Santander

All you need is hybrids

Interest in hybrid products is growing. They yield substantial benefits to end-users, allowing for a better tailoring of risks to their specific needs and appetites. Pedro Franco explores the challenges in hybrid products modelling and trading

Although payoffs from hybrid products can seem straightforward, behind the scenes they can be quite complex. First, sophisticated models are required to value them properly. Second, traders face many technical and practical problems when managing them. Finally, complex systems and procedures have to be put in place to properly capture these deals. This article expands on the first two points, presents a practical case – a cross-currency swap contingent credit default swap (CCS-CCDS) – and explores the future of the CCDS range of products.

Modelling

Hybrid models are usually built up by combining tried-and-tested single-asset models and introducing correlation between their risk factors. Although some cross-gamma is captured by static models – due to the non-linearity of these models – a large portion of the cross-gamma from a hybrid can come from the effect of the correlation among different asset classes. Introducing correlation between the risk factors increases the modelling complexity greatly.

First, the calibration has to be nested, to take into account the influence of some models on the others. The interest rate models – in the case that there is more than one – can be calibrated independently, while the rest of the models are dependent on them.

Second, well-known analytical expressions for the calibration of vanillas are no longer valid. At best, these analytical expressions have to be reworked to include various quanto adjustments; at worst, analytical expressions for the vanillas in the hybrid model no longer exist.

Finally, because of the large number of stochastic factors involved – at least one for each asset class – the valuation of a hybrid product is usually computationally intensive. This problem is further compounded when computing the Greeks of a product, especially since there are so many parameters in a hybrid model.

Trading

Technically, a calibrated hybrid model gives the trader the value of the deal, together with a hedging strategy that allows the trader to realise this value. However, the model assumes that correlation is constant, or time-dependent, and known a priori. If the trader rebalances the hedge according to the model, trading results would depend on the 'realised' correlation. This uncertainty could be reduced, should a liquid hedge for this correlation exist, which is rarely the case.

Bid offer spread introduces friction in the hedging process. Due to the dynamic nature of cross-sensitivities, a move in one asset can lead the trader to rebalance the hedge in all the other assets. The result is that the trader is usually forced to rebalance the hedge frequently. This can turn out to be especially costly when the hybrid product spans less liquid asset classes, for instance, a credit hybrid where the CDS name is illiquid.

Finally, banks are confronted with an organisational problem. Most banks' desks are organised by asset classes, and hybrid products do not fit into this structure well. Furthermore, it is not easy to adapt trading systems to multi-asset-class products, especially those with many legacy decisions behind them. This gives a competitive advantage to the more agile banks.

CCS-CCDS

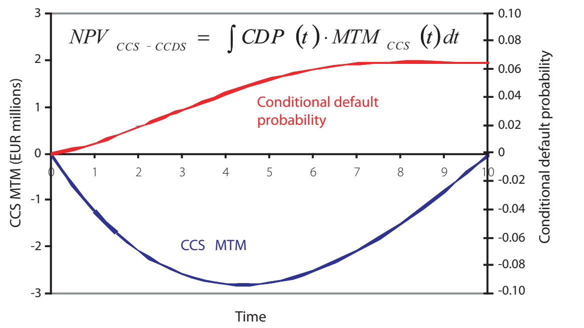
This section introduces a hybrid product, the CCS-CCDS, and illustrates its behaviour under different market conditions. A CCS-CCDS is a contract that pays the mark-to-market of a particular CCS if a credit event occurs with respect to a given reference entity. Some applications of this product would include: a corporate client adding a CCS-CCDS to a vanilla CCS receives better conditions – for example a higher coupon on the receiving leg – at the cost of extinguishing the rights and obligations of the deal in a credit event, a bank can hedge its counterparty risk in a CCS transaction by entering into a CCS-CCDS.

Table A shows the CCS-CCDS deal that will be used to illustrate this product, together with the CDS spread prices for the reference credit. A straightforward way to value this product would be to assume all markets are deterministic. Under this assumption, the

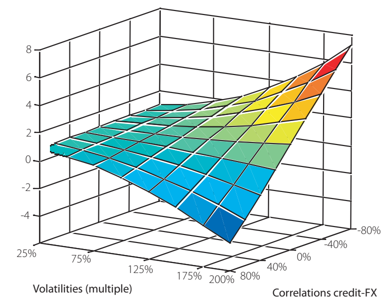
A. CCS-CCDS term sheet and reference entity CDS spreads

CCS-CCDS term sheet	CDS spreads XWZ Corporation
Trade date: June 6 2006	
Termination date: June 6 2016	1 year: 45bps
EUR Notional: EUR 100 million Semiannual amortisation: 5 million	2 years: 80bps
USD Notional: USD 128 million Semiannual amortisation: 6.4 million	3 years: 115 bps
Client receives EUR 3.97344% semi-annually ACT/360	5 years: 200bps
Santander receives USD 5.50% semi-annually ACT/360	7 years: 265 bps
Reference entity: XWZ Corporation	10 years: 335 bps

1 Valuation of the CCS-CCDS in a deterministic framework



3 Value of the CCS-CCDS with different FX-credit correlation and market volatilities



value of the CCS-CCDS could be computed by first obtaining the mark-to-market of the CCS using the forward curves and then weighting this MTM by the probability of default for the reference entity. This process is shown in figure 1. The value arrived at for the CCS-CCDS following this procedure is about €1 million.

Adding correlation implies building a four-asset stochastic model. Calibration can be performed sequentially, as shown in figure 2. Interest rate models are calibrated independently (steps 1 and 2 in figure 2). The next step is to calibrate the FX model. As an illustration, if the model chosen for the FX is a Geometric Brownian Motion, the prices of vanilla FX call options are given by:

$$C(t) = X(t)B_2(t,T)P_t^{B_2(\cdot,T)}\left[\frac{B_1(T,T)}{B_2(T,T)X(T)} \le \frac{1}{K}\right] - KB_1(t,T)P_t^{B_1(\cdot,T)}\left[\frac{B_2(T,T)X(T)}{B_1(T,T)} \ge K\right]$$

where $X(t)$ is the FX spot rate, K is the option strike, T is the exercise date of the option and $B_1(t,T)$ and $B_2(t,T)$ are the zero-coupon bonds in currencies 1 and 2. If the volatility of $B_1(t,T)/B_2(t,T)\,X(t)$ is deterministic –only some combinations of model have this property – this equation simplifies to Black's formula with volatility:

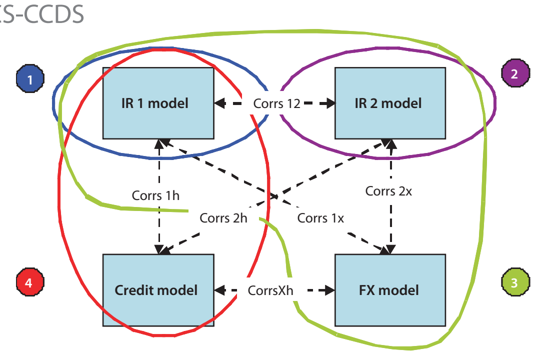
$$\sqrt{\frac{\int_t^T \sigma_{\frac{B_1(\cdot,T)}{B_2(\cdot,T)X(\cdot)}}(s)^2\,ds}{T-t}}$$

This volatility includes convexity and correlation correction terms from the two interest rate models in addition to the FX model volatility. If Black's formula were not valid, the prices of vanilla FX options would have to be computed with numerical methods that could handle several risk factors.

The last step (step 4 in figure 2) is the calibration of the credit model. This model is linked to the IR model in the base currency (IR 1 in figure 2). Similar calibration issues arise here.

Figure 3 shows the value of the CCS-CCDS as a function of the volatilities – expressed as a multiple of the level of market volatilities at the time of writing – and the correlations between the FX and credit factors. For low volatilities, the value of the CCS-CCDS converges to the value obtained within a static framework –around €1 million. The joint effect of correlation and volatility can be significant: it could turn the value of the CCS-CCDS negative, even though average CCS MTM is negative (see figure 1, noting that the average CCS MTM does not change with FX-credit correlations).

2 Calibration of a four-asset class hybrid model for the CCS-CCDS



Future applications of the CCDS product range

A market for CCDS is rapidly developing. This market is making the valuation of CCDS products more transparent. Traders are using these instruments to hedge the correlation exposure in their books, making the hedging of these types of hybrids more efficient.

Basel II will increase the incentives for banks to actively manage their credit lines. Banks can use CCDS products, selling this risk, to free up their counterparty lines. They can start with their vanilla business like swaps and CCS, but also in commodities and FX where large exposures have already built up. Later, they can use CCDS technology products on more exotic items. The development of this technology is creating a barrier to entry into the derivatives business for those banks lacking the technology to manage the contingent exposure.

Protection-buying banks can package this risk in bonds linked to CCDS. A further step would be to use securitisation techniques to give rise to products such as nth-to-default CCDS. Possible buyers for this risk include hedge funds, insurance or reinsurance companies and institutional investors.

Conclusion

Hybrid products are taking off, as the benefits to the end-users of these products are enormous. Offering these products requires a large investment in models, trading capacity and systems. Santander has been investing heavily in the capacity to offer these products. ■

Santander

Miguel Adroher Biosca
T. +(34) 91 257 2043
E. miadroher@gruposantander.com

Pedro Díaz Montañés
T. +(34) 91 257 2041
E. pediaz@gruposantander.com

Pedro Franco Ugidos
T. +(34) 91 257 2044
E. pefranco@gruposantander.com

Francisco Galiana Guiu
T. +(34) 91 257 2097
E. fgaliana@gruposantander.com

Alfonso García Alonso
T. +(34) 91 289 2035
E. alfongarcia@gruposantander.com