following Credit Event: $10m x (1-R)

b) - Long DDS protection
- Notional: $5m
- Fee leg: 100bp
- Payout following Credit Event: $5m

As the annual dollar amounts of the fee legs are identical on both positions ($50,000), the market must expect the payoffs following a Credit Event to be of equal value as well:

$$\$10m \times (1-R_{implied}) = \$5m$$

hence

$$R_{implied} = 50\%$$

In a similar way, we can deduce some more generic relationships. Again, consider the following positions:

c) - Long CDS protection
- Notional = 1
- Fee leg = S_{CDS}
- Payout following Credit Event = 1-R

d) - Long DDS protection
- Notional = S_{CDS}/ S_{DDS}
- Fee leg = $S_{DDS} \times S_{CDS}/ S_{DDS} = S_{CDS}$
- Payout following Credit Event = S_{CDS}/ S_{DDS}

As before, the fee leg in position (c) and (d) are identical - hence:

$$(1): \quad (1-R_{implied}) = S_{CDS}/ S_{DDS}$$

$$(2): \quad R_{implied} = 1 - S_{CDS}/ S_{DDS}$$

The above relationship is extremely useful in that it tells us that we can deduce the market implied recovery rate from CDS and DDS spreads. If for example CDS and DDS spreads on company ABC are 100bp and 200bp respectively, the market implied recovery rate on company ABC is:

$$R_{implied} = 1 - 100 / 200 = 50\%$$

Recovery Swaps - a Package of CDS and DDS

Since we can now offer both CDS and DDS it is a natural extension of the line of products to include packages of CDS and DDS for pure recovery rate trades. These instruments are referred to as Recovery Swaps and only pay out in case a Credit Event occurs. The Recovery Swap is based on a regular CDS and a DDS having a fixed recovery rate equal to the traded recovery rate. As such, the Recovery Swap will be priced at par and have a carry of zero bp. Although the Recovery Swap initially will be traded as two separate instruments, we see potential for trading this as a single

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instrument - depending on investor demand.

In case there is a Credit Event during the life of the Recovery Swap, the investor short recovery rates will make money on the trade if he is able to buy defaulted debt at a lower price than the recovery rate implied by the market at the time of trading. If, for example, the market implied recovery rate on the trade date is 50%, the company in question experiences a Credit Event and the investor buys bonds in the market at 40% of par, the investor can deliver these bonds into the contract, receive 50% of notional traded, and net make 10% times notional on the trade.

It is important to note that when we discuss recovery rates in the context of Recovery Swaps, we mean the cheapest deliverable type of debt the investor can source in the market following the Credit Event. This is distinct from the long term recovery rates - the value of debt instruments after a company has finished its bankruptcy restructuring.

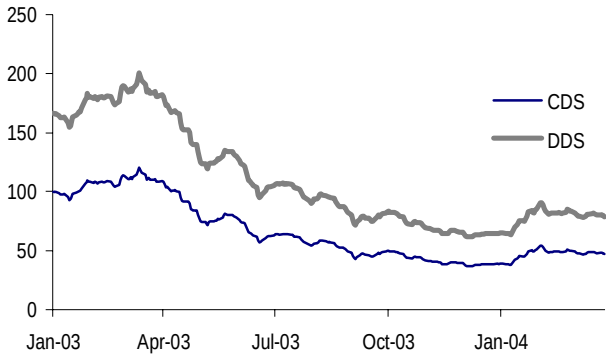
Digital CDS and Tradable CDS Indices

DDS can of course also be applied to products based on single name CDS, such as the tradable CDS indices, DJ TRAC-X Europe and DJ CDX.NA.IG. There are at least three main reasons why such products should have investor appeal:

1) A DDS index trades at wider spread than a regular CDS index

2) DDS indices are easier to settle following a Credit Event
3) DDS indices allow for capital efficient investments

Chart 1: CDS Credit Derivative Index vs. DDS Credit Derivative Index
Simulated CDS Spread, 40% assumed implied recovery rate, bp



Source: JPMorgan

We will look at each one of these features in turn.

DDS-based Indices Trade Wider

As mentioned earlier, a DDS will always trade at a higher spread than a plain vanilla CDS assuming it has a fixed recovery rate of zero percent. In Chart 1, we have simulated the spread history on CDS and DDS based credit derivative indices by making an assumption about the implied recovery rate. We have used the market standard 40% rate for simulating the DDS history. This is roughly in line with Moody's estimate of long-term average corporate recovery rates in the US market of 37%.

From the previous section we know that there is the following relationship between CDS and DDS spreads:

$$(3): \quad S_{DDS} = S_{CDS} / (1\text{-}R_{implied})$$

which means that using an implied recovery rate of 40% will make the DDS credit derivative index trade at a spread multiple of

$$S_{DDS} = S_{CDS} / (1\text{-}40\%) = 1.67 \bullet S_{CDS}$$

Using a constant implied recovery rate (and hence spread multiple) is a crude approximation used in Chart 1 for illustrative purposes. We expect implied recovery rates to change regularly, depending on investors' views on recoveries, whereas in our assumed history they are static over time. In Table 1 we show the spreads on CDS and DDS based credit derivative indices for various implied recovery rates. For example, with CDS credit derivative index spreads at 50bp and assuming a 40% implied recovery rate, DDS credit

Table 1: CDS and DDS Credit Derivative Indices for Various Implied Recovery Rates

CDS Based Index	Implied Recovery Rate	DDS Based Index
50	0	50
50	20	63
50	40	83
50	60	125
50	80	250

Source: JPMorgan

Table 2: Taking Views on Recovery Rates, Trade Details

Position	Deal spread	Size	Duration
Buy CDS protection	50	10,000,000	4.81
Sell DDS protection	100	5,000,000	4.73

Source: JPMorgan

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derivative index spreads will be at 83bp. By using a DDS based index investors thus get a pick up in spread for taking the same default risk as in regular CDS based index. In case any of the names in the index experiences a Credit Event, however, the exposure is higher in DDS due to the fixed zero percent recovery rate. This pick up in spread should be particularly attractive for investors searching for yield in the aftermath of the strong spread compression experienced from October 2002 to early this year. In particular, investors who are looking to go long credit and who do not believe any of the names in, for example, DJ TRAC-X Europe or DJ CDX.NA.IG will experience a Credit Event should use DDS. Using a 40% implied recovery rate the DDS spread is 67% higher than the CDS spread, while the extra spread volatility means that the mark-to-market likewise is 67% higher.

Settlement on DDS-based Indices

The second key advantage of DDS based indices over plain vanilla CDS based indices is that the settlement process following Credit Events is much simpler. The reason for this is that no obligations are delivered to the seller of protection, but only exchange of the notional exposure is taking place. For example, in case any of the single name CDS comprising a DDS based index experiences a Credit Event, the buyer of protection will simply receive a payment equal to the notional exposure to that particular name. The coupon on the DDS index remains unchanged, but is paid on the reduced notional amount.

Under this simplied structure, settlement on the Digital contracts will take place 5 days after the Notification of the Credit Event. In contrast, the physical settlement process on a regular CDS involves a number of steps (seen from the protection buyer's perspective): 1) Notice of physical settlement specifying which obligations to deliver 2) Buying deliverable obligations, 3) Delivery of deliverable obligations, 4) Receiving the notional amount traded on the CDS.

As an illustration of how lengthy this process normally is, the last DJ TRAC-X Europe Series 1 contracts were settled in the middle of March 2004 following the default on Parmalat on 24 December 2003. While the Parmalat settlement is considered to have taken place relatively smoothly, it thus still took almost three months before all contracts were settled.

Taking Views on Recovery Rates - CDS, DDS and Recovery Swaps

As mentioned earlier the relationship between DDS and CDS spreads provides information about the market implied recovery rate. Assessing the traded data on the two products thus makes it easy for investors to take views on whether they agree with these implied recovery rates.

Imagine for instance that we observe:
1) CDS credit derivative index at 50bp
2) DDS credit derivative index at 100bp

Using (2) we get a market implied recovery rate of:

$$R_{implied} = 1 - S_{CDS} / S_{DDS} = 1 - 50/100 = 50\%$$

The investor takes the view that the recovery rate as implied by the market is relatively too high at 50% - equivalent to the view that DDS spreads are too high. Implementing this view requires selling protection on the DDS index at 100bp and buying protection on the CDS index at 50bp. For a pure recovery rate trade the notional amounts traded on each side should be adjusted to make the trade carry neutral. In the above example, this means buying 2 units of CDS protection for every 1 unit of DDS protection sold. The combination of these two trades are economically equivalent to trading a Recovery Swap. The investor only has exposure to recovery rates and carry on the trade is zero bp. The details of the trade are outlined in Table 2.

Table 3: Taking Views on Recovery Rates, Scenario Analysis for changes in CDS / DDS spreads

	CDS	CDS P/L	DDS	DDS P/L	Trade P/L	Implied Rec Rate
1	50	0	80	47,500	47,500	0.375
2	50	0	120	- 47,500	- 47,500	0.583
3	40	- 47,500	100	0	- 47,500	0.600
4	60	47,500	100	0	47,500	0.400
5	60	47,500	110	- 23,750	23,750	0.455
6	60	47,500	120	- 47,500	0	0.500

Source: JPMorgan

Table 4: Taking Views on Recovery Rates, Scenario Analysis for Credit Events occurring

Number of Credit Events	Realised Recovery Rate	CDS P/L	DDS P/L	Trade P/L
1	50%	50,000	- 50,000	-
1	40%	60,000	- 50,000	10,000
3	50%	150,000	- 150,000	-
3	40%	180,000	- 150,000	30,000
100	50%	5,000,000	-5,000,000	-
100	40%	6,000,000	-5,000,000	1,000,000

Source: JPMorgan

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Let us analyse the P/L impact on the trade given various scenarios for movements in CDS and DDS spreads.

As shown in Table 3, we have in fact managed to isolate the P/L impact of the trade to changes in implied recovery rates. Under scenario 1, CDS spreads remain unchanged while DDS spreads tighten resulting in the implied recovery rate decreasing to 37.5% and the trade turning profitable. We observe the opposite pattern under scenario 2: DDS spreads widen out, the implied recovery rate increases and we lose money. Under scenario 6, both CDS and DDS spreads widen out - note that the implied recovery rate remains unchanged and that the trade P/L is zero.

It is of course also important to look at what happens in case one or more of the names in the credit derivative index experience a Credit Event and how the P/L is impacted by the realised recovery rate - this is done in Table 4.

When the realised recovery rate turns out to be exactly equal to the implied recovery rate of 50% the loss on the DDS position is off-set by the gain on the CDS position resulting in a net zero P/L. As expected, we make money in the scenarios when realised recovery rates are lower than the implied 50% recovery rate, which was our view at the out-set. In the extreme scenario where all names in the credit derivative index experience a Credit Event our P/L will simply be scaled up from the one Credit Event case.

DDS Valuation

DDS can easily be valued by using Bloomberg's CDSW page. Choose a bond in the same currency as the CDS which you wish to value and type CDSW <GO>. In the field: "Use Curve Rate" type "F" for false, set the "Recovery Rate" field below to 0%, type in the notional amount traded, the DDS Deal Spread and the maturity of the DDS. The right hand colum allows you to change the market CDS spreads. This provides you with the P/L on the position shown in the field "Market Value". In order to value a Recovery Swap package you will need to value both the normal CDS and the DDS via the CDSW page.

We can also use the CDSW calculator to analyze the P/L sensitivity to implied recovery rates at various spread levels. As shown in Chart 2, the P/L sensitivity on a DDS is broadly linear in spreads levels. In other words, when spreads increase, the sensitivity of P/L to changes in recovery rates roughly increases in a linear fashion (although in reality it is slightly concave).

DDS and Capital Efficiency

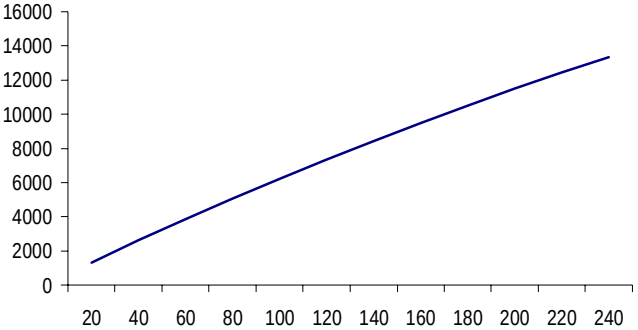
As a note to British-based investors, DDS DJ TRAC-X is a particularly attractive instrument for financial institutions (FI) because of the current capital allocation requirements on regular CDS. In a regular CDS, FIs are required by the BoE to allocate capital based on how large the potential loss is on their positions. This means that for an instrument such as DJ TRAC-X Europe Main, where the typical recovery rate is around 40%, a FI would still face 100% capital charge as this is the maximum potential loss on the position. The maximum potential loss on a 0% DDS is likewise 100% and the FI could therefore, for the same capital requirement, increase its credit exposure by roughly 67% using DDS. Bear in mind that the two positions have the same default probability, and that the additional exposure entirely is due to the fixed 0% recovery rate.

Credit Hedging Applications

As the pay out on a DDS is independent of the actual recovery rate, DDS do not serve as a good hedge for bonds and loans carrying both credit and recovery risk. There are, however, other types of credit exposure, such as credit contingent profits and losses, which are independent from recovery rates. This could, for example, be credit exposure with a different level of seniority from the traditional Senior Unsecured level which CDS are normally traded on. Under such types of credit exposure the bank would probably be

Chart 2: P/L Sensitivity to Recovery Rates almost linear in spread levels

Spreads (x-axis) vs. P/L Impact of a 1% change in recovery rates (y-scale)



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sure to have a fixed pay off following a Credit Event rather than having the additional exposure to recovery rates.

A specific example of bank credit exposure independent of recovery rates is that of off-setting CDS positions. Imagine a bank buys CDS protection at 100bp and, following credit spread widening, sells CDS protection at 200bp in equal notional sizes. This position has a mark-to-market gain in the form of a risky stream of future cash flows - if the Reference Entity experiences a Credit Event, both CDS are triggered, resulting in zero profit on the position irrespective of the recovery rate. This is a pure credit contingent loss and could be hedged by buying DDS protection with a notional equivalent to the mark-to-market on the position (for the hedge to work perfectly, the notional would have to be changed as CDS spreads change, as rates change, and as the maturity on the CDS decreases).

In our view, corporates can also benefit from the use of DDS. Consider a corporate with accounts receivables of $10m from company ABC. Accounts receivables stand differently in the creditor ranking from senior unsecured debt and may or may not be linked to senior unsecured recovery rates should company ABC default. Irrespective of this, the corporate in question may prefer a credit contingent fixed payout through a DDS rather than additional recovery rate exposure in the CDS instrument. The hedge ratio applied should naturally be adjusted to reflect the expected recovery rate on the accounts receivables. For instance, if the corporate expects to get 20% of accounts receivable back following default, it should use an 80% hedge ratio - in other words buy $8m of DDS protection on $10m accounts receivables.

Many of the uses of DDS described above naturally work better on single name DDS rather than on DDS based index products such as DDS DJ TRAC-X Europe and DJ CDX.NA.IG. As we have seen on, for example, DJ TRAC-X Europe 10Y and HY, index trading can significantly increase the trading volume in the underlying single name CDS. As volumes on DDS-based indices and Recovery Swaps increase, we would likewise expect improved liquidity in the underlying single name DDS as well.