BNP PARIBAS
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Structured Credit Trading

Structured Credit Strategy

The Bermuda triangle of Super Senior risk

The dislocation in the super senior tranches remains preponderant, having reached proportions where at current spread levels and 40% fixed recovery rate the Gaussian copula model can not calibrate the tranche prices, as highlighted in Chart 1. A relative value trade that hedges the super senior exposure with its adjacent tranche appears most appropriate, as it reduces the mark-to-market volatility and places less emphasis on the entry level of the super senior leg.

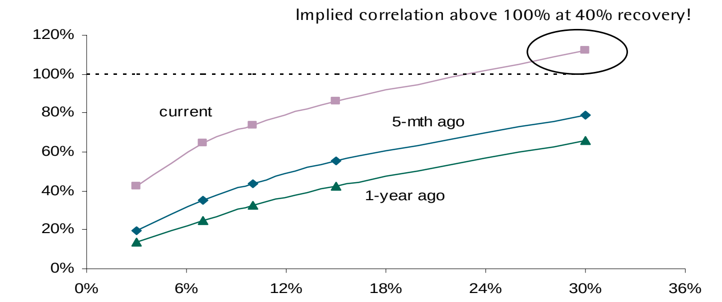
The key rationale of this trade is a normalisation of the base correlation structure. We show the current tranche market to be consistent with a severe systemic crisis and recovery rates around 20%. Our central scenario, however, is one where idiosyncratic risk increases significantly over the next few months, causing the 3% base correlation to decrease, the correlation curve to flatten and credit spreads to remain moderately high.

In the following section, we present model-free insights that intuitively allow to measure the extent of the market dislocation. In particular, the key strength of this approach is that, by acting solely on the back of no arbitrage conditions, one can determine the currently admissible loss distributions and position accordingly.

We measure the extent of the dislocation in super senior tranches in two ways:

- Through the Critical Loss Distribution;
- By constructing a near "arbitrage payoff".

Chart 1: CDX Base correlation curves[1]



Source: BNP Paribas

[1] To extrapolate the 30% base correlation at 40% recovery, we have adjusted the quotes of the 15-30% to obtain a proper calibration at 40%. We have then applied the sensitivity of the 15-30% tranche to a 1% move in the 15% base correlation to extrapolate the percentage move in the 30% base correlation point.

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The standardized tranche market allows for the computation of the expected loss of the five base tranches, extending to the 30% strike for CDX. Alongside the valuation of the 0-100% tranche, it also enables us to derive the maximum and minimum amounts of expected losses of the 60-100% tranche that are consistent with no arbitrage conditions. Note that we focus on the 60% strike because 40% recovery is the standard assumption for the underlying CDSs.

Upper and lower boundary for the 60-100%

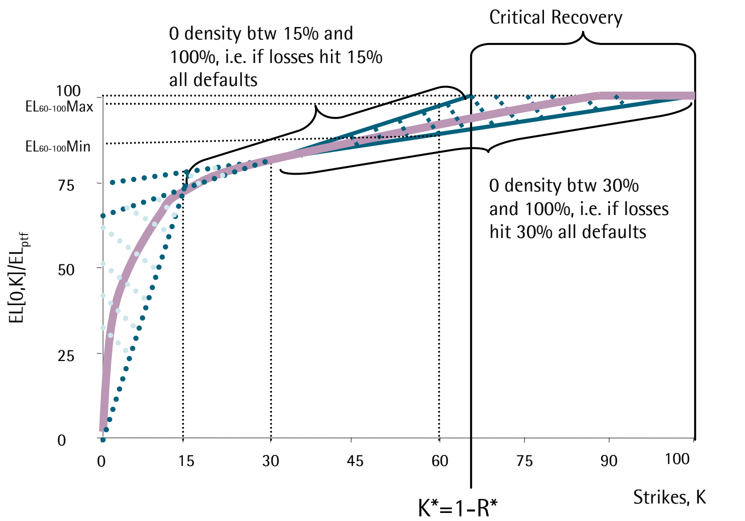
We can show that to avoid any arbitrage, the expected loss of the 60-100% can not be greater than 4/7*EL(30-100), which we can easily derive from the expected loss of the index and the expected loss of the 0-30%. Graphically (in Chart 2), the upper boundary is represented by the straight line that connects the expected loss of the (0-30) base tranche to that of the (0-100).

It is equally intuitive to derive the lower boundary for the expected loss of the 60-100%. Absence of arbitrage requires that EL(30-60) $\leq$ 2 EL(15-30). Equally, the sum of the expected loss for all tranches must add up to the expected loss of the index, establishing a floor for the expected loss of the 60-100% tranche.

The Bermuda triangle of the loss distribution

The upper and lower boundaries described above also define the range of admissible loss distributions. We represent the loss distribution by graphing the expected loss of the base tranches as a function of the strikes. This function must be positive, increasing and concave (see Appendix for more details). Also, beyond the 30% strike the function must lie within the shaded triangle of Chart 2. The lower R*, the more constrained is the loss distribution. This also implies that more risk is pushed into the 60-100% tranche, currently trading at c.30bp.

Chart 2: Expected loss of base tranches and the Bermuda Triangle



Source: BNP Paribas

The Critical loss distribution

As discussed in a previous publication[2], the strike at which the 15-30% straight line intersects the EL of the portfolio defines the Critical Recovery Rate, R*. The Critical Recovery Rate is the maximum expected recovery priced by the market under the assumption that the 15-30% and 30-100% tranches have the same seniority:

$$R^* = 70\,(1 - S_{30\text{-}100\%}/S_{15\text{-}30\%}),$$

where:

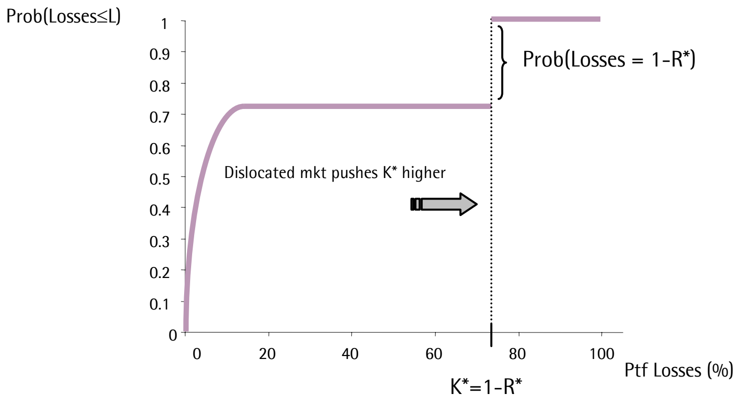
$S_{30\text{-}100\%}$ and $S_{15\text{-}30\%}$ are the spreads of the 30-100% and 15-30% tranches, respectively.

From the Critical Recovery Rate, we can equally derive the Critical loss distribution, defined by the following:

- A maximum recovery R* such that Prob (Losses>1-R*) = 0;
- Prob(Losses>15%) = Prob(Losses>30%) = Prob(Losses=1-R*);

An illustration of the Critical Recovery cumulative loss function is displayed in Chart 3.

Chart 3: Critical Loss function



Source: BNP Paribas

By construction the Critical loss distribution places the least amount of risk in the 60-100% tranche consistent with tranche pricing.

As highlighted in Table 1, R* is currently at 30 having decreased from 40 only 3 months ago. This emphasizes the strong dislocation that characterises the super senior tranches in CDX.

Table 1: CDX Critical Recovery Rate

	5Y	7Y	10Y
Current	30	30	34
1 week ago	34	31	36
1 month ago	27	30	34
3 months ago	40	40	43
1-year average	*37*	*38*	*43*

Source: BNP Paribas

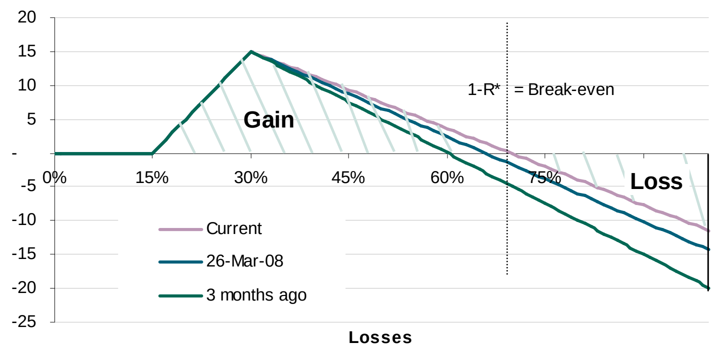
[2] The Critical Recovery Rate is discussed in greater depth in Structured Credit Strategy, *Relative Value in the 22-100% iTraxx Tranche*, 17 September 2007.

More triangles: an attractive zero-cost payoff…

A further way to evaluate the extent of the current dislocation in the super senior involves constructing a zero cost trade 'short protection in the super senior tranche against long protection in the junior super senior' and analysing its payoff.

A zero cost or carry neutral trade executed last week, would have involved an investment ratio of c.1.8:1 (super senior vs. junior super senior tranche). Chart 4 compares the payoff of this trade from a historical perspective. It highlights how the level of losses at which the trade starts losing money is now considerably higher than it was for example 3 months ago.

Chart 4: Trade Payoff: Ratio x Short prot. 30-100%, long prot. 15-30%



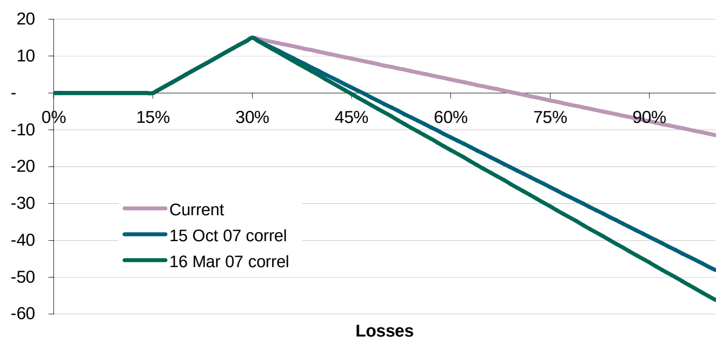
Source: BNP Paribas

For illustration purposes, chart based on 15mn of 15-30%.

We can easily show that the threshold at which we start losing money is indeed 1- R*. Therefore, high break-even loss rates will be strictly equivalent to a low Critical Recovery Rate. The more the break-even rate (1-R*) decreases, the smaller the long protection leg in the 15-30% tranche, the greater the carry: for example, for a break-even of 45%, the carry of a position involving USD100mn in the 30-100% and 14mn in the 15-30% is 384,000 per annum.

Further, to show to what extent the current levels of correlation are responsible for this market dislocation, we price the same trade at former levels of correlation, for example 5 months ago and a year ago. Again, Chart 5 highlights how in this case, the loss at which the trade would start losing money is considerably higher today.

Chart 5: Trade Payoff: Ratio x Short prot. 30-100%, long prot. 15-30%



Source: BNP Paribas

Zero cost trade: Sensitivity analysis

The most popular trade combining long risk in the super senior vs. short the junior super senior tranches is likely to be the zero cost trade. Despite leaving the investor net long risk, this strategy is overall an acceptable balance compared to alternative combinations that are either carry negative or carry positive but significantly longer risk.

At the outset the key features of the carry neutral trade (fully displayed in Table 2) are:

- Locally gamma positive: The trade is gamma positive when all spreads widen by 10%. However, a substantial spread widening would make the trade gamma negative. It is also gamma positive from an idiosyncratic perspective when the tightest name widens by 500bp.
- Negative correlation sensitivity: Both legs of the trade are negatively exposed to a parallel bump in correlation (+1%).
- Negative recovery sensitivity: The super senior tranche is negatively affected by a drop in recovery, while the effect on the 15-30% is negligible.

Table 2: Sensitivities of carry neutral trade (*)

	Buy Prot. 15-30%	Sell prot. 30-100%	Net[1]
Notionals	-64,773,000	100,000,000	33,530,000
Annual Carry	-571,000	571,000	0
Gamma[2]	378,000	-264,000	114,000
i-gamma[3]	138,000	-53,000	85,000
Correl sensi (+1%)	-8,000	-54,000	-62,000
Recovery sensi (-5%)	21	-8,000	-8,000

Source: BNP Paribas [1] 30-100% equivalent. [2] Calculated as change in PVs when spreads widen by 10%.
[3] Calculated as change in PVs when the tightest name widens by 500bp.
(*) Data as of 1 April. Pricing and sensitivities calculated with stochastic recovery.

We mentioned at the outset of the piece that the main rationale of the strategy is the normalisation of the correlation curve. To elaborate on this point, we evaluate the performance of the trade (as described in Table 2) over the next six months assuming the normalisation of the base correlation and under three spread scenarios: spreads tighter by 10%, unchanged and wider by 150%. Results in terms of PV changes are summarised in Table 3.

Table 3: Scenario results

	Correl ↓ Spds x 90%	Correl ↓ Spds unchanged	Correl ↓ Spds x 150%
Trade P&L	330,000	466,000	1,262,000

Source: BNP Paribas

Appendix

We define $\Phi(L)$ as the probability that losses are equal or smaller than L (i.e. cumulative distribution function) and $\varphi(L)$ as the loss density function. We have the well know properties that $\Phi(1)=1$ and $\Phi^{'}(L)=\varphi(L)>0$.

We can then define the expected loss of the tranche [0,K] as the sum of the two terms:

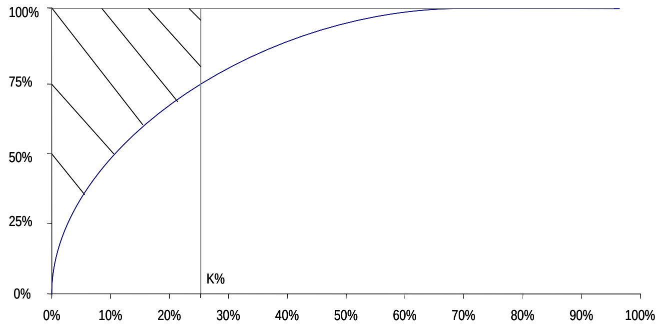
- the probability that the losses L are equal or smaller than K times the corresponding loss L, plus
- the probability that the losses exceed K times the corresponding loss of the tranche, K.

EL [0,K] = $\int_0^K \varphi(L)LdL + \Pr ob(L>K)K$

= $\left[\Phi(L)L\right]_0^K - \int_0^K \Phi(L)dL + K(1-\Phi(K)) = \int_0^K (1-\Phi(L))dL$

Therefore, as we draw the graph of the cumulative loss function $\Phi(L)$, we can identify EL[0,K] as the shaded area above the function, given that $\int_0^K \Phi(L)dL$ is the area below the line.

Chart 6: $\Phi(L)$



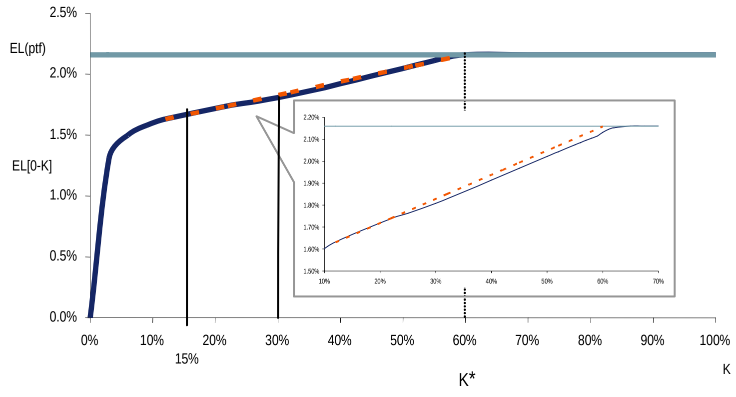
Source: BNP Paribas

We can then also derive the graph of the expected loss function.

f(K) = EL[0,K] = K- $\int_0^K \Phi(L)dL = \int_0^K (1-\Phi(L))dL$

As K is comprised between 0 and 1, f(K) must also be comprised between these boundaries. The expected loss function must be positively sloped as f'(K)= 1-$\Phi(K)>0$ and concave as f'' (K) = -φ(K)<0. The graph of the expected loss is displayed in Chart 7.

Chart 7: Expected loss function



Source: BNP Paribas

Setting the second derivative of f(K) equal to 0 implies that $\varphi = 0$. Thus, there is no density of loss between K and K*, i.e. if losses reach K, they reach K*.

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