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QUANTITATIVE CREDIT

STRATEGY & ANALYSIS

Credit Derivatives

EUROPE

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CPDOs

The new best seller?

- **CPDOs' combination of high coupons and high ratings should ensure popularity**
- **Mark-to-market losses can be severe; structure looks much better when held to maturity**
- **Roll to new indices helps mitigate default and downgrade risk, but can move the markets**
- **Due to high leverage, issuance is likely to have significant effect on spreads, index skew and cash-CDS basis**

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Contents

Introduction.....	3
Why it works Dynamic leverage or something more?.....	5
Sensitivity Analysis	7
Market Impact.....	11
Conclusion	14

Introduction

While credit markets have been rallying significantly for the last two months, market participants have been trying to understand the main drivers behind the scenes. The usual suspects include investors selling protection on equity tranches, and widespread covering of shorts by real money. What seems to be the hottest topic, though, is the latest innovation in the credit derivatives market. It is called a Constant Proportion Debt Obligation (CPDO) and it adds one more acronym to the list of innovative structured credit products.

CPDOs have received the interest not only from credit structured products desks but also from equity derivatives desks who are asking for their impact on credit spreads and whether they are behind the recent fall in short-dated equity volatility.

Offering a AAA rating on both the coupon and the principal and a very attractive spread of 200bp above Libor, the CPDO product seems to have appealed not only to investors in search of yield, but also to new classes of investors for whom the rating is important due to Basel II regulatory capital requirements. A rated coupon and principal – plus, of course, the high level of those coupons – are likely to make the structure attractive also to retail investors.

CPDOs can be seen as variants of Credit Constant Proportion Portfolio Insurance (CPPI) products where the reference portfolio is a credit portfolio that can vary in size depending on its Net Asset Value (NAV). Unlike the Credit CPPI, though, which offers principal protection, CPDOs offer a rated fixed coupon but no principal protection and the leverage mechanism is different. If the trading strategy followed by the Credit CPPI performs well in terms of having a positive Mark-to-Market (P&L) the leverage increases so that it can benefit from increased returns, whereas if spreads widen and the strategy underperforms leverage decreases. In a CPDO the leverage control works the opposite way: increasing if spreads widen (and the structure has lost money) and decreasing if the structure outperforms.

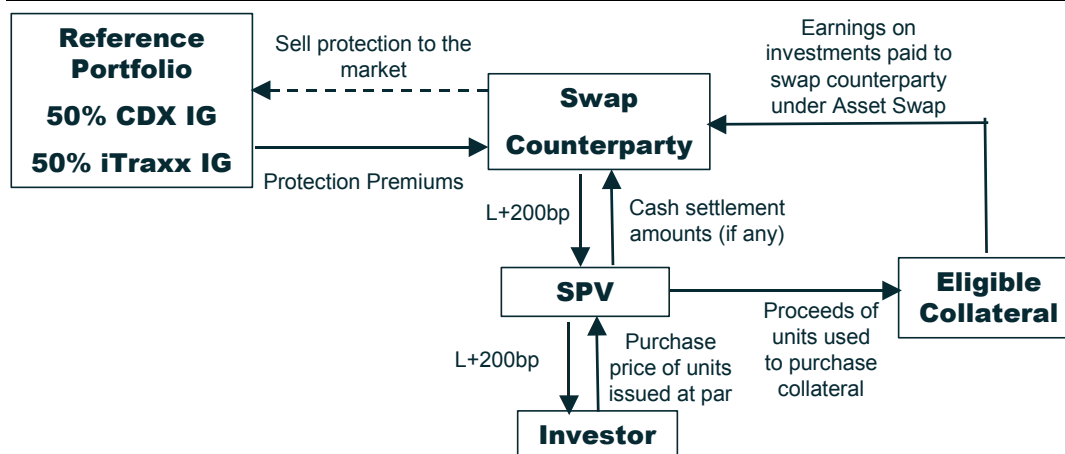
In being rated for both coupon and principal CPDOs share one of the advantages of a CDO, but with the added benefit that the CPDO does not suffer from direct price exposure to correlation as the CDO tranches do. Having experienced the lesson from May '05, investors are much more wary of sudden changes in correlation and the impact of this volatility on the various tranches. Hence, the absence of correlation from the CPDO structure makes it immune to correlation changes and thus leaves its value unaffected.

In this note we argue that CPDOs are set to become an attractive alternative to other structured products (such as the credit CPPI, and leveraged super senior, mezzanine and equity tranches) that have been popular with credit investors. We further argue that the structure – at least on a hold to maturity basis - is robust and resilient to the majority of spread widening scenarios, with blow-ups in spreads/many defaults failing to force the structure into a forced unwind especially if they occur early in its life. Finally, we examine the effect that CPDOs are likely to have in the movement of credit spreads, the skew of the indices, the cash-CDS basis, tranches and index rolls.

In their basic structure, CPDOs resemble static funded synthetic CDO. The products offer a high (AAA) rated coupon and rated principal on the basis of a rule-based levered strategy. In contrast with credit CPPI, the principal is not protected and hence no part of the notional is allocated to a cash reserve account or a high-quality zero-coupon bond. Instead, the investor's notional is levered up by a leverage factor and then invested by the SPV into a set of eligible investments. The returns of the assets are transferred to the issuing bank in the form of an asset swap. The bank then sells protection to the credit market on a portfolio comprising normally 50% iTraxx Europe Investment Grade (IG) and 50% CDX IG for which it receives premia. In return it pays a spread (around L + 200bp when the product was first launched) to the SPV to pay back to the investor.

The reference portfolio is then rebalanced every six months when the credit indices roll to the new series of most liquid names in the market. This adds to the resilience of the structure (and especially so in the rating agencies' models) because it helps mitigate the risk of default and/or severe downgrade of any of the names in a given series.

Figure 1. A CPDO Structure diagram



Source: Citigroup

The bank uses the dynamic leverage control feature of the structure to subsequently buy or sell protection according to a trading rule in order to enable the strategy to generate the coupon and principal for the investors. An important restriction is a maximum leverage multiple, beyond which, the bank can no longer sell further protection to the market. This feature is obviously designed to cap the risk in the structure.

The ratings for these transactions are obtained using the rating agency models such as S&P's CDO Evaluator, Moody's CDOROM and Fitch's VECTOR. The main inputs to these models are the probabilities of default of each asset in the credit portfolio, recovery rates and asset correlations. From these inputs the models generate default times and the associated loss amounts for the assets and the portfolio. The second stage is then to simulate the interest rate and spread processes. Combining the two stages, for each simulation they are able to obtain the Mark-to-Market Gain or Loss and the Cash-In/Cash-Out times that indicate whether the actual generated cash flows are higher or lower than the promised contractual cash flows. At the end, the distribution of possible values is used to determine whether the proportion of simulations which generate lower cash flows than the promised ones (the "failed" simulations) relative to the total number of simulations is lower than the default probability threshold set by the default term structure of the rating agency at the maturity horizon (in this case 10 years).

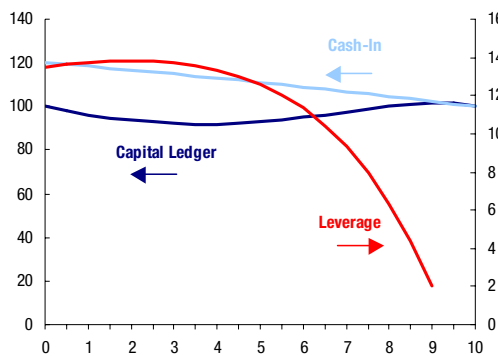
Why it works Dynamic leverage or something more?

The newly launched CPDO products offer an impressive 200bp above Libor (or Euribor if issued in Euros) on a AAA rated instrument. This return even if on a levered strategy is sufficient provoke the curiosity of even the most suspicious investor. One would, in principle, wonder how on earth a AAA-rated product can earn so much spread. We have even been joking that in this product a A-rated asset (the average rating of the iTraxx and CDX indices is A) is levered up by 15 times and then seems magically to turn into a AAA-rated asset paying 200bp! In fact, the ratings are not magical, but the explanation is not very simple either. At first we thought that the answer purely lies in the leverage mechanism. However, having investigated the cash flows of the structure further, we have surprisingly discovered a number of other factors that influence the performance of the strategy.

Nevertheless, the leverage control mechanism is an important factor and it's worth explaining how it works.

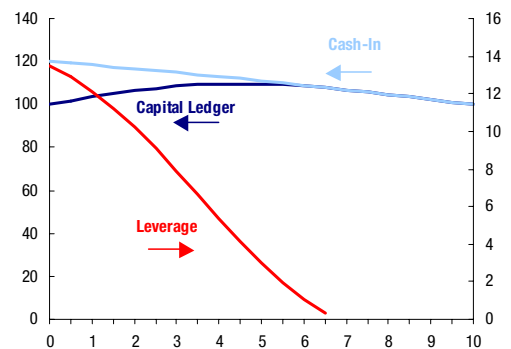
Although the precise trading rules are sometimes proprietary, the general principle is that leverage increases when the structure incurs losses to compensate for the decrease in the NAV (i.e. initial spread widening; Figure 2), whereas leverage goes down both when spreads widen enough and the accumulated carry outweighs the mark-to-market loss, and when spreads tighten (Figure 3) to benefit from the Mark-to-Market gain. However, much of the structure's behaviour depends on just how close the initial leverage is relative to the maximum.

Figure 2. Impact on leverage when spreads widen



Source: Citigroup.

Figure 3. Impact on leverage when spreads tighten



Source: Citigroup.

The leverage multiple is such that under the spread, coupon, and interest rate dynamics, the desired ratings for the coupon and the principal are achieved given the time horizon of the transaction. Tenors for these products are relatively long (about 10 years) thus giving sufficient time under most realistic spread scenarios to recover par by maturity or earlier “Cash-In”. The strategy cashes in if at any point prior to maturity the instrument builds up enough NAV to pay the PV of the remaining coupons and the principal. In this case the strategy would unwind and the money would be put in a deposit account earning Libor until maturity.

$$\text{Cash-In Barrier} = \text{PV Notional} + \text{NPV Coupons} + \text{NPV admin fees}$$

$$\text{Capital Ledger} = \text{NAV} = \text{Notional} + \text{Carry} + \text{MtM} - \text{admin fee} - \text{gap fee}$$

$$\text{Cash-In condition: } \text{NAV} > \text{Cash-In Barrier}$$

On the other hand, the strategy would Cash-Out if the NPV of how much the issuer makes in premia and fees adjusted by the Mark-to-Market falls below 10% of the notional.

If a strategy starts at maximum leverage, any spread widening will result in mark-to-market losses. The performance of the structure will depend on how much and how persistent the sell-off is, as well as how early or late it takes place. In most scenarios (see Sensitivity Analysis below), we find that the captured carry plus interest received from funding will be enough to outweigh the losses and therefore eventually to cash in, although there may be quite serious mark-to-market losses in the meantime and we have also constructed scenarios where the strategy cashes out. In addition, surprisingly enough, starting at a lower leverage does not make any significant difference to the final result. The reason is that normally when we widen spreads, the first time that we adjust the leverage factor, it increases to the maximum in any case.

There is one important point to emphasise about the rating of this structure. A corporate bond is given an A rating if upon simulation of defaults of the reference entity, the proportion of paths resulting in default out of all simulated paths is less than the probability of default for a given time horizon. It is therefore difficult to imagine how, by leveraging such an asset 15 times, the company would be able to achieve a AAA rating. The AAA rating of the CPDO structure however, is not simply a result of default scenarios. It is driven by a mixture of spread and interest rate dynamics, the total coupon paid to the investor, and more importantly, the trade-off between the carry and mark-to-market. As a result we argue that the achieved rating corresponds not just to default risk but also to spread risk, interest rate risk, and credit migration valuation risk.

The next section explores various scenarios of comparative static analysis by changing the parameters of the model and investigating the impact on the leverage multiple, the NAV, the distribution of value and the Cash-In and Cash-Out time distributions.

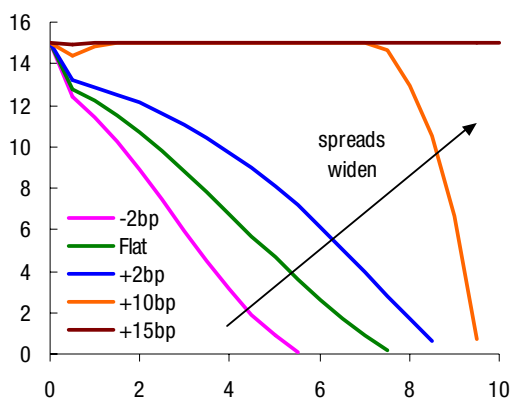
Sensitivity Analysis

Despite the relative simplicity of current structures, CPDOs seem to have significant potential to adapt to wide ranging market conditions. Again jokingly, we have started calling the product a “hydra”: almost every time we tried to kill it by subjecting it to severe stress, it seemed somehow to be able to recover par by maturity. There are, however, a number of scenarios (other than absurdly extreme amounts of spread widening and defaults) which the structure seems to struggle with. Below we consider how the interplay of both market factors and structure parameters affects the note’s final value, its rating and the probability of an early cash-in. As a base case, we considered a structure that pays L+200bp with spreads at 40bp and maximum leverage of 15.

What if spreads widen?

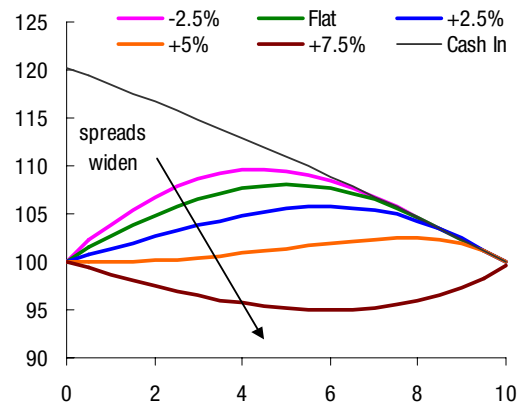
The CPDO structure seems to be extremely robust under numerous different scenarios for spreads. Generally, the structures re-levers when NAV goes down and de-levers in the opposite case. When spreads widen the notes lose value due to MTM losses but gain thereafter through an increase in carry. Fixed and monotonic spread widening increases mark-to-market losses thereby increasing leverage, but as the pick up in carry starts to outweigh it, the NAV goes up and leverage decreases. For more severe spread widening conditions the structure remains at maximum leverage for longer periods of time and may not have sufficient time to recover until maturity. Our base case structure was able to sustain 15bp widening semi-annually up to 340bp and still recover par after 10 years (Figure 4). Even for a more aggressive scenario, with spreads widening at a constant rate we were still able to breakeven using 7.5% sell off every 6 months (Figure 5).

Figure 4. Leverage of CPDO under various spread conditions (X bp widening every 6 months)



Source: Citigroup

Figure 5. Sample CPDO paths under various spread conditions (% widening every 6 months)



Source: Citigroup

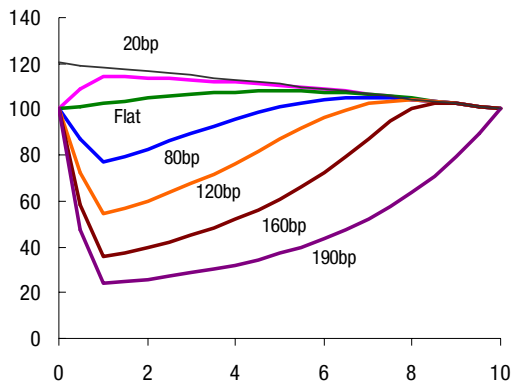
What spread shocks can be absorbed?

CPDO is an adaptive product. It re-adjusts itself to current conditions and assumes them to persist going forward. In this game of constant catch up, CPDOs are susceptible to sudden shocks that result in severe MTM losses. Most of the structures have a built-in knock out barrier at 10% of par, at which point the structure unwinds. This sudden death scenario imposes a limit on how much the structure can sustain. Our base case structure was able to cope with spreads widening up to 190bp occurring as a one-off jump at the end of 12 months, and yet still to cash in after 10 years assuming spreads remained the same thereafter (Figure 6). This is quite a lot more severe than any historical period of spread widening, which is usually short-lived in any case.

Does timing of these shocks matter?

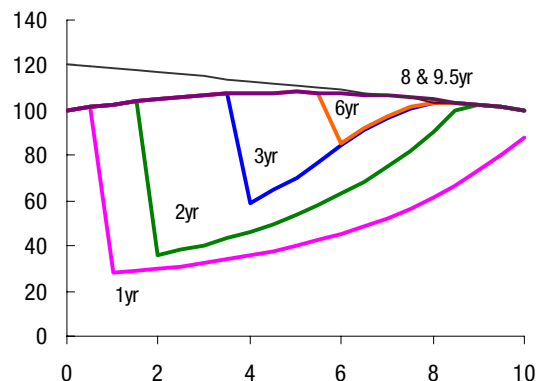
Most CPDOs start at a high leverage close to the maximum needed to recover the coupon. Losses at this stage will have higher impact and longer recovery due to capped leverage. Additionally, should the losses be significant enough they may escalate the situation such that the structure will knock out. Figure 7 demonstrates the effects of spreads quadrupling at various points in time during the life of the transaction. Shocks close to maturity have very little effect on NAV of the note. This is because the structure has de-levered significantly and has more room to re-lever dramatically to catch up fast.

Figure 6. Sample CPDO paths for a spread jump from 40bp to the levels shown after 12 months



Source: Citigroup

Figure 7. Sample CPDO paths for 4 times widening after 1-9.5 years



Source: Citigroup

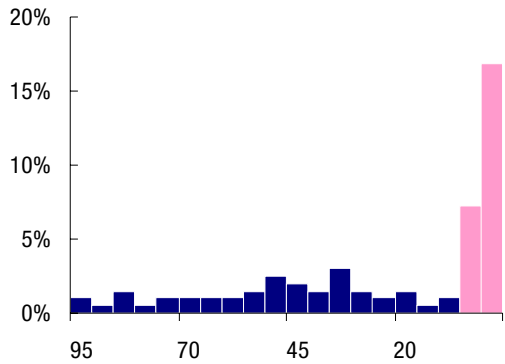
Risk of defaults?

Rating agencies require CPDOs to re-invest into “newly” minted indices at each roll. This is based on the assumption that investment grade names are highly unlikely to default in the next 6 months. Nevertheless, somewhere between four and five defaults are still assumed and this does not prevent the structure from achieving a AAA rating. The impact of defaults is similar to spread shocks, and results in an immediate MTM loss and needs re-levering to compensate. In the current low default environment it seems unlikely that the structure will be seriously impaired by a sudden surge in defaults. However, damage from spread contagion caused by an odd default or even a downgrade may be more significant.

Is spread volatility a significant factor?

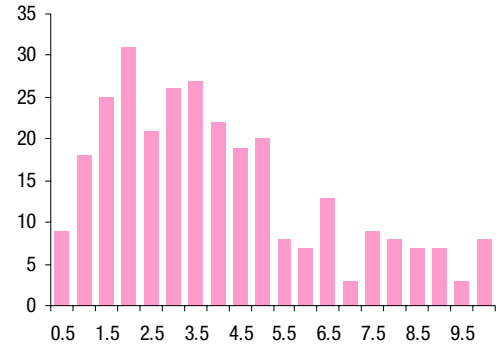
Changing conditions are not good news for CPDOs. Currently, rating agencies model spreads with 25% spread volatility. At higher volatility the structure will have a sharp increase in knock out scenarios (Figure 8). In these extreme conditions of repeat shocks the NAV spirals down and leverage reaches its maximum. As we argued earlier knockouts will be more likely earlier in the life of the transaction (Figure 9)

Figure 8. Final value distribution for a sample CPDO with a high volatility of credit spreads



Source: Citigroup

Figure 9. The distribution of cash out time for a sample CPDO with a high volatility of spreads



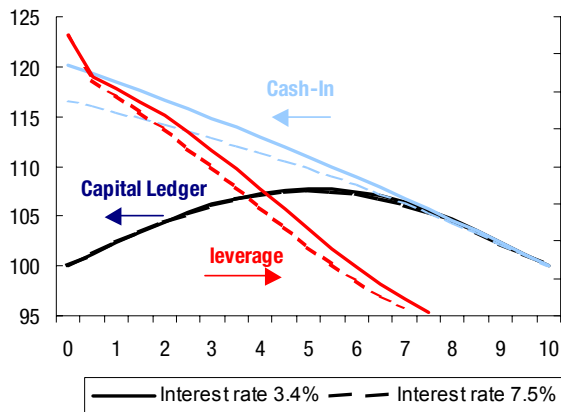
Source: Citigroup

How do interest rates fit in?

For a given level of spread that remains constant throughout the life of the trade, the impact of higher interest rates (again constant throughout) is almost negligible. Higher interest rates decrease the PV of the liabilities but they also decrease the NAV of the note. However, the impact on the NAV of the note is smaller because the increase in coupon payment is offset by the increase in the interest received on the funding. Hence, overall, the impact on the PV of liabilities is relatively larger and this allows the structure to deleverage and cash in slightly faster (Figure 10).

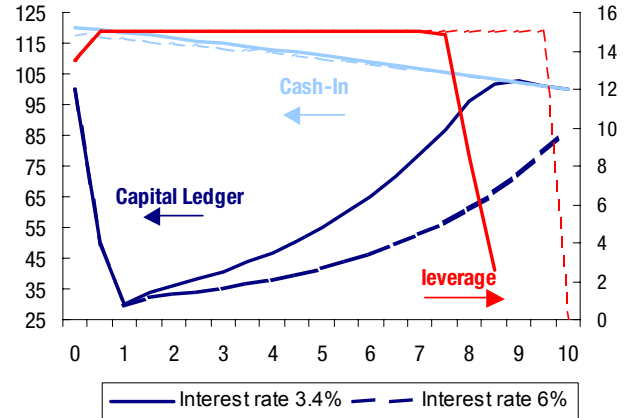
The result just mentioned depends heavily on the assumption that spreads remain constant through time at a given level. If spreads blow up (for example from 40bp jump to 120bp, then 180bp and back to 170bp for the rest of the time) early in the structure and remain at those high levels an increase in interest rates causes the structure to cash out (Figure 11). The reason is that the mark-to-market loss and the Libor that is paid as part of the coupon are so big that the carry and the amount of interest received are not sufficient to allow the structure to recover. In this scenario, we observe an increase in leverage for higher interest rates in an attempt to generate more income but unfortunately there is not enough time left or sufficient leverage to make a comeback.

Figure 10. Impact on leverage from increasing levels of interest rates (each level constant through time)



Source: Citigroup

Figure 11. Sharp increase in spreads will cause the structure to cash-out even for relatively moderate increases in interest rates

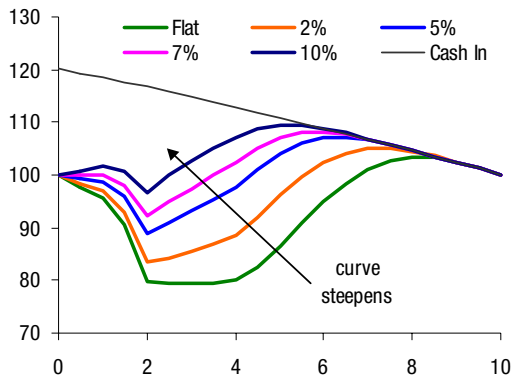


Source: Citigroup

Rollercoaster down the curve?

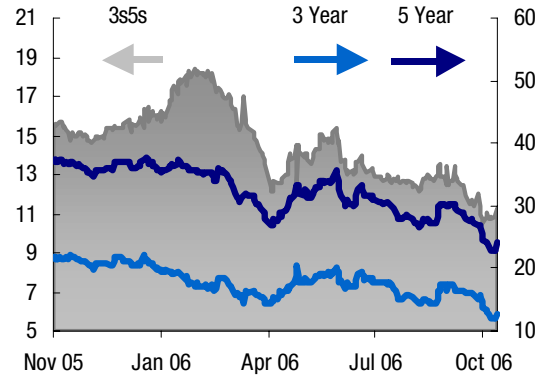
One of the key assumptions of the rating methodology is a significant return from rolling down the curve. Most investment grade credit curves are upward sloping. The value of index protection sold by the CPDO at issue will be worth less in 6 months when it will need to be bought back. Credit curves tend to be steeper in their shorter maturities and then flatten out between 5- and 10-years. This makes selling 5yr protection more attractive even though the majority of current structures have 10 year final maturities. In our simulations we found that return from time decay plays a significant role in counteracting potential spread widening (Figure 12). Currently, as part of their rating methodology S&P assume a 7% curve roll down. This, however, strongly relies on credit curves remaining steep. 3s5s credit curves have flattened significantly over the course of this year to a record low of 11bp (Figure 13). Further issuance of CPDOs may drive further flattening, making it ever more challenging for CPDO issuers to justify high ratings.

Figure 12. Sample CPDO paths for various assumptions of roll down the credit curve



Source: Citigroup

Figure 13. iTraxx 3s5s spread curve, iTraxx 3 and 5yr index spreads (basis points)



Source: Citigroup

Market Impact

Clearly CPDOs have quickly caught the attention of credit investors. After the roll, credit spreads - although already almost at record tights - nose-dived by more than 20%, surrendering 7bp of spread. While this was not just due to CPDOs, it is nevertheless clear that CPDO-related over-supply of index protection or mere pre-positioning has sent shockwaves across credit markets. Going forward, we continue to expect CPDOs to have an important effect on markets, in five key areas: spreads, index skew, the cash-CDS basis, tranches and index rolls. We look at each in more detail below.

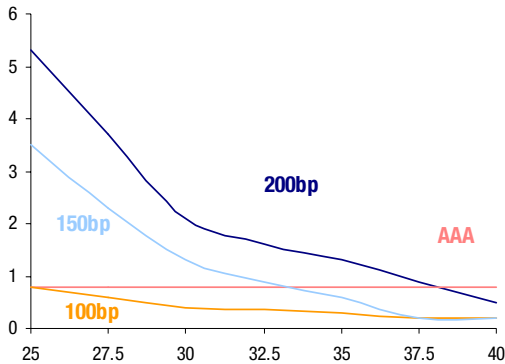
Spreads

CPDO structures are bound to push credit spreads down. All known structures involve selling significant amounts of protection for a highly limited number of assets (in fact: two only iTraxx and CDX IG) in a very short space of time. The high leverage built into CPDO structures means that even relatively modest issuance (when compared to CSOs) – which we estimate at \$1.5 – 2bn in notional terms thus far- will translate into almost \$30bn of index protection sold, causing significant pressure on spread levels. Although the effect so far amounts to less than \$50bn (the average amount of index protection notional changing hands daily), it may considerably change the expectations of the market participants bidding down the cost of protection.

As markets tighten new CPDO structures are less likely to sustain higher coupons and still preserve AAA ratings. With leverage capped, less carry means lower coupons. Indeed, when structures were initially marketed at 200bp spread over Libor average iTraxx/CDX index spreads were around 40bp. Now with combined spreads of around only 28bp, we estimate that issuers can only commit to around about 120 –130bp in order to preserve AAA ratings (Figure 14). In other words, spreads need re-widen to the levels 37-38bp for initial 200bp spread structures become viable again (Figure 15).

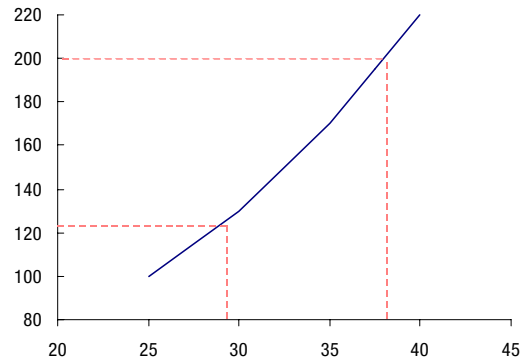
Once issued, CPDOs will act as a market stabilising force. This is contrary to CPPI, which utilises leverage to foster market bubbles and re-enforce any crash. CPDO structures will buy back protection after rallies and sell more protection should spreads widen. This will counteract the market and force spreads to mean-revert. Hence CPDOs, like CDOs, may act as a “backstop” – helping to prevent spreads from widening too much – but (contrary to some recent, rather wild speculation) they are unlikely drive spreads down to zero.

Figure 14. Loss probability (per cent) vs index spread at issuance (bp) for various levels of coupon spread (bp)



Source: Citigroup

Figure 15. Breakeven coupon spread (bp) for AAA structure vs index spread at issuance (bp)

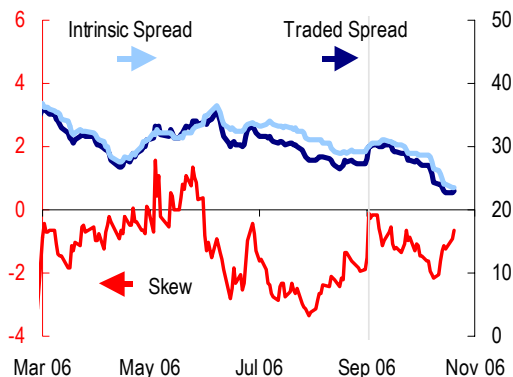


Source: Citigroup

Single Names and Index Skew

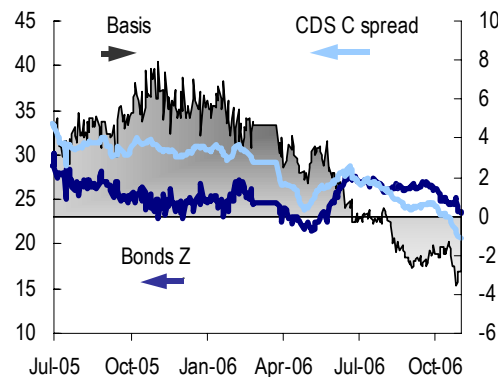
Plunging index spreads will have a technical pull on single name credits. One of the features of the current structure is that it invests in liquid investable indices, iTraxx IG and CDX IG. Credit indices are credit default products that reference a portfolio of 125 single name credits. By no arbitrage, the aggregate duration-weighted sum of spreads for all constituent names (the intrinsics) should closely replicate the index spread. In practice, the level of the traded index regularly trades away from the intrinsics due to a number of reasons – a difference known as the “skew”. Traditionally, one of the main reasons for skew to exist is the imbalance between demand and supply on the index and its constituents. Initially, CPDO issuance will create a significant oversupply of index protection pushing the skew down into negative territory. However, as soon as the skew reaches levels interesting for index arbitrageurs they will enter the market selling expensive single name protection and buying cheap index protection. This transmission mechanism will force most of the single name credits to rally in line with the index and keep the skew within the limits of the “no-arbitrage” zone. Indeed, as we show in Figure 16 as spreads rallied the skew initially widened to -2bp, but then had to come in as single names caught up.

Figure 16. iTraxx Europe, 5-year, Traded, Intrinsic and Skew (basis points)



Source: Markit, Citigroup

Figure 17. Average basis on Euro and Sterling Credit (basis points)



Source: Markit, iBoxx, Citigroup

Cash-CDS Basis

Continuing CPDO issuance is likely to have a knock-on effect on bond markets, sending aggregate bond spreads tighter. Single name CDS and bond markets are closely linked. Recently, the size of the basis - a difference between CDS and bond spreads – has been greatly influenced by the synthetic CDO issuance. Unlike CPDOs, these instruments sell protection on a variety of single name credits leaving bonds largely unaffected. This technical imbalance has pushed the normally positive basis down, into the negative territory (Figure 17). While in principle more CPDO issuance could send the basis down even further, we reckon it is unlikely as new basis traders come to the market. As index and single name CDS rally bonds will eventually follow.

Tranches

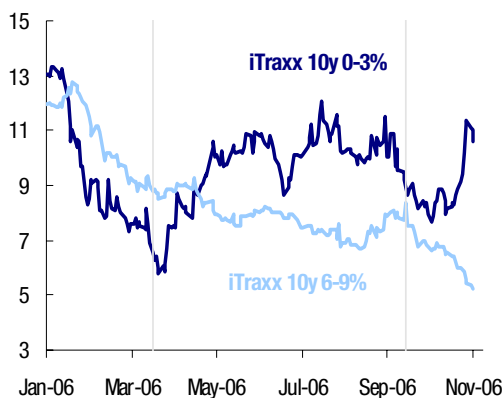
Tranche markets will also be affected by CPDO issuance, even though CPDOs themselves have no correlation component. Tighter spreads are likely to inject further confidence into the minds of equity investors, fuelling equity outperformance (Figure 18). Mezzanine tranches have already begun to cheapen up, as market participants speculate that they will eat into traditional mezzanine and AAA tranches’ market share, thanks to CPDOs’ higher yield and comparable ratings. Although some of this may happen, we would not expect to see a significant dent to the CSO market for a number of reasons. Firstly, it is the sheer size of the synthetic market. Creditflux reported a strong Q3 2006 for CSOs, with an equivalent of more than \$350bn of index notional has been issued. This is more than 10 times the size of CPDO issuance. Secondly, CSO structures are highly versatile and invest in a wide range of credit assets. CPDOs will become serious contenders should the universe of investable assets broaden up or trading strategies become more complex. Lastly, tranches as a correlation product explicitly attract their own investor base, while CPDOs are specifically marketed as “no correlation” structures.

Roll and Index Composition Changes

Index trading dynamics around the roll will be significantly affected by CPDO “rollover”. To manage the risk of early defaults most of the structures are required to roll their entire positions every six months. This creates a situation at which all CPDO vehicles may attempt to buy back and sell index protection at a very short and predetermined point in time. Most market participants will pre-position for this event pushing the spread on old indices wider. Currently, the rating agencies have built in a 2bp two-way transaction cost. However, these technical flows and potential liquidity gaps may result in a larger MTM loss for CPDO note holders than is otherwise expected.

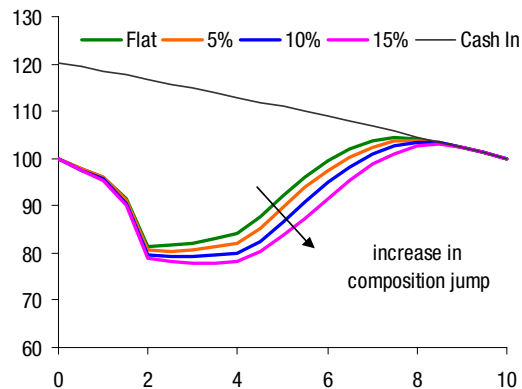
Change of composition is another downside factor that plays into the roll dynamics. By construction, “blown up” or downgraded credits are removed from the new basket and replaced with “average” spread names. As the result the new basket tends to be less risky and have less carry. For CPDOs that means that when spreads widen idiosyncratically the MTM losses on the old series may not be fully compensated for by the increased carry on the new series. For example, the GM and Ford downgrade has resulted in large MTM losses in CDX4. These names were subsequently removed from CDX5 and it was issued at a lower spread. Although clearly a factor, we found this “loss of carry” to have a relatively weak influence on CPDO final value unless happening under extreme conditions (Figure 19).

Figure 18. 10yr iTraxx Relative Base Correlations (per cent)



Source: Citigroup

Figure 19. CPDO NAV sample paths for various sizes of composition change at the roll.



Source: Citigroup

Conclusion

We believe CPDOs are here to stay for a good while. The product has a complex structure, with much interplay between the various parameters. Many investors may understandably feel uneasy going so long, given where we are currently on the credit cycle, with the extended rally of recent years at risk of reversal over the next few. Time-wise, one might think that getting into a structure that increases leverage when spreads widen and losses occur is not so wise at the present part of the cycle. Nonetheless, our sensitivity analysis has shown that breaking the structure is not an easy job and that, although not necessarily unrealistic, it takes a few things to go wrong and a lot of spread volatility to kill it. As such, one of the major drivers of its success or otherwise is likely to be the number of investors who find ways of holding it without needing to mark to market.

Another fear is whether the AAA rating on both the coupon and the principal will still be able to be maintained while still paying a mouth-watering 200bp coupon. In fact, there are some signs that rating agencies are already backtracking on their AAA – perhaps because the mere presence of so many rule-based structures in the market will create a strong incentive for other market participants to lean on spreads and create forced unwinding later in the cycle. If this is the case, it is likely to impact the demand for this product, especially for investors for whom the high rating is crucial.

Current fears about the impact of the product on credit spreads and demand for tranches are perhaps slightly exaggerated. The leverage control mechanism of the structure works in an opposite way to credit CPPI, which is to say that the structure unwinds when spreads tighten by buying protection and thus not squeezing spreads further as CPPI would. Likewise, when spreads widen, the structure leverages more, which translates to selling protection and thus pushing spreads down. Overall, if anything, the product is therefore likely to have a stabilising effect on credit spreads.

Last but not least, looking forward, we expect the structure to reference a more diversified portfolio than that of the two investment grade indexes and to expand into more bespoke portfolios. To add to the complexity and the sophistication of the transaction, issuers will also look into more exotic trading strategies that extend beyond current rule-based ones. One way or another, we had better get used to CPDOs and their effect on the markets.

Disclosure Appendix A1

ANALYST CERTIFICATION

We, Panayiotis Teklos, Michael Sandigursky, and Matt King, hereby certify that all of the views expressed in this report accurately reflect our personal views about any and all of the subject securities, issuers, currencies, commodities, futures, options, economies or strategies. We also certify that no part of our compensation was, is, or will be directly or indirectly related to the specific recommendation(s) or view(s) expressed in this report.

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