BARCLAYS CAPITAL

RESEARCH

CDS Curve Trading Handbook 2008

Quantitative Credit Strategy

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Straight talk on curves

Curve trading, like many aspects of the credit derivatives market, has grown dramatically in the past few years. Most users of credit default swaps have curve exposures in their portfolios, even if they do not trade curves explicitly. Curves also represent an important source of alpha for a varied and growing part of the credit investor base.

This handbook is designed as a comprehensive introduction to curve trading and risk management. It comes at an interesting juncture in the credit market, as the subprime fallout continues to fuel the most significant volatility since the 2002 period. Although macro-positioning and risk-reduction are the focus for investors in times like this, curve effects can be dramatic and related opportunities potentially rewarding.

What factors are driving curves in these changing market conditions? One dominating effect has been the unwind of large portfolios of steepeners. This has led to considerable flattening in curves. Steepeners became unattractive once volatility hit, due to convexity, and due to a fundamental shift in default-timing expectations. In some sectors – global financials and US homebuilders in particular – distressed flattening behaviour is evident, reflecting serious concern in those names. It is the first time since 2002 that we have seen such widespread bear-flattening effects. Lastly, technical pressure from synthetic CDO hedging activity is much diminished, although it is difficult to establish the net effect of this change on curves. This technical was a driver of curve shapes and tight spreads in the first half of this year and it may be sometime before activity in the market leads to significant flows again.

This handbook covers topics from the basics of curve shapes and behaviour to frameworks for analysing and identifying trades. The core comprises new material and analysis, together with previous articles written by Barclays Capital's Credit Strategy teams; the emphasis is on carefully selected examples of curve trades in practice – successful and unsuccessful. The result is a thorough treatment, detailing not only the reasons to implement a curve trade but also how best to execute based on various motivations.

Quantitative Credit Strategy

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Trade ideas used in this guidebook

Previously published trade ideas from Barclays Capital's Quantitative Credit Strategy and US Credit Strategy teams are used as examples throughout this guidebook. Many ideas have been collaborative efforts with the Barclays Capital US and European fundamental credit research teams.

We have included them in this handbook to illustrate applications, concepts and market dynamics discussed in the respective chapters of the book. Each trade idea is presented as a boxed example, with a link to the original publication. We review the motivation for the trade at the time of original publication, the recommended trade format, and a short analysis of how the trade performed. As with any investment strategy, we caution that past performance may not be indicative of future returns.

A full index of Quantitative Credit Strategy and US Credit Strategy curve trade ideas is presented in the Index of Publications at the end of the guidebook, covering all trades published since October 2006 (when we began single-name ideas in this format). Much of the material in this guide has been put together as a result of our collective experience monitoring the performance of trades we recommend. The trade ideas selected in various chapters of this guidebook are selected for relevance to the topic, or as an illustration various applications of these trades. We have intentionally selected a balance of trades that played out as expected as well as those that behaved differently from our forecasts and underperformed. Indeed, many of the trades that underperformed are the most interesting to study in terms of improving understanding of curve behaviour.

Note that other, non-boxed, examples (such as sections labelled Case Study) are hypothetical examples that were not necessarily recommended as trades at the time, but help illustrate effects described.

A detailed description of our trade idea selection process is given in Quantitative trade selection process, page 129.

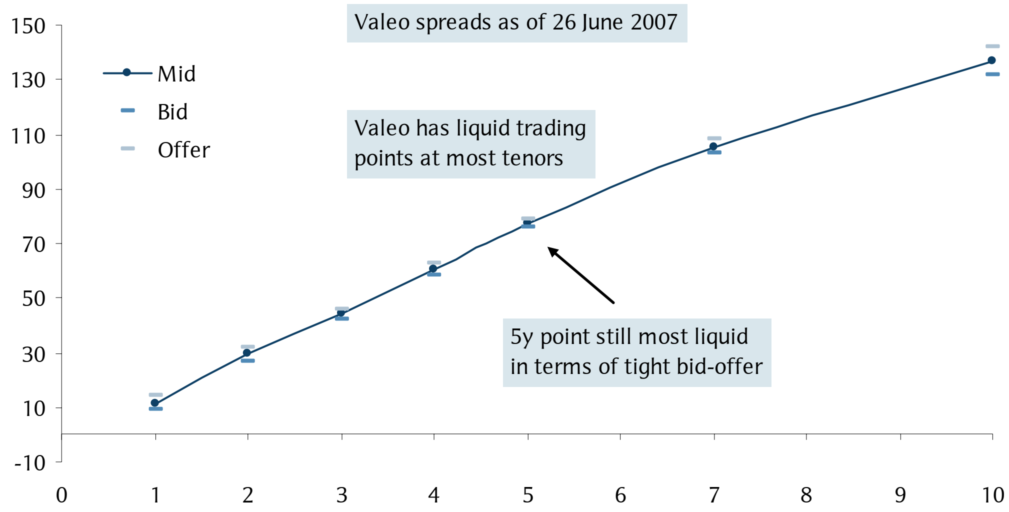
Trade idea examples

Overview of curve trading

Trading CDS curves

Liquidity has grown dramatically in the credit default swap market over the past few years in tenors other than the 5 yr point. Trades can now be constructed involving any combination of the liquid tenors. This is true of both the European and US markets. Currently, liquidity on high-grade names is still better than in HY issuers, but this is also gradually changing.

Figure 1: CDS can be traded across the term structure on many names



Source: Barclays Capital

Curves provide an amazingly rich asset class, with many applications. Some of the typical reasons and advantages in trading curves are summarised in Figure 2. Naturally, much of this handbook is dedicated to elaborating on these ideas, and direct links are provided from each box.

Figure 2: Potential advantages of CDS curve trades

New source of alpha – Take views on changing curve shapes See A bearish steepener: Continental, p.8	**Low beta to market:** Curve trades can be constructed with low market risk See Aligning signals: Fiat flattener, p.130.	**Optionality** – Certain curve trades demonstrate option-like payoffs that can be exploited See Attractive "optionality": Valeo butterfly, 20 Apr 2007, p.12
Implement directional credit views – using the most efficient point on the curve See Optimal execution of a long-credit view: SAS flattener, p.11	**Why trade CDS curves?**	**Risk-reward profile** – Curve trades offer many varied risk-reward profiles See Curve trades as volatility plays: TUI flattener, p.62
Hedging – Using the full CDS term structure can lead to more accurate and efficient hedging of credit risk	**More inefficiencies** – Curves are less well analysed, offering opportunities to trade See Slope model framework, p.120	**Capital efficient trading** – For certain investors curve trades can be very capital efficient – especially when default neutral See Capital treatment: Leveraging curve trades page 69

Source: Barclays Capital

The remainder of this chapter is focused on various trade examples which illustrate some of the ideas introduced in Figure 2.

Expressing a bearish view

Often, curve trades provide an interesting alternative way of expressing a fundamental view. In this example, a steepener allows a way of expressing a negative view on the company with a small positive carry.

A bearish steepener: Continental

See *Quantitative trade ideas: CONTI 5s10s steepener*, 04 December 2006.

Trade rationale: In our view, a 5s10s curve steepener trade appeared attractive on Continental based on a number of factors. The fundamental view was for continued LBO risk with the potential for curve steepening on market speculation or company announcements. Additionally, our Quantitative Slope model (see Slope model framework, p. 120) flagged the CONTI 5s10s as too flat on the basis of comparing its curve (on a percentage basis to the 5 yr spread) to its own trading history and to its peers. This is illustrated in Figure 3 where we plot the six month 5s10s percentage-slope range as a vertical bar and the current level as a horizontal bar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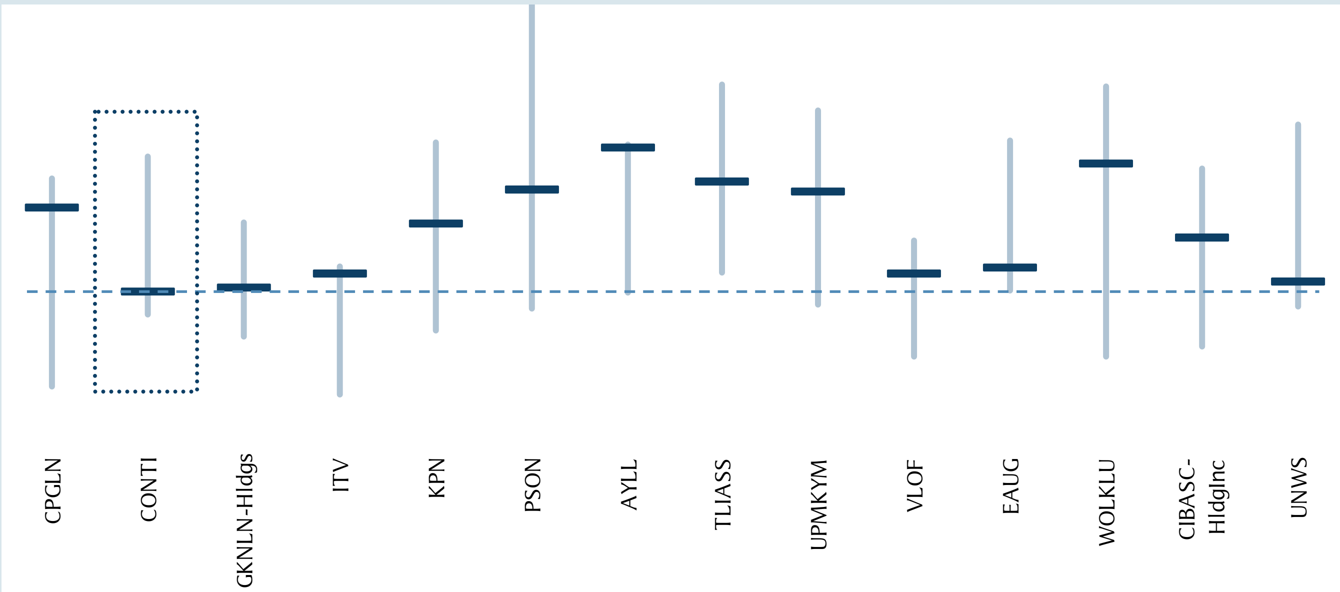
4 December 2006
Quantitative Trade Ideas – CONTI 5s10s Steepener
Figure 1: CONTI market data and model signals
Figure 2: Approximate trade metrics

Figure 3: Continental curve: Flat compared with historical levels and peers



Source: Markit, Barclays Capital

Trade format: 5s10s DV01-neutral steepener, Sell €17mn 5 yr CONTI protection, buy €10mn 10 yr protection.

Trade evaluation: The curve steepened substantially over the following months, from around 34 bp to 40 bp plus, on various news flow.

Expressing a bullish view

Curves also present an alternative format for expressing a bullish view on a company. In this example, the curve trade had potentially greater upside than the pure direction trade, in our view at the time.

Implementing a bullish view: AmerisourceBergen (ABC) flattener

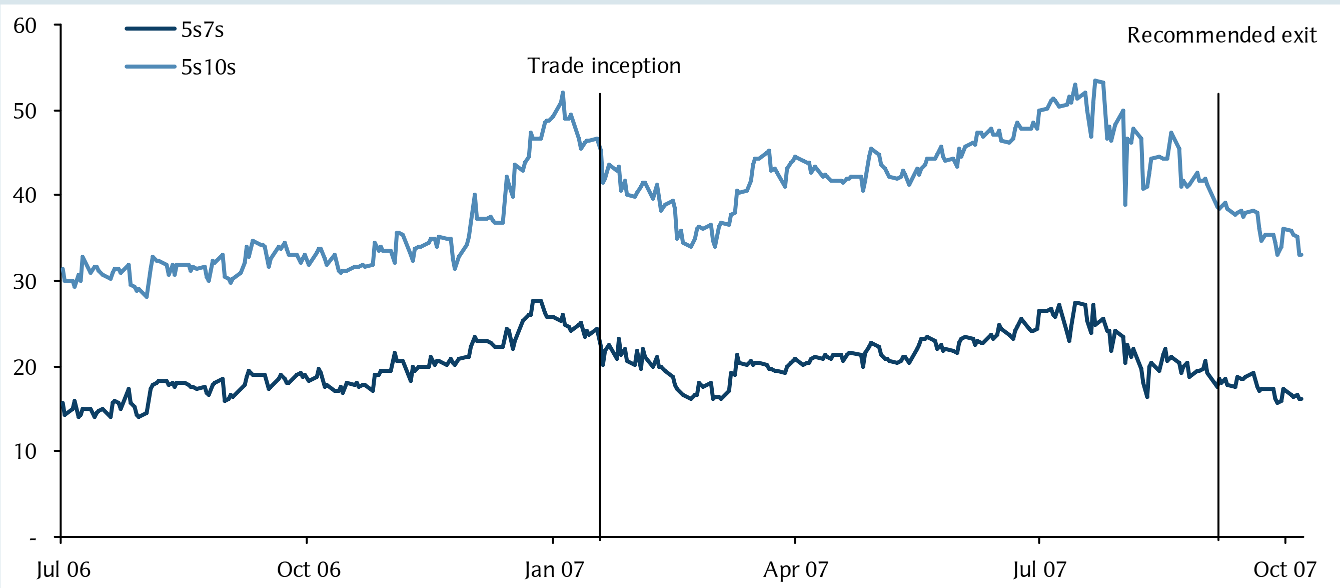
See *Model-based strategies: ABC flattener*, 05 February 2007.

Trade rationale: In early February 2007, we believed that the pharmaceutical distributors – including ABC – had been unduly designated LBO candidates. Based on fundamentals, our analyst believed they were likely to remain independent, public companies. As a result, we believed the steepening on the back of LBO concerns was likely to reverse. Although selling 7 yr or 10 yr protection outright would have been one way to express a bullish view in this case, it would not hedge against the possible normalization of the curve at a higher level of absolute spreads. Although the 5s10s offered better potential upside in terms of model-forecasted curve flattening, the 5s7s trade had the advantage of a more attractive roll-down and carry profile.

The trade: A DV01 neutral 5s7s or 5s10s flattener. Buy $13mn 5 yr and sell $10mn 10 yr for the 5s7s, or, buy $16.5mn 5 yr and sell $10mn 10 yr for the 5s10s.

Trade evaluation: The trade initially worked well, with curves flattening into the spring. However, renewed LBO fears and the summer's volatility reversed gains for a few months before recovering again early in the fall. On September 20, 2007, we recommended exiting the trade, since curves had flattened according to our model's targets. Curves have continued to flatten since our recommended exit, indicating that fundamentals are once again driving valuations in this name.

Figure 4: ABC flattened as LBO concerns abated



Source: Barclays Capital

Implementing a pair trade with embedded curve views

Curve trades do not always have to be executed in a standard format. For instance, we believe that curve views can enhance traditional pair trades by focusing attention on the most effective maturities. For further discussion, see Diagonal curve trades, p.93.

Out of Sara Lee (SLE), Into Kraft Foods (KFT)

See *Model-based strategies: Beta-neutral foods,* 15 May 2007.

Trade rationale: In May, our analysts believed that SLE had the characteristics consistent with a company that could be an LBO candidate, while they believed that KFT was an undervalued and well-run company. In addition, model signals indicated that SLE 3s10s were too flat and KFT 5s10s were too steep. As a result, both fundamentals and model signals pointed to a further divergence of 10 yr spreads, back toward the levels seen late in 2006, see Figure 5.

Trade format: Buy \$10mn10 yr protection on SLE, Sell \$20mn10 yr protection on KFT.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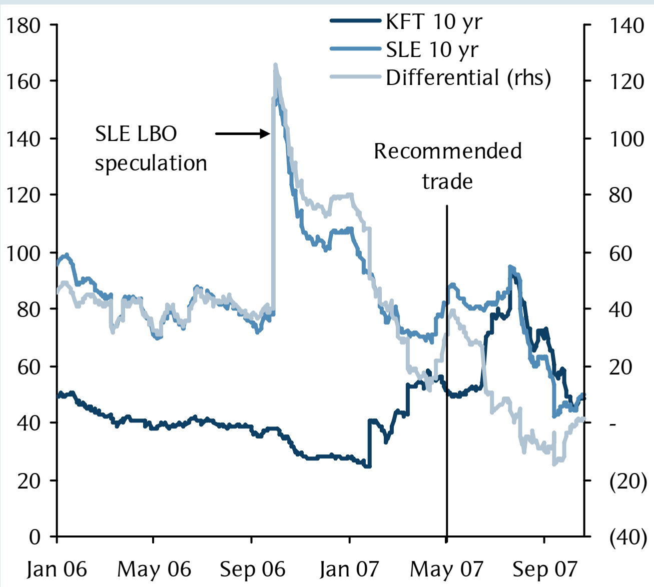
May 15, 2007
Model-Based Strategies: Beta-Neutral Foods – Out of the Cheesecake into the Cheese

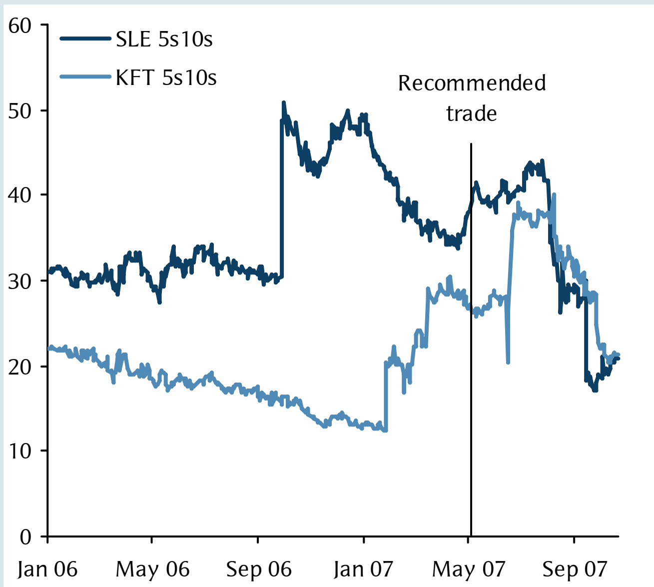
Rationale for weighting: The 2:1 weighting was chosen so that the net position was hedged on a beta*DV01 basis (explained further in Diagonal curve trades, p.93).

Figure 5: Unfortunately for the recommended trade, Sara Lee LBO speculation has faded



Source: Barclays Capital

Figure 6: A Kraft flattener would have outperformed, while a Sara Lee steepener would have lost money

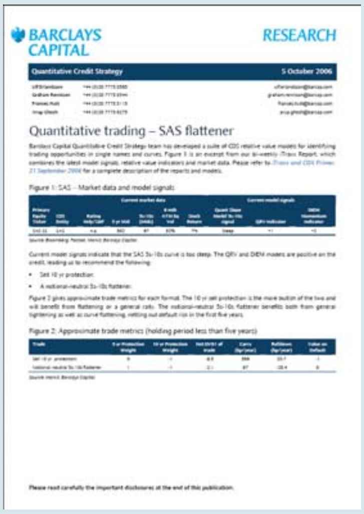


Source: Barclays Capital

Trade evaluation: This trade unfortunately underperformed on both sides, as the LBO concerns around SLE have faded with the increased cost of debt in the market. In the first month of the trade, the underperformance was compounded by Nelson Peltz's reported activist interest in KFT. Although the spread differential has begun to move in the right direction, this example shows that, while curve views can enhance the returns to a fundamentally motivated trade when things go right, they can sometimes exacerbate losses when things go wrong. As can be seen in Figure 6, most of the underperformance of the trade has been driven by a general tightening and flattening of the SLE curve. If the trade had been implemented as two separate curve trades, the steepener on SLE would have lost money and the flattener on KFT would have outperformed.

Optimal execution of a long-credit view: SAS flattener

See *Quantitative trading – SAS flattener*, 5 October 2006.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Quantitative Credit Strategy — 5 October 2006

Quantitative trading – SAS flattener

Trade rationale: At trade inception, SAS rode on a strong positive momentum both in the credit and equity. Both directional models and our fundamental analyst signalled credit positive on SAS. This suggested a high probability of further out-performance according to our selection criteria. At the same time, our quantitative slope model indicated that the curve was trading too steep.

Trade format: Either a DV01 notional neutral flattener (less bullish position) or selling 10 yr protection outright (more bullish).

Trade evaluation: The positive trend in the credit continued, and with a strongly positive carry on the trade, it performed well. At its tightest, the 5 yr traded at 140 bps. The curve remained surprisingly steep, however, with little variation of the 5s10s around the 100 level even when the 5 yr traded at its tightest.

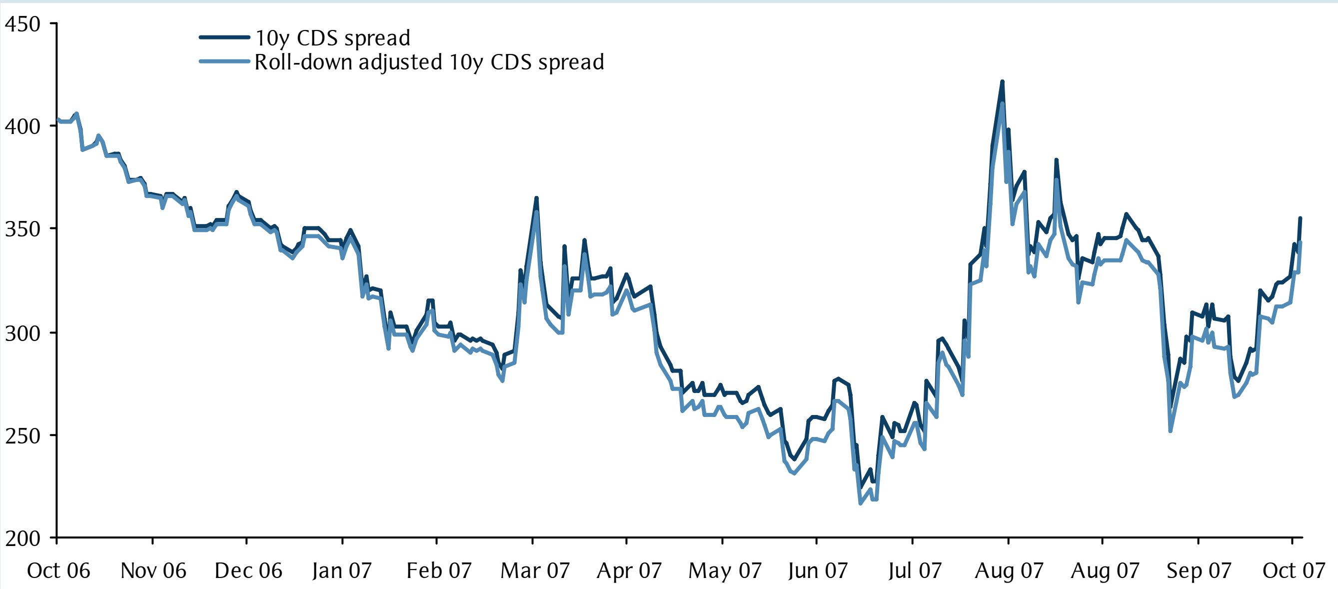
With the general spread widening in the summer of 2007, the bullish position obviously took some pain, but we started to see the curve flattening instead. On October 22, we mark the 5 yr (Dec-2012 contract) at 240 bp with a 5s10s of 75 bp. For the original Dec-2011 contract, we would calculate a rolldown from the 5 yr to the 4 yr position of around 45 bps, and for the 10 yr to the 9y a roll-down of approximately 12 bps. This illustrates the greater roll-down on the short end of the curve compared with the long end. In this case, as we have seen a very substantial flattening in the curve, the outright long risk protection in the 10 yr has actually outperformed the 5 yr. Without this, the outright 5 yr short protection position would have been the better choice due to its greater roll-down.

Figure 7: SAS – Market data and model signals

Current market data						Current model signals			
Equity Ticker	CDS Entity	Rating Mdy/S&P	5 yr Mid	5s-10s (Mids)	6M ATM Eq Vol	Stock Return	Slope signal	QRV Indicator	DIEM Indicator
SAS SS	SAS	n.a.	302	97	*32%*	7%	Steep	+1	+2

Source: Bloomberg, Factset, MarkIt, Barclays Capital

Figure 8: SAS 10 yr spread, market quoted and roll-down adjusted



Source: MarkIt, Barclays Capital

Attractive “optionality”: Valeo butterfly, 20 Apr 2007

See *Quantitative trade ideas: Valeo hedged flattener*, 20 April 2007.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Quantitative Credit Strategy 20 April 2007

Quantitative trade ideas: Valeo hedged flattener

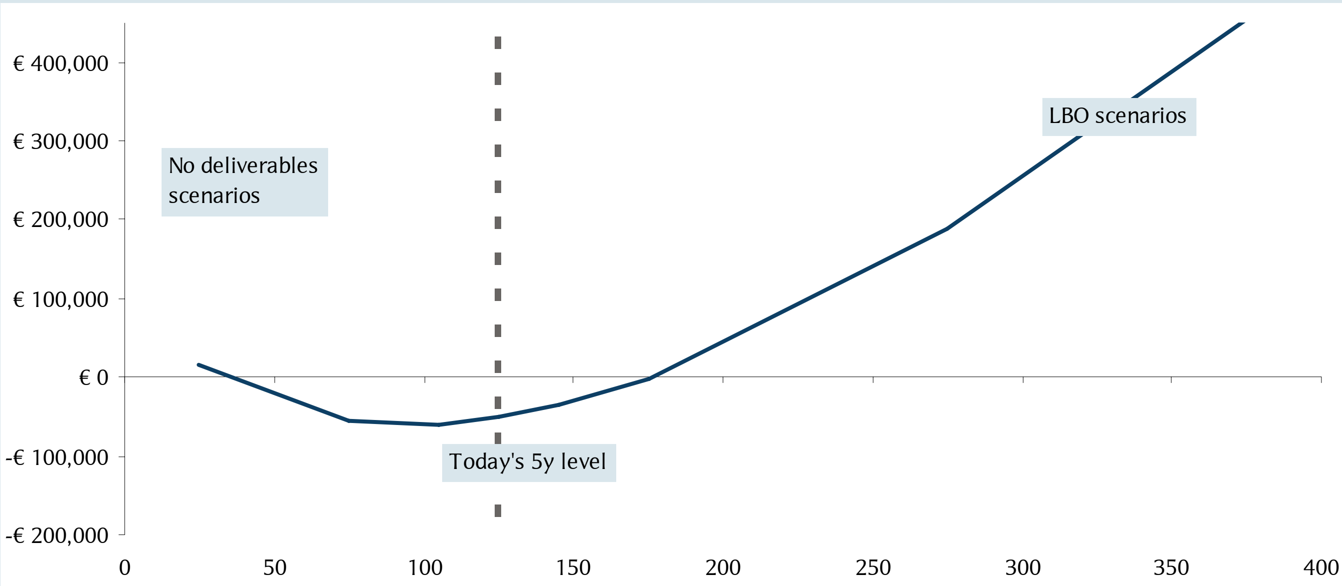
This trade idea serves as an example of a more complex curve position with an attractive payoff profile.

Trade rationale: Following a dying-down of private-equity speculation on Valeo, our model indicated that the long-end of the curve was left out of shape and remained too steep, while the front end was too flat. A 3s5s7s10s butterfly position offered an attractive payoff profile estimated by our models, and shown in Figure 9. This unusual option-like payoff profile is based on empirical curve behaviour of different parts of the curve, and convexity effects. This profile is appealing if an LBO does crystallize (RH region of chart), and the trade does not likely lose much money if spreads tighten (LH region of chart).

Trade format: A 3-5-7-10s straddle: sell €10mn of protection on the 3 yr and the 10 yr each, buy €7mn of protection on 5 yr, €13mn on the 7 yr.

Trade evaluation: Although an LBO did not materialise in Valeo, the curve did normalise in line with model targets.

Figure 9: Valeo butterfly trade – estimated pay-off profile for different 5 yr spread scenarios



Source: Barclays Capital

Considerations that affect curve trades

Curve trades add many new dimensions to trading strategies using CDS. The cost of this enhanced flexibility and opportunity set is an increased number of market, technical and economic factors that impact the execution and profitability of the trades. Much of this guide is dedicated to understanding and managing these factors. In Figure 10 we give a broad summary of some of these factors. Each will be addressed in various sections and examples.

Figure 10: Curve trades - considerations

Trade economics – Carry and roll-down costs/benefit See Carry and roll-down, p.54.	**Deliverability** – Corporate restructuring can sometimes leave CDS worthless See Bid-related events – exploiting unusual CDS payoffs, p.75.	**Residual default risk** – Some curve positions leave residual default exposure. See Curve weightings – some considerations, p.44.
Transaction costs – are often higher than straight 5 yr. See Transaction costs, p.63.	Curve trades - considerations	**Execution** – Not all curve points trade actively on less liquid names See Execution issues, p.63.
Crisis liquidity – Curve liquidity tends to drop dramatically in times of extreme market vol. See Execution issues, p.63.	**Technical effects** – CDO, and roll technicals can impact curve shapes See CDO technicals and curves, p.102.	**Off-the-run contracts** – Holding curve positions leads to contracts aging See Carry and roll-down, p.54.

Source: Barclays Capital

What drives the shape of the curve?

At the heart of many – though not all – curve trades is a view on the shape of the CDS curve on a single-name or index. In order to take such a view, a framework is required to evaluate the shape of the curve based on fundamental factors such as default risk, and, critically, what will drive it to change. In this chapter we address the first of these issues. The following chapters build on this with an analysis of the dynamics.

Curve shapes embed a view on the timing of default risk

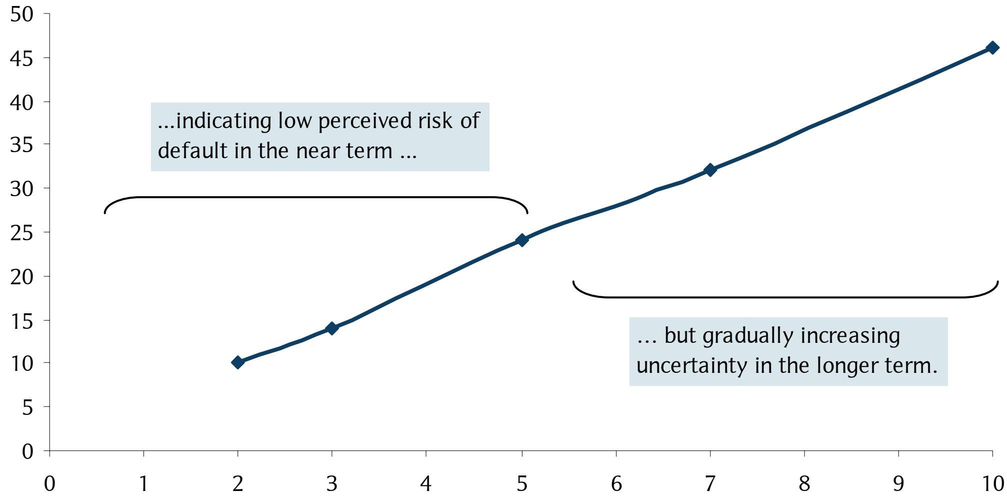
Much as government bond yield curves embed the market's perception of future interest rates, the credit default swap curve relates to the market's perception of the timing of a possible default. The CDS curve tells us in a sense how much investors are willing to pay for protection against default at different points over the next 10 years. Given the curve on a particular name we can calculate how much it would cost to insure against default between any two dates in the next ten years. For instance we can calculate the price today that investors would be willing to pay for protection starting in five years time for one year. Forward contracts such as this are analogous again to forwards in government curves or indeed interest rate swap curves. We will return to the topic of forwards in some detail (Understanding forward spreads, p.113). Here, we focus on some examples to illustrate the ideas.

Upward sloping curves

For high quality issuers, short-term risk is small, but uncertainty inevitably grows with time

CDS curves are typically upward sloping for high grade companies, with the possible exception of during periods of particular stress in the credit market. Why is this? Typical high grade companies have low perceived default risk in the short term (hence their high rating) and so investors are not willing to pay excessively for protection in the first few years. However, at more distant horizons, uncertainty grows – five years from now we can't be sure that even the strongest company will not run into difficulties. Therefore investors are willing to pay a premium for longer dated protection. Figure 11 illustrates this with France Telecom's CDS curve.

Figure 11: Steep upward sloping curve – France Telecom, 2 July 2007



Source: Barclays Capital

A note on the term structure pricing and the link to forward spreads

One confusing aspect with the arguments presented here is in the exact meaning of the curve protection prices. In the France Telecom example 5 yr protection is trading at 24 bp and 10 yr at around 45 bp. These are the annual premiums due for protection starting today. Consider an investor wanting default protection for ten years. Buying 10 yr protection today involves paying the higher premium even in the first few years where risk is thought to be lower. So, why would the investor spend 45 bp a year for the first five years for the same protection afforded by the 5 yr contract? Why not just buy 5 yr protection and then buy a second five years worth at the end of those five years?

The explanation relates back to the pricing of forwards. The risk of rolling a 5 yr protection position is that the pricing has changed in 5 years time and the cost of that second 5 years of protection has risen. Buying 10 yr protection for ten years would cost 450 bp in total (assuming no default and ignoring time-value discounting). The rolling investor has spent just 5x24bp = 120 bp in the first five years. Therefore provided that the new 5 yr annual protection price is less than (450 bp – 120 bp) ÷ 5 = 66 bp then they are in the money.

The reason for highlighting this is that risk premium in the curve actually grows more quickly than the curve itself (in the case of upward sloping curves). In this example, France Telecom 10 yr spread is a little under double the 5 yr spread. However, the implied risk in the second five years is actually much higher, judging by this 66 bp breakeven level. The implied risk in the second five years is closer to three times that in the first five years.

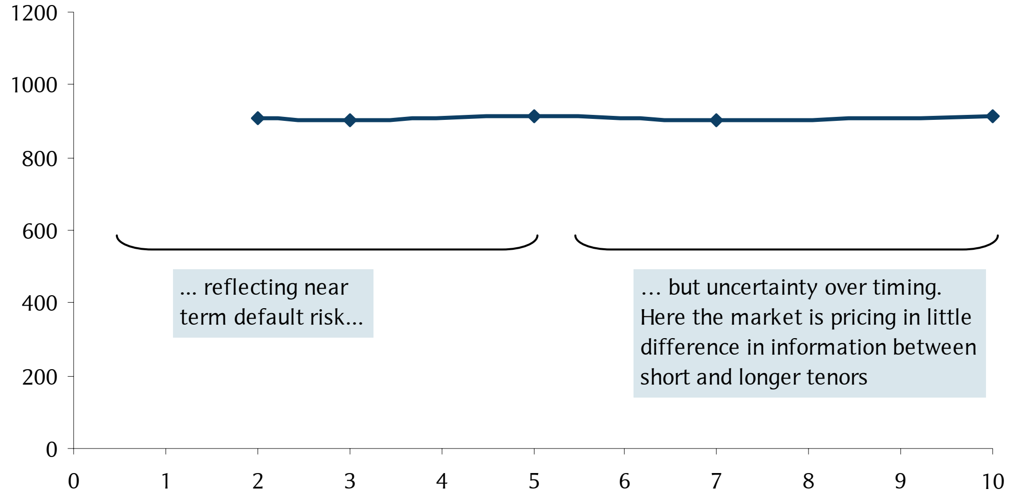
The argument above relates very closely to the pricing of forward contracts. The 66 bp breakeven level is close to the 5x5 forward CDS spread (the 5 yr CDS premium starting in 5 years time). The only difference is that the true forward takes into account the possibility of default before the ten years is up (and therefore that not all the premiums would be paid) and also the time-value of money.

Flat curves

Curves do trade flatter when nearer-term default risk is rising, but timing of a default is uncertain. In benign market conditions only low-rated companies will trade with a very flat curve. However, in weaker market conditions, especially when default rates are rising, even investment grade companies can trade with flat curves.

A flatter curve represents the market's view that default is a real possibility for this issuer, but that timing is very uncertain. Figure 12 illustrates this with the example of Beazer Homes during the uncertainty of the outcome of a fraud investigation.

Figure 12: Flat curve – Beazer Homes, 24 July 2007

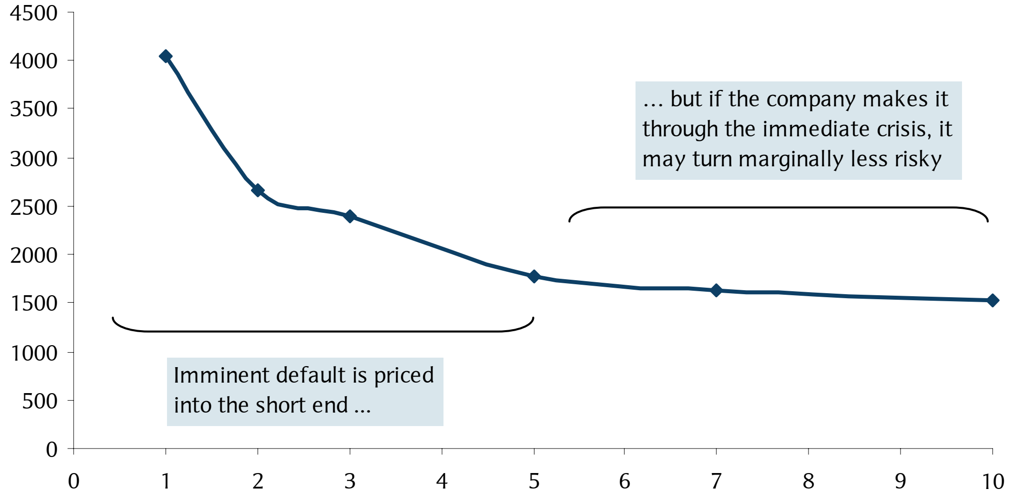


Source: Markit, Barclays Capital

Inverted curves

Curves also occasionally invert, typically when the name is in distress and immediate default is likely. A downwards sloping curve reflects the perception that if the company survives over the short term, it may come out a stronger credit. Curve inversion behaviour is another topic we return to in some detail later. See Inversions, p.107.

Figure 13: Inverted curve – Delphi, 30 September 2005



Source: Markit, Barclays Capital

Fundamental drivers of curve shape

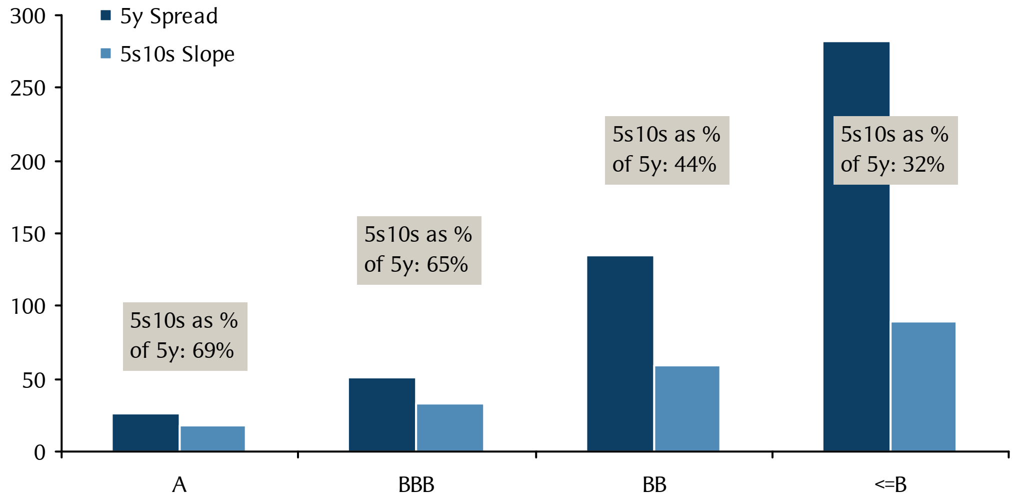
Curve shapes represent an implied view on the timing of any default. How do market participants judge that risk timing? Clearly there ought to be a link to fundamental aspects of the companies in question.

Credit quality

As described in the previous section, the credit quality of an issuer will affect its curve shape. Figure 14 illustrates this directly. Here we bucket European CDS into rating categories and look at both the average 5 yr spread and the average slope between the 5 yr and 10 yr spread in a benign credit environment[1].

We see a clear pattern of 5 yr spread increasing and the 5s10s slope increasing as we go down the rating spectrum. What is more informative, however, is to consider the 5s10s slope as a proportion of the 5 yr spread. For single-A credits we find a ratio of 69% on average – that is the 10 yr spread is 169% of the 5 yr spread on average. This ratio falls as we move down the credit spectrum. In other words, the perceived risk of default in the second five years for low-rated companies is not that much greater than for the first five years. For high-grade companies, it is much greater.

Figure 14: Credit quality affects both the absolute curve shape and the ratio of the 5s10s curve to the 5 yr spread



Note: Based on European CDS, July 1st 2007. Source: Markit, Bloomberg, Barclays Capital

Default rates

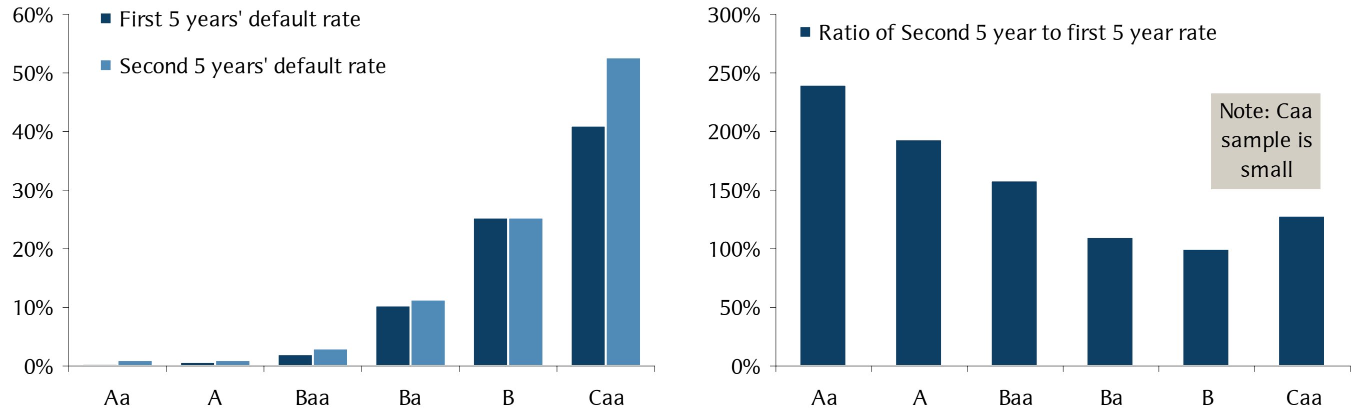
This pattern of decreasing curve ratios with decreasing rating can be neatly explained by looking at historical default rates. Figure 15 compares the default rate in the first five years to the second five years, per rating category. The right-hand panel presents these numbers as a ratio – we see a similar effect in terms of a dropping ratio as we move down the rating spectrum.

This doesn't come as a surprise. A Aa-rated company will typically have a low chance of defaulting in the first five years. In the second five years, although probably still low, the default rate is going to be higher as there is a chance the company may have been downgraded. For a Caa-rated company there is a substantial chance of default in the first five years. In the second five years the company, if it has survived, may continue to have a

[1] This analysis was carried out on 1 July 2007 immediately before the market started reacting to the subprime troubles and related liquidity crisis.

high default risk but it could also have improved its credit quality and been upgraded. On average, the second five-year risk is only marginally greater than the first five years.

Figure 15: Comparing default rates over the first 5 years and second 5 years, per rating category.



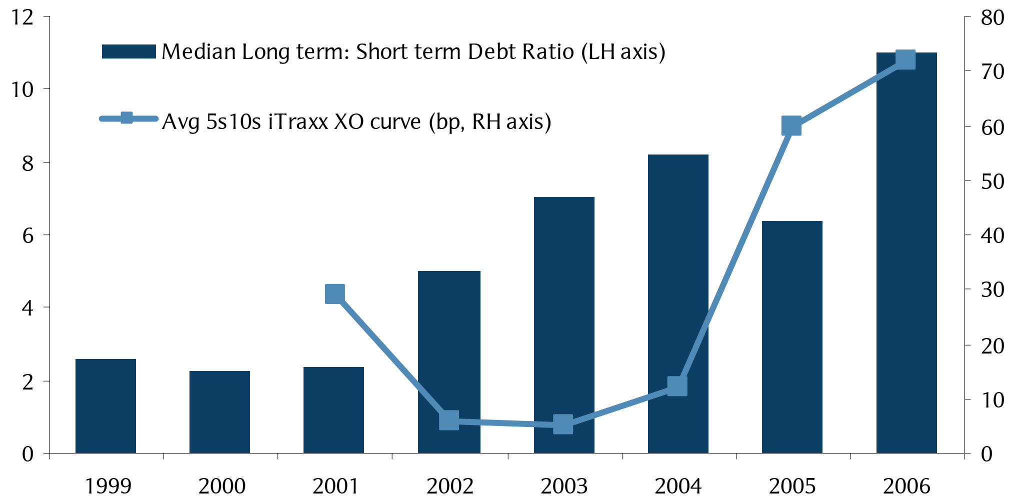
Source: Moody's, Barclays Capital

Debt maturity profile

Credit quality and historical default rates are by no means the only fundamental drivers of curve shapes. The other natural factor is the profile of underlying liabilities – bonds, loans and other credit facilities. Clearly, companies with no short-term debt redemptions have a low chance of defaulting in the short term (it would have to default on interest payments or would have to issue new short-term debt).

Figure 16 illustrates this with the example of European high yield companies (with CDS trading) over the years 2004-2007. Over this period, company balance sheets where refinanced with long-dated debt causing a steepening of the curve (short-term risk falling, long-term risk rising). Please see *The need to refinance: Risks look limited, European Alpha Anticipator*, 7 September 2007.

Figure 16: Median iTraxx Xover Long term: Short-term debt ratio, versus average 5s10s curve slope

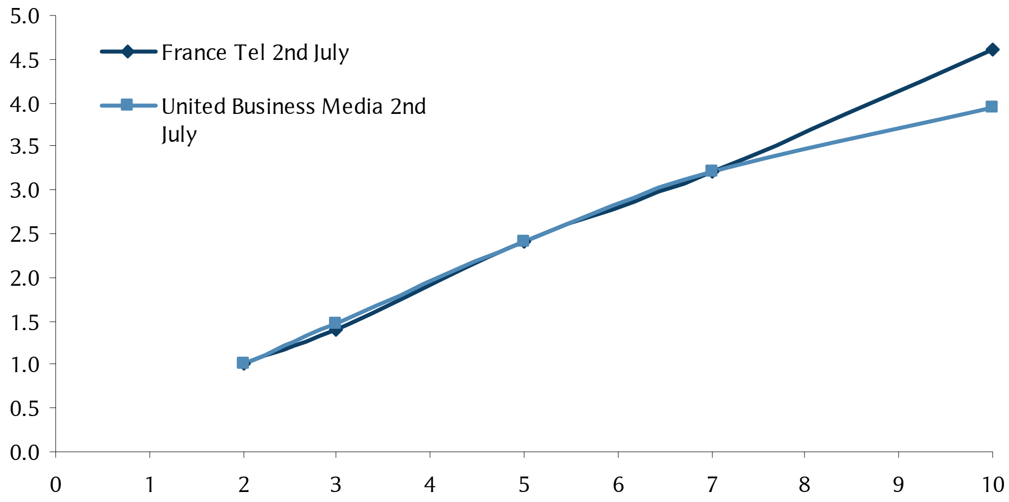


Source: Factset, Markit, Barclays Capital

The debt-maturity profile should also affect names relative to each other. In periods of low default rates, however, the maturity profile of debt is actually only a weak factor in determining curve shape. We expect this to become more relevant, especially for High Yield companies, if we enter a higher default rate regime.

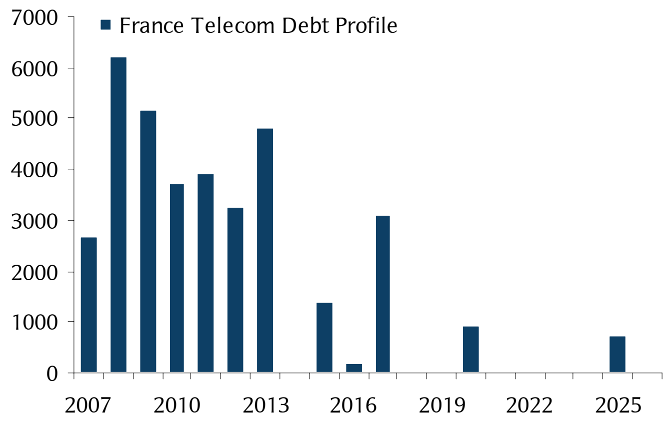
Figure 17 illustrates an extreme example of two TMT companies with very different debt maturity profiles but only marginally different curves.

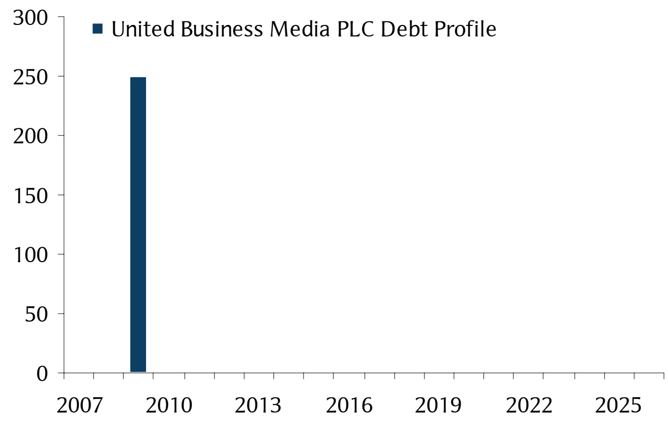
Figure 17: Comparing France Telecom and United Business Media CDS curves – curves rebased to 1 at the 2y point



Source: Markit, Barclays Capital

Figure 18: Debt maturity profiles, France Telecom and United Business Media





Source: Factset, Barclays Capital

Other fundamental drivers

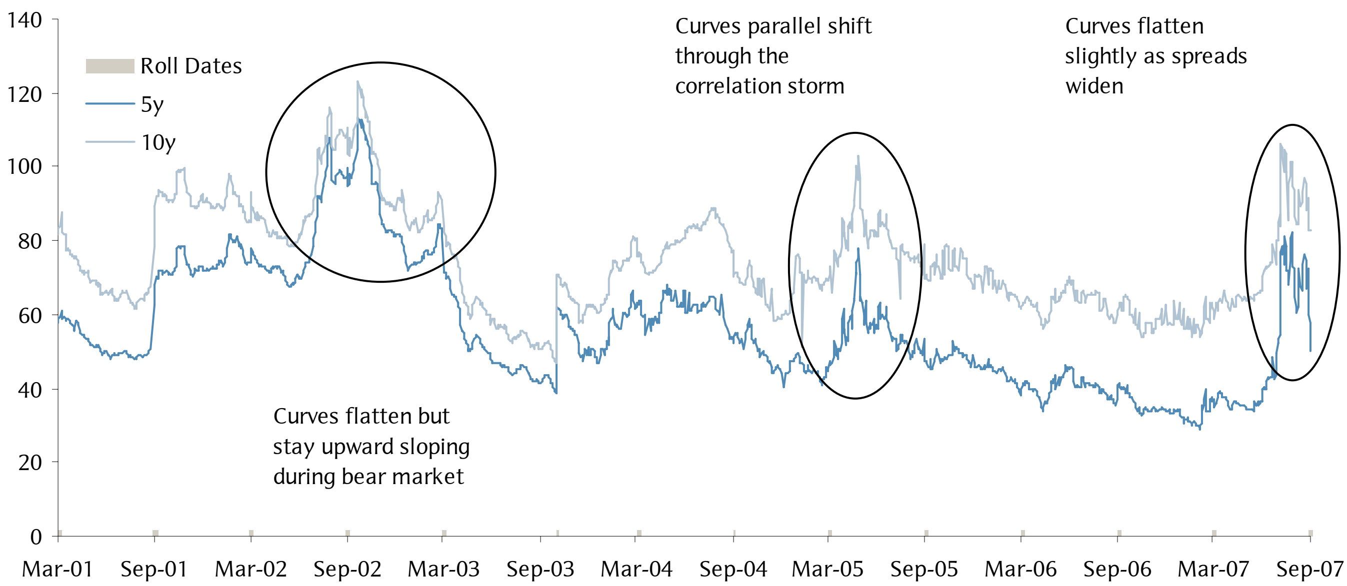
Other fundamental factors do affect curve shapes. We will cover these variously in following chapters. In particular, company events, either announced or anticipated, such as LBOs or mergers can have marked effects on curves. We address this topic in Chapter 4 of this section.

Curve dynamics: Indices

Curves are of course far from static – indeed curve trading potential would be limited if they were. Although the volatility of the curve is often substantially lower than the volatility of underlying spreads we do find dramatic variation over time, with a clear link to the credit cycle.

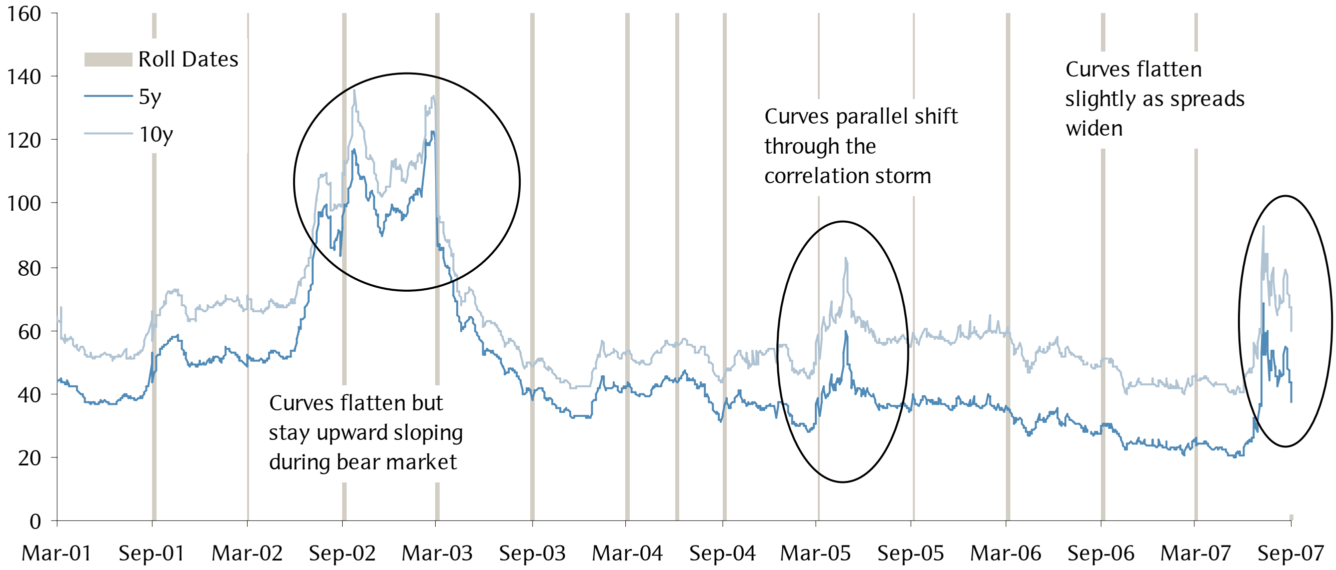
In Figure 20 to Figure 21 we plot the CDX IG and iTraxx Main and Xover indices 5 yr and 10 yr spread series. The series are plotted back until early 2001 using our reconstructed QCX series (see Appendix B: Barclays Capital QCX indices, p.141).

Figure 19: QCX CDX IG series 5 yr and 10 yr spreads



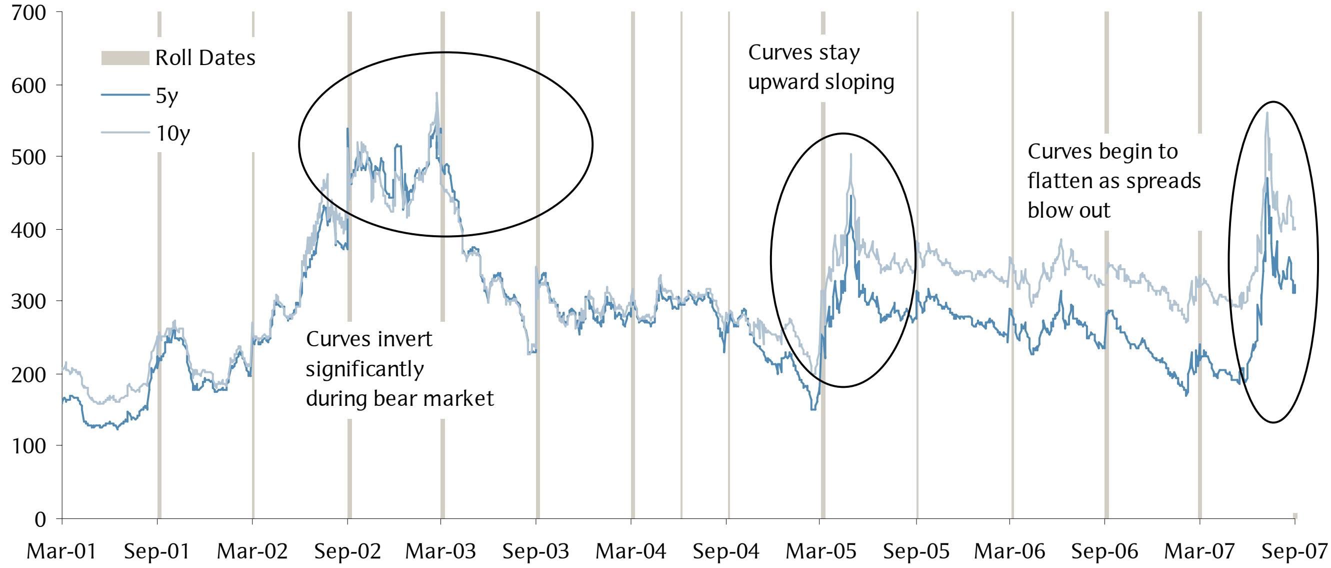
Source: Markit, Barclays Capital

Figure 20: QCX iTraxx series 5 yr and 10 yr spreads



Source: Markit, Barclays Capital

Figure 21: QCX iTraxx Xover series 5 yr and 10 yr spreads



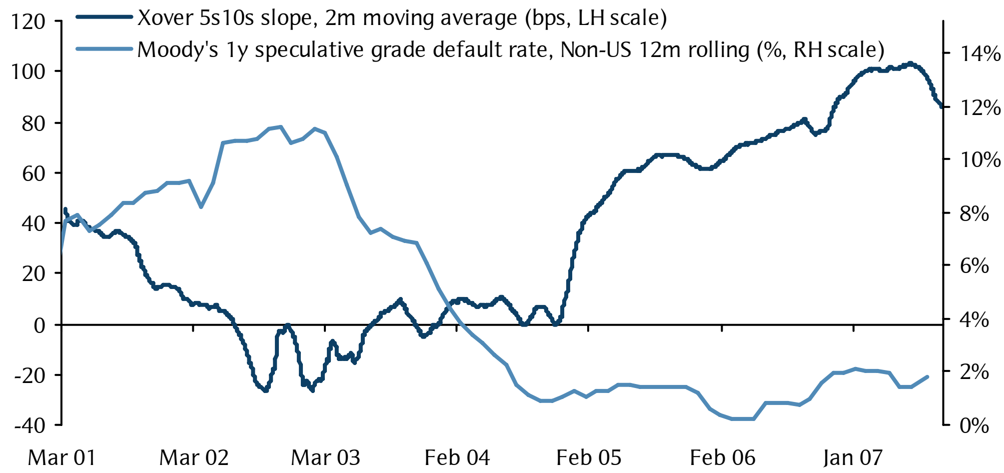
Source: Markit, Barclays Capital

In each chart we see a similar pattern over the various parts of the credit cycle. An immediate observation is the extent to which the 5s10s slope changes through this period. We clearly see how the curve steepened (the gap between the two lines increased) over the credit bull market of 2003-mid 2007. It is also striking to see the flat and inverted curves of the credit bear market of 2001-2002.

Curve shapes and default rates

Figure 22 further illustrates the connection between curve shape and default rates. The chart shows the Moody's speculative grade 1 yr default rate versus the 5s10s slope of the iTraxx Xover curve across the credit cycle. This effect is precisely the macro equivalent of the charts in the previous chapter showing the effect of higher perceived default risk on curve shape.

Figure 22: Default rates display a link with Xover curve shape



Source: Markit, Barclays Capital

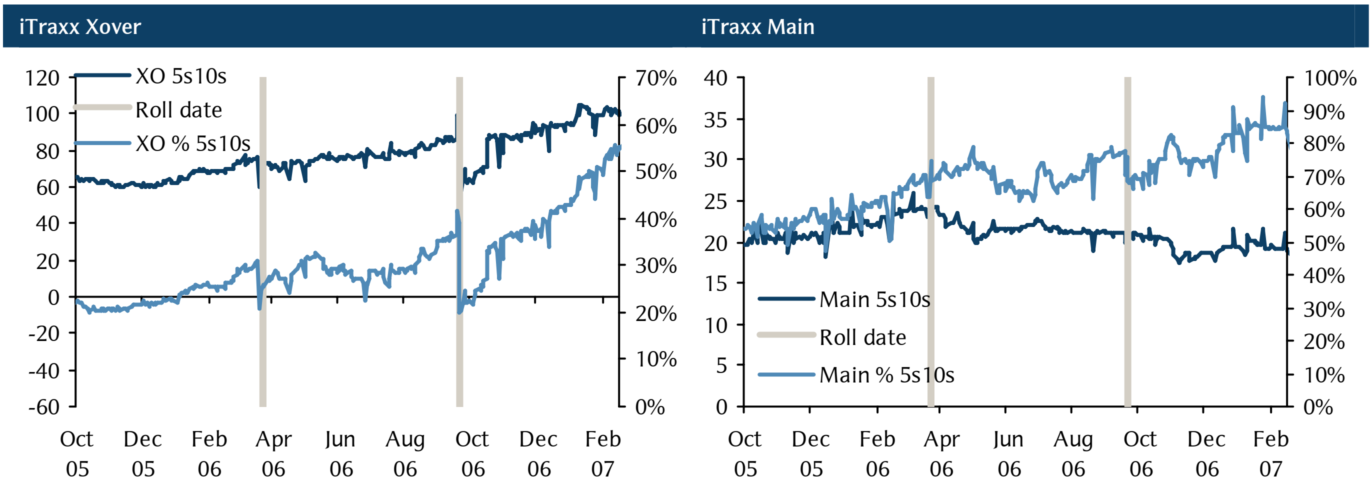
Index curve behaviour in stable credit conditions

Digging a bit deeper we find that the patterns of behaviour that the credit indices exhibit varies markedly on the overall credit environment.

In benign credit market conditions with low default rates, curves are generally steep, as investors price in a back-loading of risk. Carry and roll-down dynamics make steepeners attractive trades to hold (see Carry and roll-down, p.54 for an in-depth treatment of carry & roll-down). This creates a strong technical tightening pressure on 5 yr spreads and a relative steepening in the curve.

Figure 23 illustrates this empirically by examining both iTraxx Main and Xover indices during the benign period of Oct 2005 to the beginning of Feb 2007. In both cases we find the percentage-slope increasing (the ratio of the 5s10s curve to the 5 yr spread) – implying that the multiple by which future credit risk is scaled over current credit risk is increasing. On an absolute basis, the Main curve has stayed roughly constant in this period. In the case of the Xover curves, the carry and roll trade was so attractive that the curve steepened even in absolute terms. We could go as far as describing the extent of the steepening over this period as anomalous and inconsistent with theory and previous empirical behaviour. This was one trade that was quickly derailed in the market sell-off in the summer of 2007.

Figure 23: Benign market conditions – behaviour of 5s10s (LH axis) and % 5s10s (RH axis)

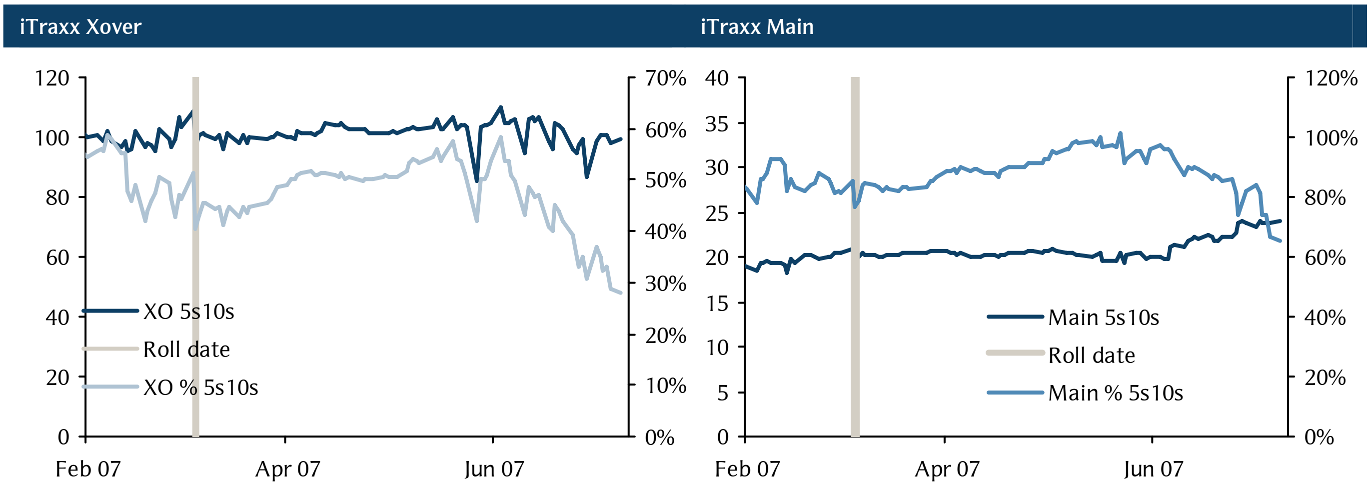


Source: Markit, Barclays Capital

Curve behaviour in volatile conditions

Curve behaviour during sell-offs is dramatically different. Typically curves initially move in parallel, as the 5 yr point is actively traded and the 5s10s remains constant. This results in a percentage flattening. Figure 24 shows the same graphs as above but over the two market sell-offs in late Feb 2007 and July 2007.

Figure 24: Volatile market conditions – behaviour of 5s10s (LH axis) and % 5s10s (RH axis)



Source: Markit, Barclays Capital

Single-name curve dynamics

In this chapter we take a detailed look at the behaviour of single-name credit curves across different parts of the credit cycle. A recurring theme throughout this section is the distinction between spread and curve volatility driven by company-specific events or news and volatility driven by changes in the overall market environment. Curve behaviour can be quite different in the two cases.

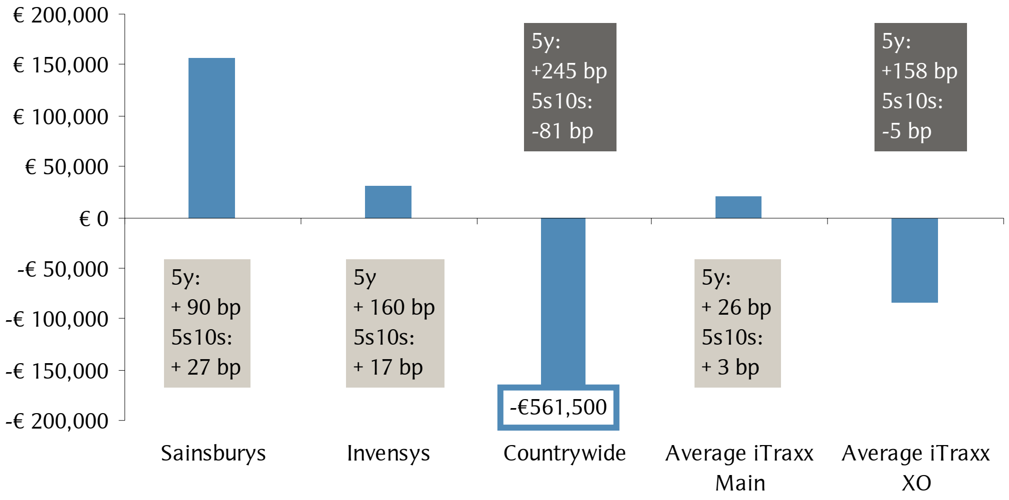
This chapter begins with an analysis of curve behaviour over the summer 2007 period of volatility. Many investors were taken by surprise by the failure of curves to react in the way anticipated. Specifically, steepeners implemented as bearish trades failed to perform or, in cases, significantly underperformed.

Steepeners in credit market sell-offs

The performance of steepeners over the summer was varied and apparently erratic

Curve steepeners in the 5s10s part of the curve were extremely popular over the two years leading up to July 2007. Investors of various types built up large portfolios of these positions, driving curves to unprecedented steep levels (see Figure 25). Part of the motivation for such trades was the attractive combination of positive carry & roll-down and a supposedly bearish position. However, the latter assumption generally failed to play out over the summer's volatility. In fact, performance of 5s10s steepeners was seemingly erratic over this period. Figure 25 below illustrates this with the example of P&L calculations for some specific hypothetical trades, as well as typical performance of steepeners on iTraxx Main and Xover names.

Figure 25: Erratic performance of steepeners? P&L of assorted DV01 neutral 5s10s steepeners initiated on 1 Jun 07 and closed on 31 Aug 07, including carry



Source: Markit, Barclays Capital

What stands out from Figure 25 is that while spreads widened by 26 bp on average for iTraxx Main names and 158 bp on average for the Xover names, steepeners did not perform in the case of Main and actually lost money for Xover. And yet, for some single-name-related bearish events, steepeners did perform. We split the events into the following types:

- Market effects driving all curves simultaneously;
- Idiosyncratic events driving one curve at a time;
- The type of idiosyncratic event – rating downgrade, negative headlines, LBO, distressed situation/fraud etc.

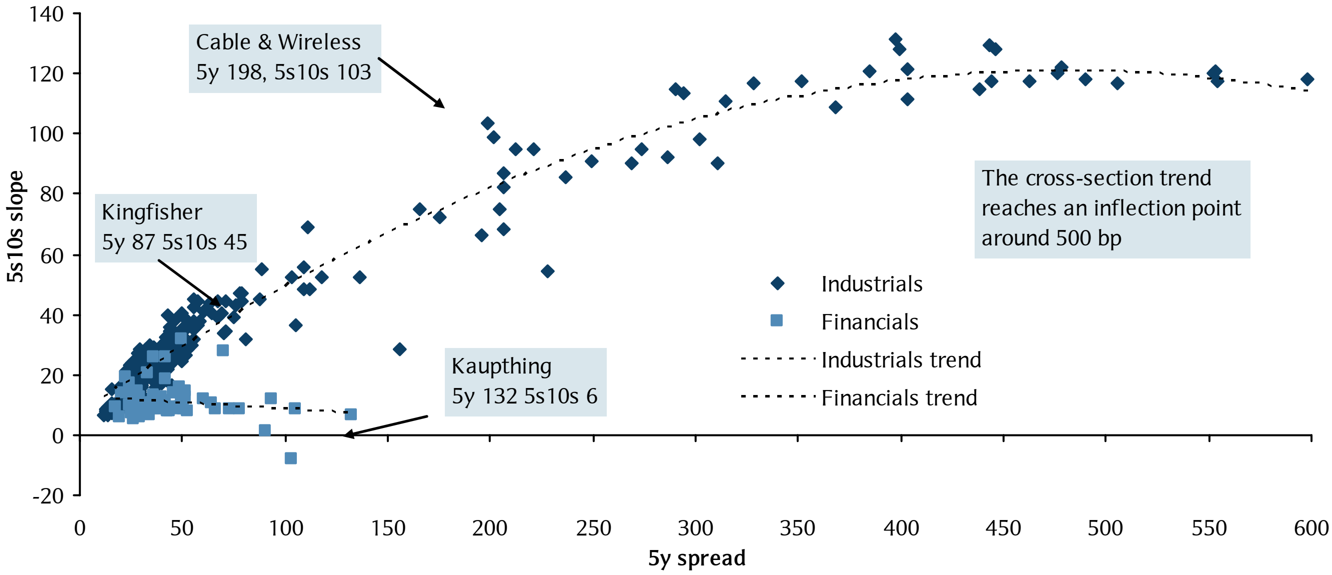
Although perhaps surprising, the fact that steepeners did not perform on a market-wide sell-off is not unique to this particular episode of volatility. In fact, the behaviour is entirely consistent with previous sell-offs, as illustrated by the historical index curves presented in Figure 19 to Figure 21.

The curve cross-section

We find that a convenient tool to analyse curve behaviour is the credit curve cross-section. An example of this is given in Figure 26. This 5s10s cross-section chart plots each individual CDS on the axes of 5 yr spread (horizontal axis) and 5s10s slope (vertical axis). In this example, we look at the cross-section on 19 September, immediately before the September CDS roll. Financials are identified separately from non-financials in the chart as curve behaviour is empirically quite distinct – we address some reasons for this in a later section. The chart additionally shows trend lines that best fit the cross-section shape. These trends turn out to be highly informative of likely single-name behaviour, as we will see in the next section.

Note that the analysis in the next few charts is carried out on the European CDS universe (iTraxx Main and Xover constituents). In fact, that analysis maps easily across into the US universe, as shown in the example Case Study of bear flattening: Belo Corp (BLC), p.28.

Figure 26: Using the curve cross-section – iTraxx Main and Xover (series 7) names, 19 Sep 07



Source: Markit, Barclays Capital

Idiosyncratic events – Curves track the cross-section

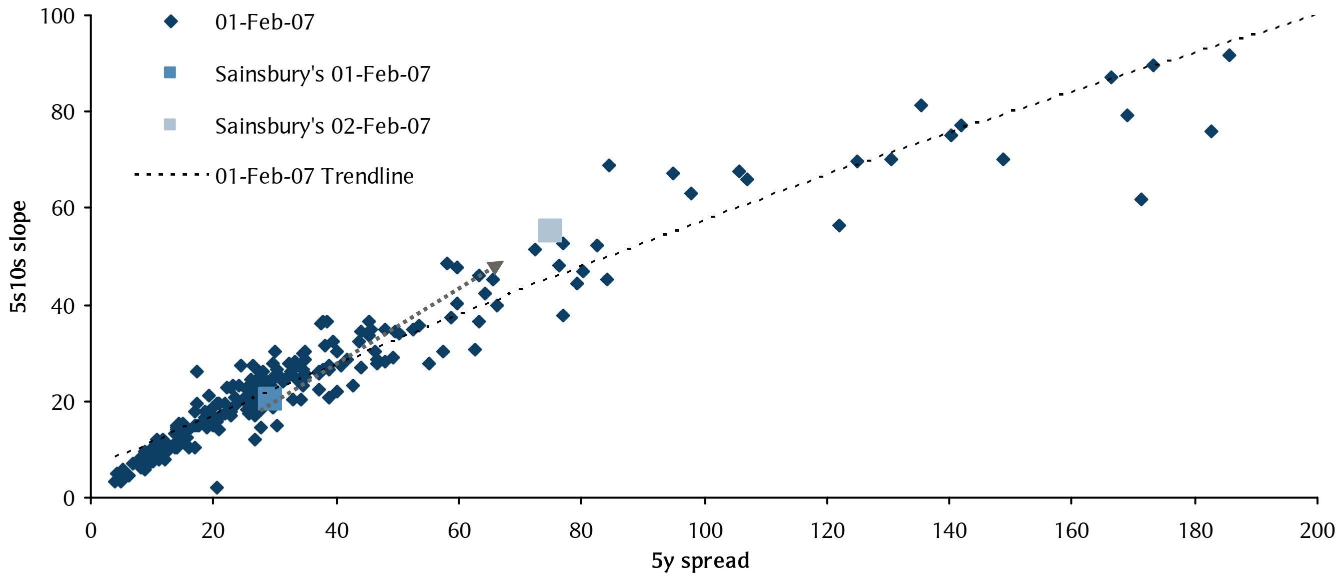
We saw in Figure 25 how idiosyncratic events sometimes lead to curve steepening (and therefore a positive P&L for steepener positions). The exceptions were in more distressed situations – we will consider these in a later section.

In fact, what we find consistently is that when spread widening is due to an idiosyncratic event – and not a market-wide sell-off – then the curve behaves according to the prevailing cross-section relationship.

We illustrate this with a couple of examples. The first is with the initial LBO-related speculation on Sainsbury's in February 2007. At this time, the credit market was still trading in a stable, benign manner. Figure 27 shows the curve cross-section on 2 February. Marked out on the cross-section is the Sainsbury's CDS on 1st and 2nd February. Clearly, as the LBO speculation hit, the 5 yr spread widened from around 30 bp to around 80 bp. The curve roughly tracked the cross-section, steepening from around 20 bp to around 55 bp.

Also worth noting on this chart is how the deviation from the trend-line increased; Sainsbury's lay bang on the trend-line immediately prior to the announcement but ended up slightly steep of the line after the announcement. This effect was quite common among LBO-rumoured companies – the steeper-than-average curve reflected the LBO situation and the possibility of early-retirement of short-term debt to be replaced by longer-term debt.

Figure 27: Tracking the cross-section – Sainsbury's LBO speculation, Feb 2007



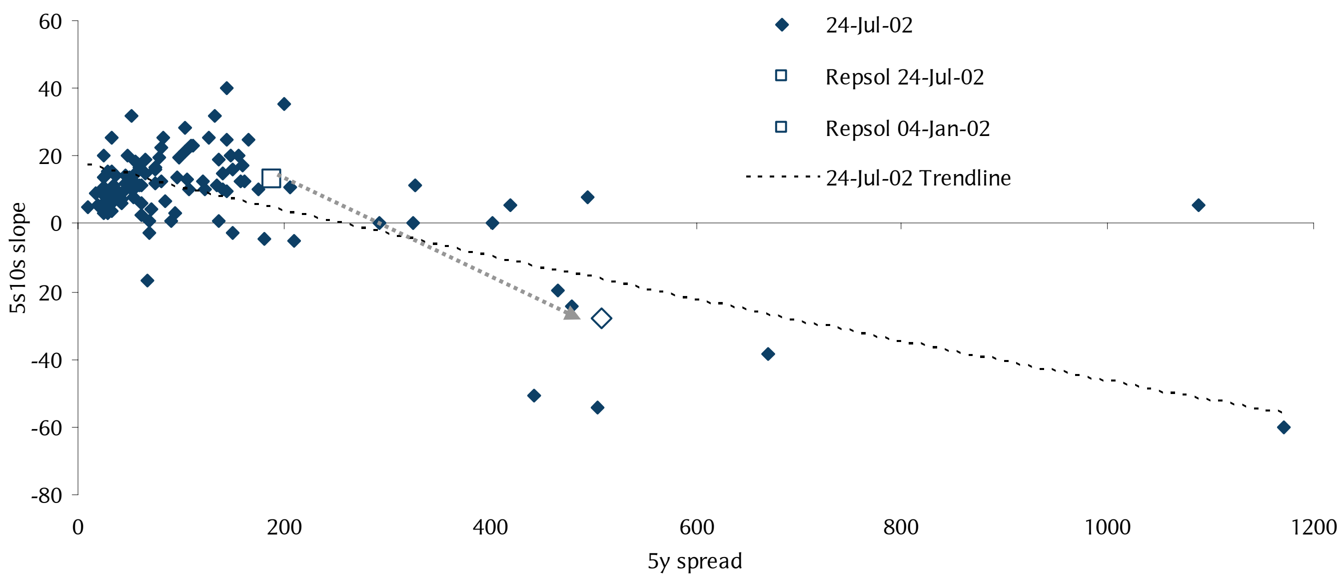
Source: Markit, Barclays Capital

Even in the distressed market conditions of 2002, the cross-section is informative

Our second example of idiosyncratic curve behaviour focuses on Repsol during the highly volatile credit markets of 2002. Figure 28 shows the cross-section of July 2002. The first point to note is the striking difference in cross-section shape – in particular the steep downward sloping trend-line. Curves behaved quite differently in this period due to the greatly heightened default risk. We see from the chart that curves started inverting for most issuers trading above 350-400 bp in the 5 yr. Companies that were downgraded or had operational issues such as Repsol experienced a flattening of the curve as the spread widened out.

In the chart we see the progression of Repsol spreads from the beginning of- to mid-2002. Again, the trend-line is shown to be a reasonable determinant of the curve shape.

Figure 28: Tracking the cross-section – Repsol YPF downgrade, January-July 2002

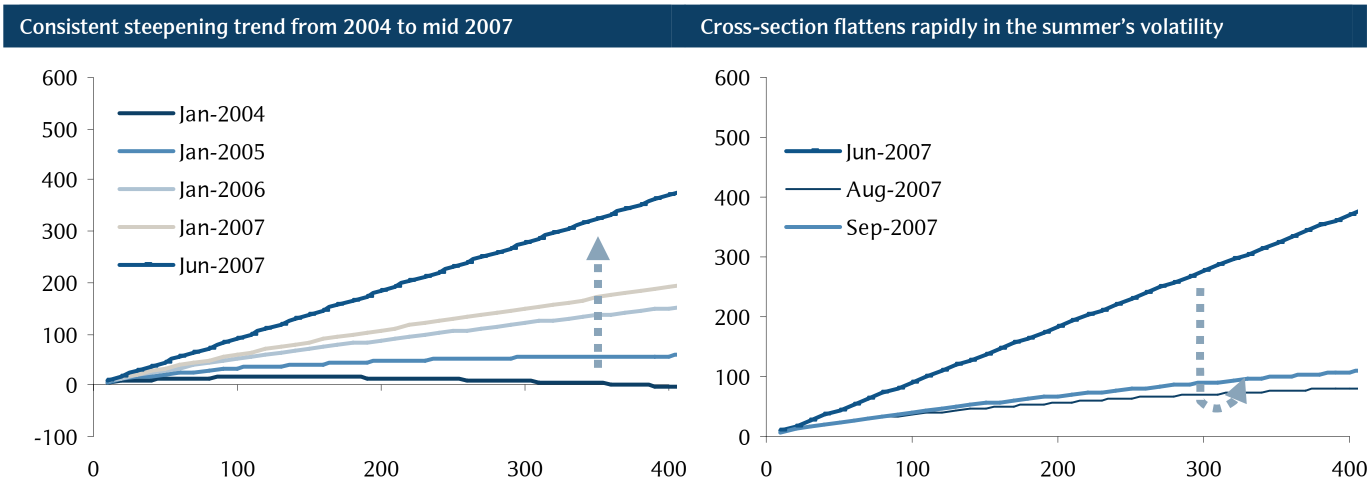


Source: Markit, Barclays Capital

Changes in the cross-section – All curves affected

Market volatility can cause a change in the cross-section, affecting all curves simultaneously and consistently. In benign credit market conditions, the cross-section is stable, or at least slow moving, but in more volatile times it can change very quickly. These dynamics are illustrated in Figure 29

Figure 29: Cross-section trend-lines over time – the gradual steepening from 2004 to 2007 followed by the rapid flattening in the summer

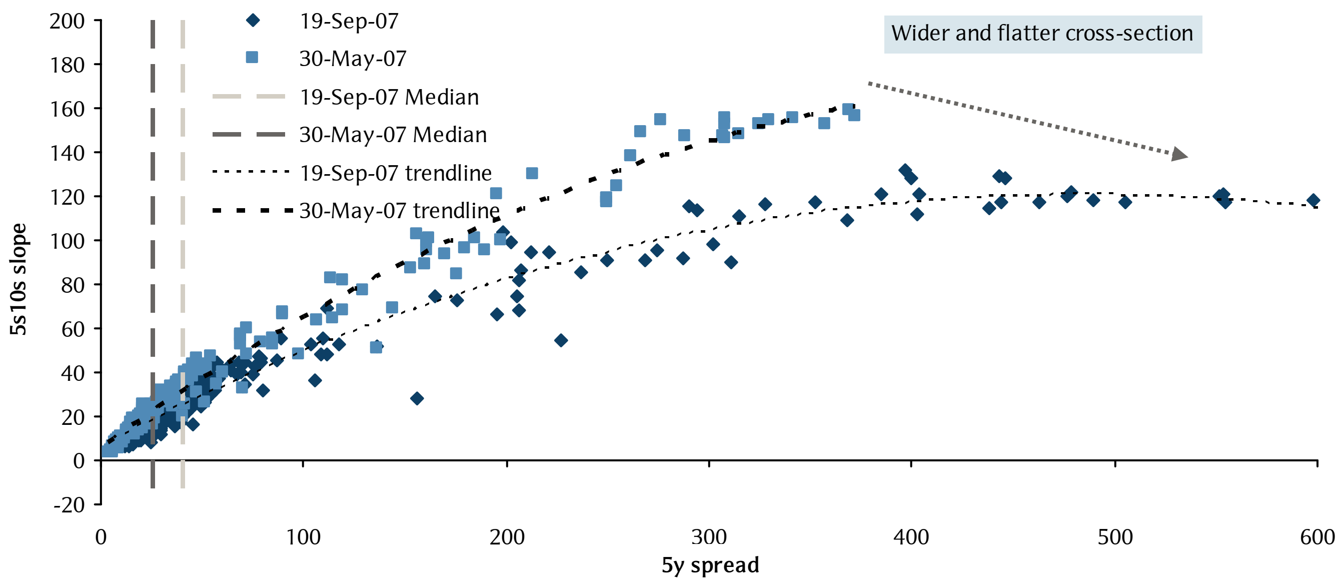


Source: Markit, Barclays Capital

We can examine the second chart in Figure 29 in more detail by looking at the underlying CDS. This is shown in Figure 30. Here we plot two cross-section curves on the same axes for all non-financial CDS in the ITraxx Main and Xover series 7 indices, for 30-May-2007 and 19-Sep-2007 (immediately before the CDS roll on the 20-Sep-2007).

Two clear macro-level effects take place here – a sharp flattening of the cross-section combined with a widening of all names. The chart shows the median 5 yr spreads for each date as well – the September median is nearly double the May median.

Figure 30: Changing cross-section this summer: Non-financials moving wider and flatter



Source: Markit, Barclays Capital

In the absence of idiosyncratic noise, CDS maintain their relative position in the cross-section

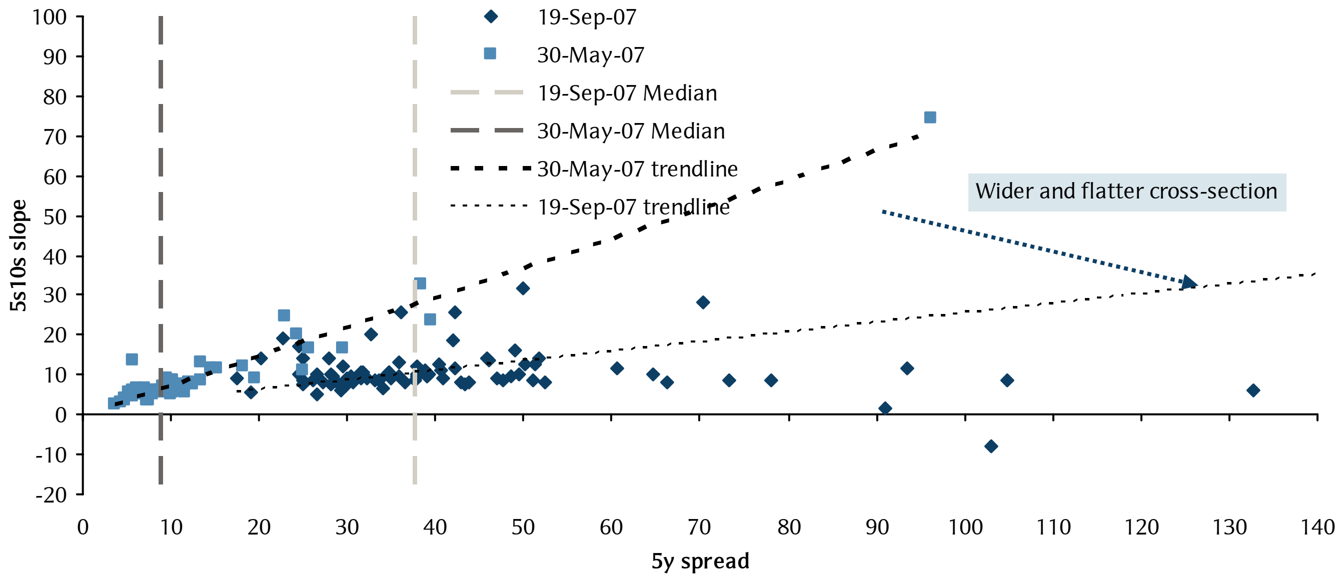
On a more micro-level there are some more subtle effects. Without idiosyncratic noise, single-names spreads broadly move according to their betas to the market and, as such, maintain their cross-section relative position in the charts. In the example in Figure 30, lower spread names (typically investment grade names) move directly to the right from May to September, reflecting a widening and parallel shift of the curve. Wider spread names, however, widen out but also drop down (ie, flatten).

The trend-line also helps identify an inflection point of around 450 bp, after which spread widening translates into curve flattening – and in the extreme – inversion.

Figure 31 shows the corresponding curve cross-section chart for the senior CDS of financial companies in the iTraxx Main Series 7. Although a similar pattern of widening and flattening is present, the effects are far more dramatic, reflecting the concentration of the summer's concerns and volatility in this sector.

We see that the median spread jumped from around 9 bp to 38 bp, while curves parallel shifted to the right, or flattened. We discuss in following sections some possible explanations for the substantially different curve behaviour in financials, and in particular, the much lower curve-flattening threshold.

Figure 31: Changing cross-section this summer – financials moving dramatically wider and flatter



Source: Markit, Barclays Capital

Both Figure 30 and Figure 31 should be compared with the extreme curve cross-section of mid-2002, shown in Figure 28. Clearly, the credit market conditions of July to September 2007, though volatile, do not match those of 2002. In particular, default rates are still at all-time lows in this period compared with peak default rates in 2002. However, the cross-section change does represent some kind of middle ground between the steep upward sloping cross-section in the benign markets of early 2007 and the downward sloping cross-section in the distressed markets of 2002.

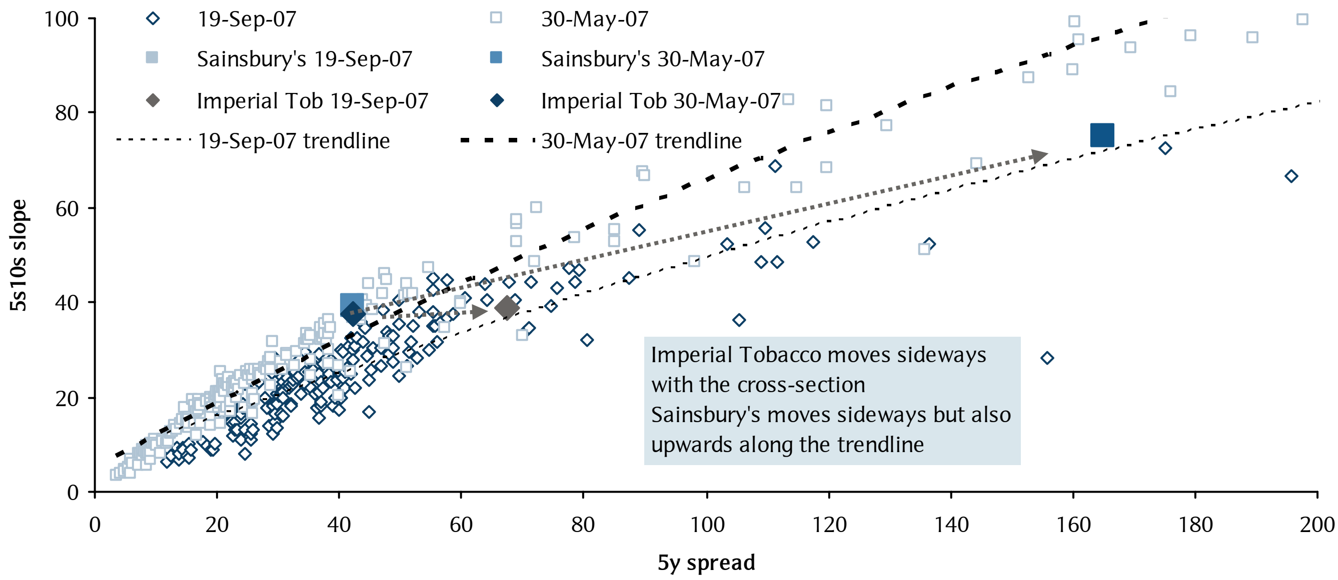
Idiosyncratic events in volatile times – effects combined

In this section, we put both idiosyncratic and market volatility together with the examples of Sainsbury's second bid rumours and Imperial Tobacco (chosen as an issuer with little significant idiosyncratic activity over the summer).

Figure 32 shows the non-financials cross-section identical to Figure 30. Highlighted with the squares is the movement of Sainsbury's CDS spreads and curve. We see how the combination of change in cross-section and bid-rumour-driven widening explain the change in curve shape. This is an example where the trend-line does govern the change in curve shape as a function of the change in 5 yr spread, but where the trend-line itself shifts dramatically over the same period.

Imperial Tobacco, in contrast, simply parallel shifts to the right. It starts trading almost on top of Sainsbury's on the chart, but simply moves with the cross-section maintaining its relative position in the cross-section with little news to disrupt it on an idiosyncratic basis.

Figure 32: Combining cross-section and idiosyncratic dynamics – Sainsbury's bid example



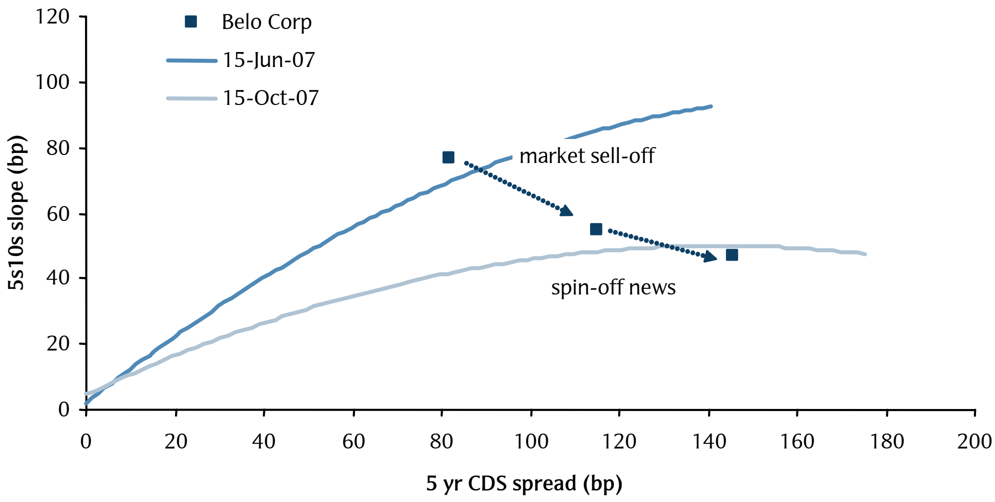
Source: Markit, Barclays Capital

Case Study of bear flattening: Belo Corp (BLC)

On October 1, 2007, media company Belo Corp (BLC) announced plans to spin off its newspaper business from the television broadcast part of the company. Spreads reacted on concerns that the remaining debt load would have to be supported without the significant earnings provided by the *Dallas Morning News*. BLC has already been downgraded to Ba1/BB+/BB+ and been put on negative watch by all three ratings agencies.

Typically, one would expect steepeners to pay off in the sort of scenario above where leverage is expected to increase and there will be earnings and debt-related concerns. However, examining the spread and curve movement of BLC, we find that it is consistent with an idiosyncratic widening, as well as part of a broader market sell-off. As the market broadly widened in July up to the day of the announcement, BLC 5 yr spreads widened from 80 bp to 115 bp and 5s10s curves flattened 20 bp, generally following the changing market cross-section relationship. After the news of the spin-off, the 5 yr spread widened a further 30 bp and curves flattened another 10 bp. In this case, the spread-curve relationship remained consistent with the prevailing market cross-section.

Figure 33: Tracking Cross-Section – Belo Spin-Off Announcement, October 2007

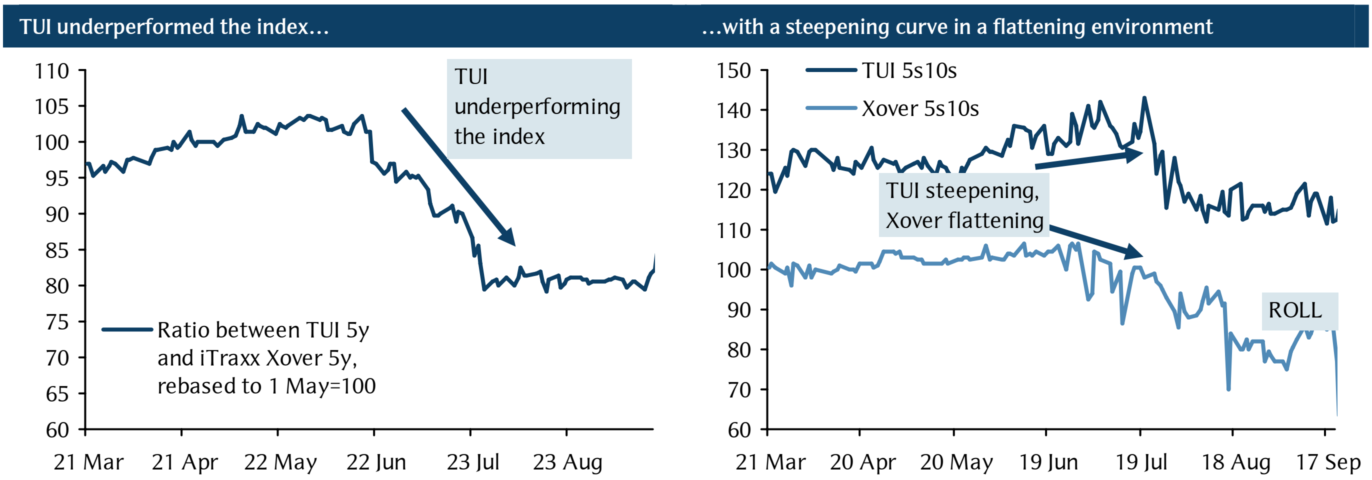


Source: Barclays Capital

Case study on TUI

We find the dynamics surrounding TUI in the summer of 2007 a further example for highlighting the distinction between idiosyncratic and systemic curve movements. Beginning mid June and ending with the peak of market volatility in the last days of July, TUI strongly underperformed iTraxx Xover, as shown in the left hand panel of Figure 34. Following this idiosyncratic underperformance, the TUI 5s10s curve steepened somewhat in the face of the Xover 5s10s flattening strongly in the same period of time, see right hand panel of Figure 34.

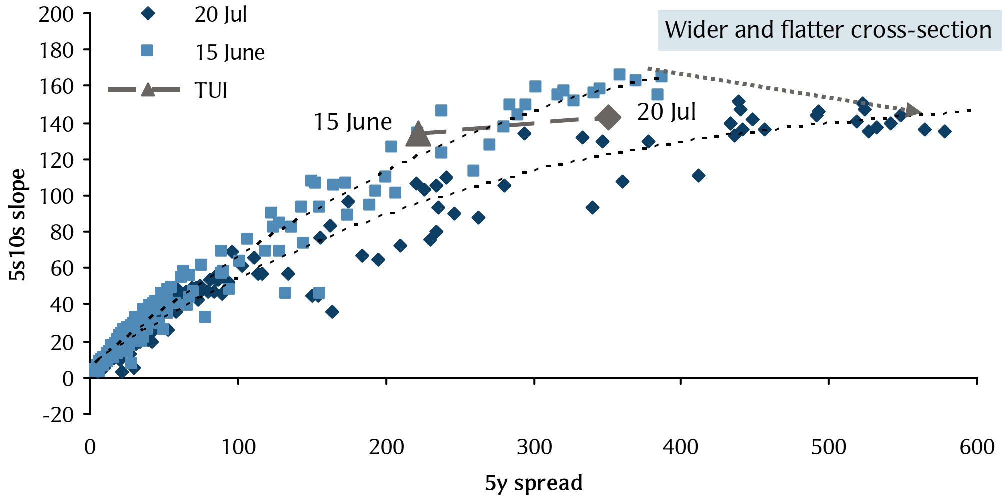
Figure 34: TUI fighting systemic curve flattening.



Source: MarkIt, Barclays Capital

Looking at the cross-section dynamics, we get a very precise picture of what happened in the 5s10s. Figure 35 shows the cross-sections at the inception and ending of the underperformance. We can see how the substantial widening in the 5 yr, travelling to the right along the cross-section curve, motivates an idiosyncratic driven slightly steeper curve on 20 July. Had the market stayed where it was originally, however, we would have expected a much steeper curve toward the 150 region for a 5 yr trading at 350 bps. But the move towards systematically flatter curves worked as a counterforce to idiosyncratic steepening, with the actual 5s10s reaching 130-135 bps instead.

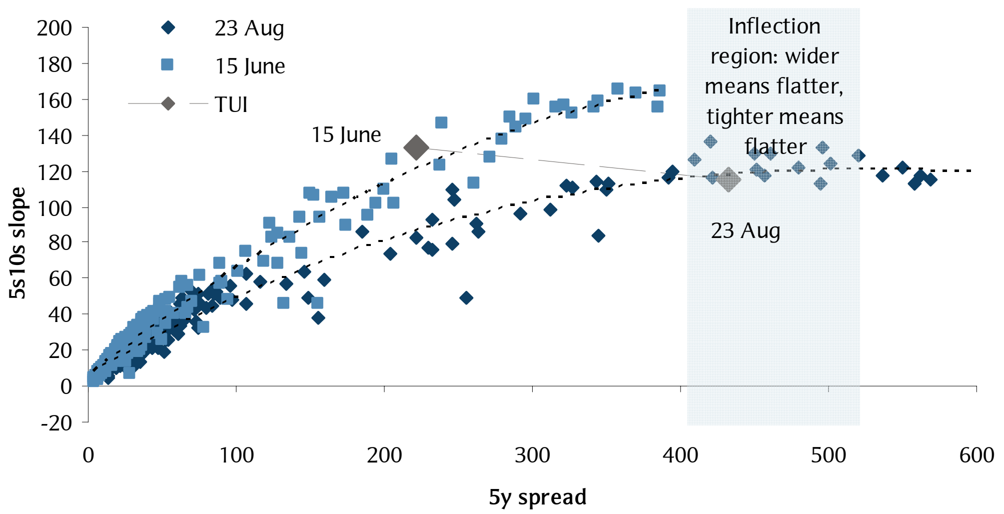
Figure 35: TUI following the cross-section dynamics



Source: MarkIt, Barclays Capital

Finally, Figure 36 shows the same chart but with 23 August data. We see how TUI reaches a critical zone in the cross-section profile. In this zone, any significant idiosyncratic news (leading to movement of TUI on the same cross-section profile) will result in a flatter curve. Hence, the negative idiosyncratic momentum that drove TUI wider will have a diminishing and eventually decreasing effect on the 5s10s curve as the credit gets closer to this inflection region. We illustrate how to potentially profit from curve trades in this region in the example Curve trades as volatility plays: TUI flattener, p.62.

Figure 36: TUI reaching the inflection point.



Source: MarkIt, Barclays Capital

Single-name dynamics: Further topics

Inflection points and the cross section best-fit line

Inflection points: at what point do curves start flattening?

In several of the examples of the previous chapter, we have discussed the idea of curve inflection points – cut-off values of 5 yr spread after which curves begin to flatten rather than widen. This effect is consistent with the observation that companies in distress typically have flat or even inverted curves. We discuss inverted curves later, in Inversions, p.107.

Inflection points are highly time-varying and there is a dependence on the industry sector of the company. We see an example of this in the comparison of Figure 30 and Figure 31 – financials consistently tend to behave in a distressed manner at lower spread levels than corporates. Similarly, US Homebuilders have demonstrated interesting flattening behaviour – see Distressed curves and recovery rates: Case study on US homebuilders – September 2007, p.81.

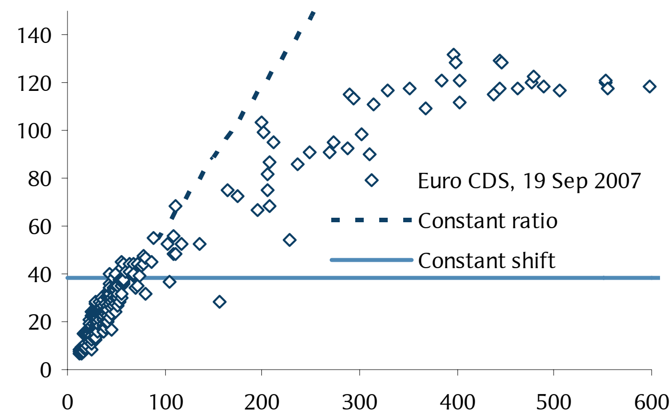
While on this topic it is highly relevant to bring up the question of the appropriate statistical model to use for the fitting of the curve cross-section. A number of possibilities present themselves:

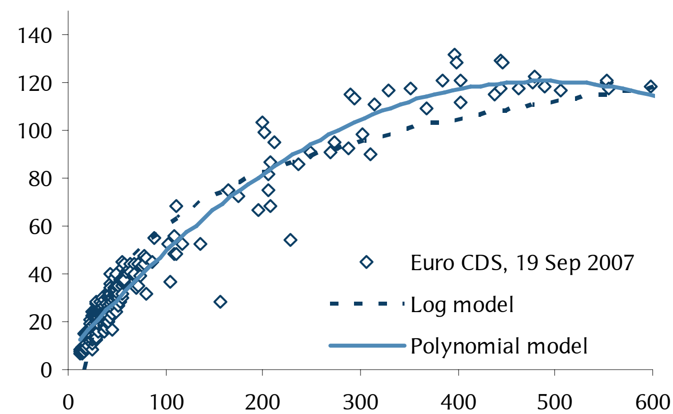
- Constant shift model: $S_{10y} = A + S_{5y}$
- Constant ratio model: $S_{10y} = B \times S_{5y}$
- Log model: $\log S_{10y} = \alpha + \beta \log S_{5y}$
- Polynomial model: $S_{10y} = a_1 + a_2 S_{5y} + a_3 S_{5y}^2 + a_4 S_{5y}^3 + \ldots$

Figure 37 gives an example of the fit quality of these different models for European CDS on 19 September 2007. We return to this discussion in the context of risk-management (see Risk management of portfolios including curve risk, p.98) and curve weighting schemes (see Non-standard weighting schemes, p. 42). However, we see clearly here that the last two models fit the cross-section best.

Figure 37: European CDS cross-section fit models

Poor fit: Constant shift and constant ratio	Better fit: Log and polynomial

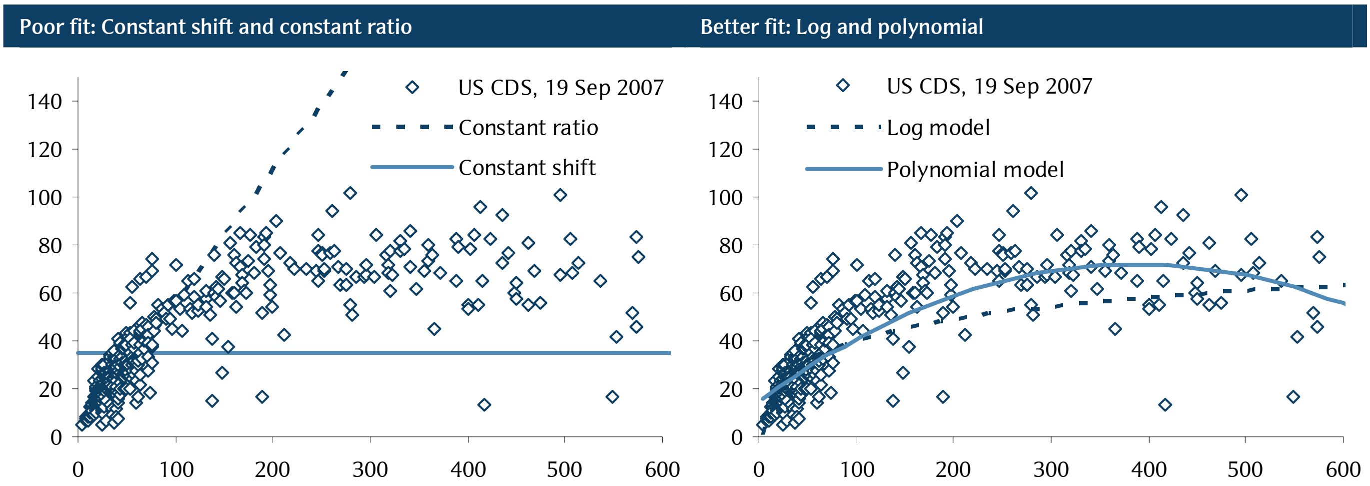




Source: Markit, Barclays Capital

Figure 38 shows a similar picture for US CDS on 19 September 2007. Here we see that, in fact, only the polynomial model is able to deal with the true inflection point. This brings up one of the key issues in fitting the cross-section to include an inflection point – that of having suitable and reliable enough data points out at the extreme spread levels in order to fit a model to. In most benign credit periods there will be very few, if any, such names. In those periods, the log model is sufficient in terms of fit, but will not be accurate for very large changes in spread (precisely – the log-model cannot be used for spread changes extending to spread levels beyond the widest spread name in the universe at that time). Note that it is hard to motivate having a polynomial model with degree higher than three.

Figure 38: US CDS cross-section fit models



Source: Barclays Capital

In periods where there are no distressed names to fit to, it may be possible to artificially add data points from historical periods of distress, where the credit environment otherwise is similar. Although this adds several layers of estimation error to the process, it may be better than to ignore the inflection point possibility altogether.

What drives changes in cross section?

An interesting question is why does the cross-section start to flatten with volatility? Cross-section flattening on volatility is a consistent pattern through time and was by no means an anomaly unique to the summer 2007 period.

Some of the reasons for the change in cross-section over the summer 2007 might include:

- **Re-pricing of risk closer in term structure**: Steep upward sloping curves reflect a market view that default risk is concentrated in the medium to long-term, and that short-term risk is low. In periods such as the summer 2007, there is a rapid readjustment of expectations as the possibility of default rates rising at a nearer horizon increases.
- **Forwards:** Some investors look at implied forward spreads – see Understanding forward spreads, p.113. As spreads widen, if curves are upwards sloping, forward spreads become extremely high. For example, at the height of the volatility in August, some wider-spread Xover names such as NXP traded with 5 yr spreads of 600 bp, 5s10s curves of 120 bp and implied forwards well above 1000 bp. Investors can bet against these extreme forward spreads being realised by trading curve flatteners in various formats.

- **Convexity effects:** DV01-neutral steepener positions are negatively convex (see Convexity effects, p.58) and are therefore painful to hold in periods of high volatility. In some extreme examples, steepener trades lost money despite significant curve steepening.
- **Overcrowded steepeners:** Finally, specific to the 2007 volatility period, many investors holding large steepener portfolios may have decided to unwind with the lack of performance and the negative convexity. Given the popularity of these trade, large-scale unwinds would have a flattening effect.

One final note is that the curve cross-section is also highly affected by technicals such as the synthetic CDO bid – see CDO technicals and curves, p.102 for further discussion.

Why are financials different?

Financials curve cross-sections reach an inflection point at much lower spreads than non-financials

Empirically, we do find that financials' curves in Europe and the US behave differently from corporates – in particular, the threshold after which curves begin to flatten is much lower. Spread-implied default probabilities are still almost negligible at these spread levels, however, and yet the curves are acting as if the names are in distress. For example, on an idiosyncratic basis, we saw Kaupthing trade with a flat curve at various points in 2006 when the 5 yr was trading only in the 60s or 70s. In the US, the brokers' curves, BSC in particular, have traded flat or inverted over the summer, with the 5 yr spreads around 100-140 bp. Typically, we would expect this kind of distressed curve behaviour on corporates only when spreads reach much higher levels.

This reflects, in part, the fact that even moderate spread-levels are unsustainable for most financial companies' business models

The best theoretical argument comes in the form of forward spreads. It can be argued that financials' – especially banks' and insurance companies' – business models require them to be highly rated, and therefore, low-spread names compared with typical corporates. Indeed, their businesses won't survive unless funding levels are reasonable. Current levels would be unsustainable, therefore, on anything other than a short-term basis.

As an example, consider the iTraxx Senior Financials index (a sub-index of the iTraxx Main) on 30 August 2007. Based on the spot curve at 45 bp and 51 bp in the 5 yr and 10 yr, respectively, the 5 yr spread 5 yrs forward is around 60 bp. Although forward spreads typically embed a certain amount of risk premium, it is nonetheless difficult to envisage many scenarios where 5 yr spreads on the iTraxx senior financials would be trading in the 60 bp range in 5 years' time (unless it happens, coincidentally, to be another crisis period). It seems more likely that either the current crisis is resolved and spreads retrace to at least the low 20s, or things get a lot worse with a broader financial crisis and spreads blow out dramatically. Either way, spreads in the 40 bp plus range are unsustainable and curves reflect this.

Insurance steepeners ahead of hurricane season


Model-Based Strategies for Trading Insurance CDS

See *Model-based strategies for trading insurance CDS*, US Alpha Anticipator, March 8, 2007.

This trade recommendation example highlights the pitfalls of expressing bearish views on financials with steepener positions. These trades were caught out in the sub-prime sell-off which drove both sector spreads and idiosyncratic performance on names like Radian.

Trade rationale: In March 2007, our fundamental analyst downgraded his recommendation on the P&C insurance sector to Underweight, partially due to the upcoming hurricane season. In addition, the quantitative directional DIEM signal (discussed more in Directional models, p.124) was negative, and the slope model highlighted several curves as too flat.

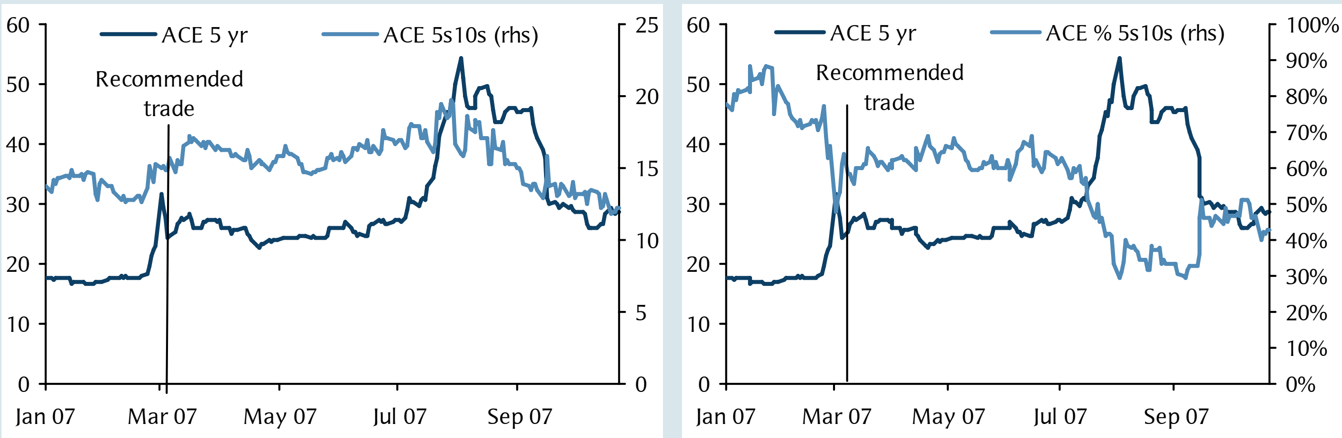
Although 7 yr and 10 yr bespoke activity had likely been responsible for compressing the 5s7s and 5s10s CDS curves, we believed the flattening had been overdone. These views could be expressed via buying 10 yr protection either outright or versus the IG index, but the suggested curve trades benefited from generally positive carry.

Trade format: DV01-neutral 5s7s or 5s10s steepeners on MBIA, CNA Financial, Liberty Mutual, ACE Limited, PMI Group, Radian Group, and MGIC Investment.

Trade evaluation: This trade performed modestly in the first few months but was then rocked by the summer's credit crunch. Both the market-wide sell-off and financial sector behaviour led to significant spread widening. Steepening of the recommended curves was at best limited. ACE, for example, steepened only marginally in absolute terms over the course of the summer, despite its 5 yr spread nearly doubling (Figure 39).

Figure 39: ACE steepened only marginally during the summer, despite a near doubling in 5 yr spreads (bp)

Absolute slope steepened marginally (bp) | **Percentage slope actually flattened**

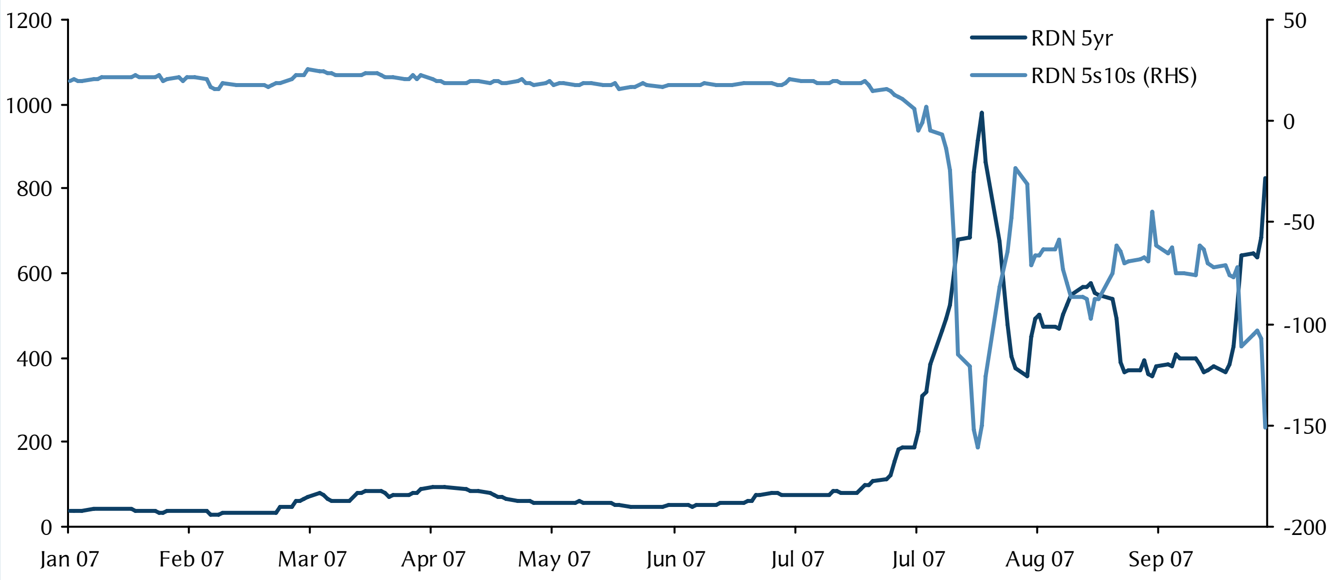


Source: Barclays Capital

Radian has underperformed on a more significant scale (Figure 40), inverting as the extent of its exposure to the US sub-prime residential real estate market bubbled to the fore, causing negative ratings actions and concerns about the viability of its business model.

These insurance steepeners illustrate that, although steepeners can often be a way to structure a positive-carry short, the performance of such trades is affected by market-wide or industry-wide effects. In particular, we were caught out on this trade by the nature of financial companies reaching a bear-flattening threshold at much lower levels than corporates (see Why are financials different?, p.33).

Figure 40: Radian has inverted on US sub-prime concerns



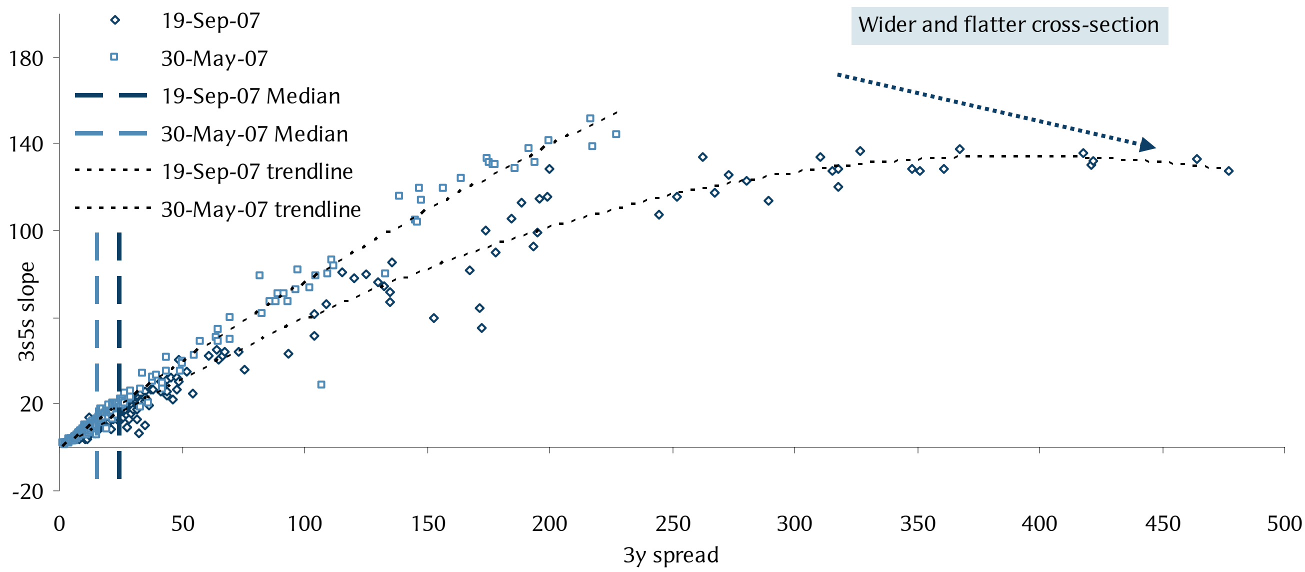
Source: Barclays Capital

What about the front end of the curve?

Most of the analysis so far has been on the 5s10s portion of the curve. In fact, we find the same logic and rules apply for other parts of the curve. In Figure 41 and Figure 42 below we examine the 3s5s curves on European iTraxx Main and Xover names, in an identical fashion to the 5s10s above.

The non-financials chart looks very similar to Figure 30 (the corresponding chart for 5s10s). In this case, the horizontal axis gives 3 yr spread and vertical axis 3s5s slope.

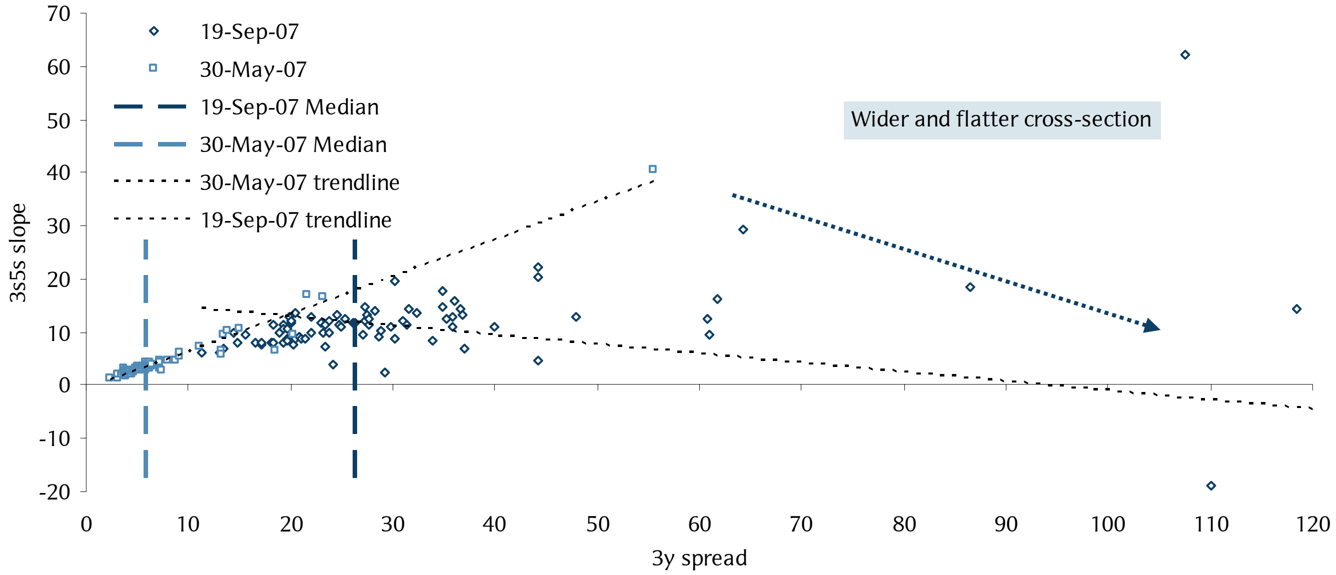
Figure 41: Applying the same tools to the front end of the curve: Non-financials 3s5s curves



Source: Markit, Barclays Capital

Figure 42, showing the financials front-end curves, is again similar to its 5s10s counterpart in Figure 31. It is worth noting that an even shorter-end cross-section such as of 1s2s curves may show even more inverted curves, as very short-dated protection is bid-up on financials due to counterparty hedging.

Figure 42: Financials 3s5s curves – significant inversion behaviour through the summer's turmoil



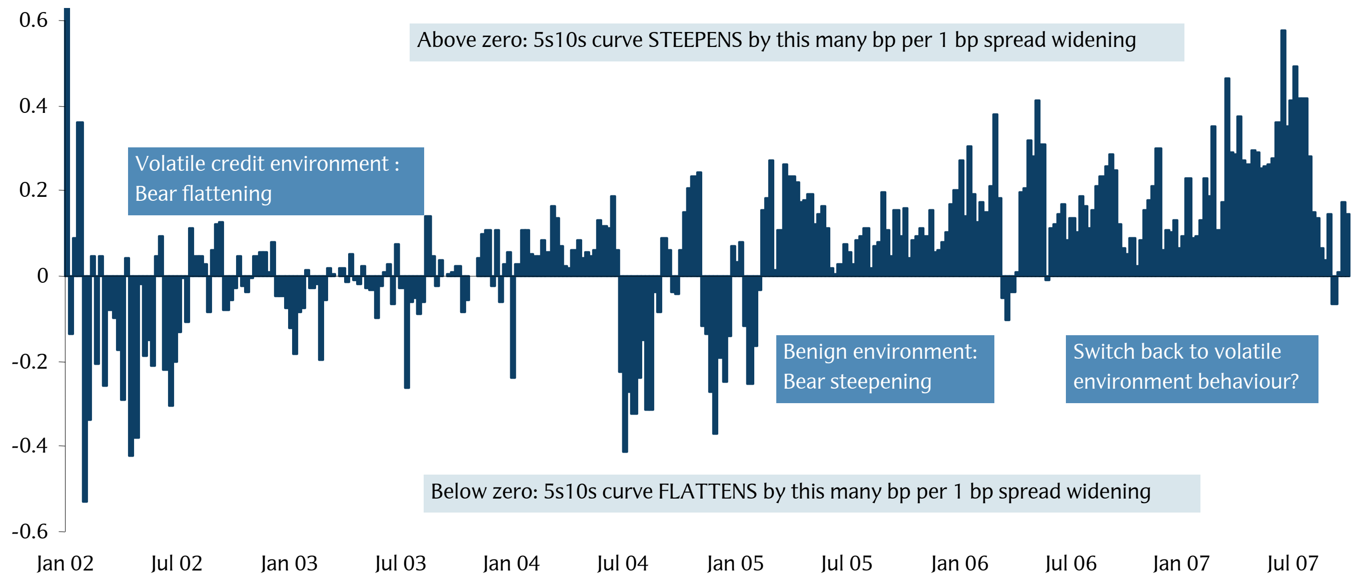
Source: Markit, Barclays Capital

Curve reaction to spread-widening – a systematic test across time

Our final piece of analysis is a systematic test of whether curves are generally reacting in a bear-steepening manner or bear-flattening manner, across different credit market environments. Figure 43 plots results for European CDS from 2002 to 2007. We measure the average response in terms of change in 5s10s curve, for a 1 bp widening in the 5 yr spread. So, when the bars are positive, 5s10s curves typically steepened when spreads widened. When the bars are negative, the curves flattened when spreads widened. When they are around zero, this shows that curves were parallel-shifting.

Although this data series is noisy (due to variable data quality), some overriding patterns are visible, and consistent with our cross-section analysis. Firstly, during the volatile credit market environment of 2002 we see strong negative responses, suggesting bear-flattening behaviour – ie, curves flattened by as much as 0.2 to 0.5 bp per bp that spreads widened, on average. Further to the right, we see the transition into the long credit bull market where we find general bear-steepening behaviour – that is, curves steepening by around 0.3 bp on average for every bp of widening. The last period of August –September 2007 shows a change back to more parallel-shifting and even bear-flattening behaviour.

Figure 43: Response of single-name 5s10s curves to a 1bp widening in the 5 yr, European CDS



Source: Markit, Barclays Capital

So when are steepeners bearish trades?

We conclude from our analysis that, under certain conditions, steepeners do express a bearish view on a credit. Broadly speaking, these conditions are summarised below.

Conditions for using a steepener to express a bearish view

- You are expressing a bearish view for a specific credit on an idiosyncratic basis – not a bearish view on the market. We find that an idiosyncratic-driven widening in spreads on a single-name translates into a steepening of the curve in line with the prevailing curve cross-section relationship.
- Market conditions are reasonably stable – in particular default rates should be low and the curve cross-section upward sloping. We saw that in distressed periods such as 2002, most widening lead to bear-flattening of curves. The curve cross-section changes in market sell-offs – even if it remains upwards sloping, single-name curves need not steepen when spreads widen unless there is idiosyncratic noise.
- If there is a high perceived risk for a company to run into serious trouble or any kind of distress, steepeners are inappropriate. This is especially true of financial companies, as we have discussed, which typically experience bear-flattening at much lower spread levels than non-financials.

Implementing curve trades

Constructing the DV01-neutral steepener

The majority of curve trades are implemented "DV01-neutral". The standard steepener position is constructed by, for example in the case of a 5s10s steepener, selling 5 yr protection and buying 10 yr protection. The term "DV01-neutral" refers to the weighting scheme used – that is, how much notional to buy and sell.

The "DV01" is short for the dollar change in the present value of a CDS contract due to a 1 bp change in the spread. In the next section we take a step back and review exactly what DV01s mean and how they are calculated. Intuitively, they are equivalent to the duration of the position – a DV01-neutral CDS position is analogous to a duration-neutral bond position.

In a DV01-neutral trade, the notionals of protection that are bought and sold on each curve point are chosen so that the DV01 (or duration) of the combined trade is zero. This is simply achieved by using the ratio of DV01s:

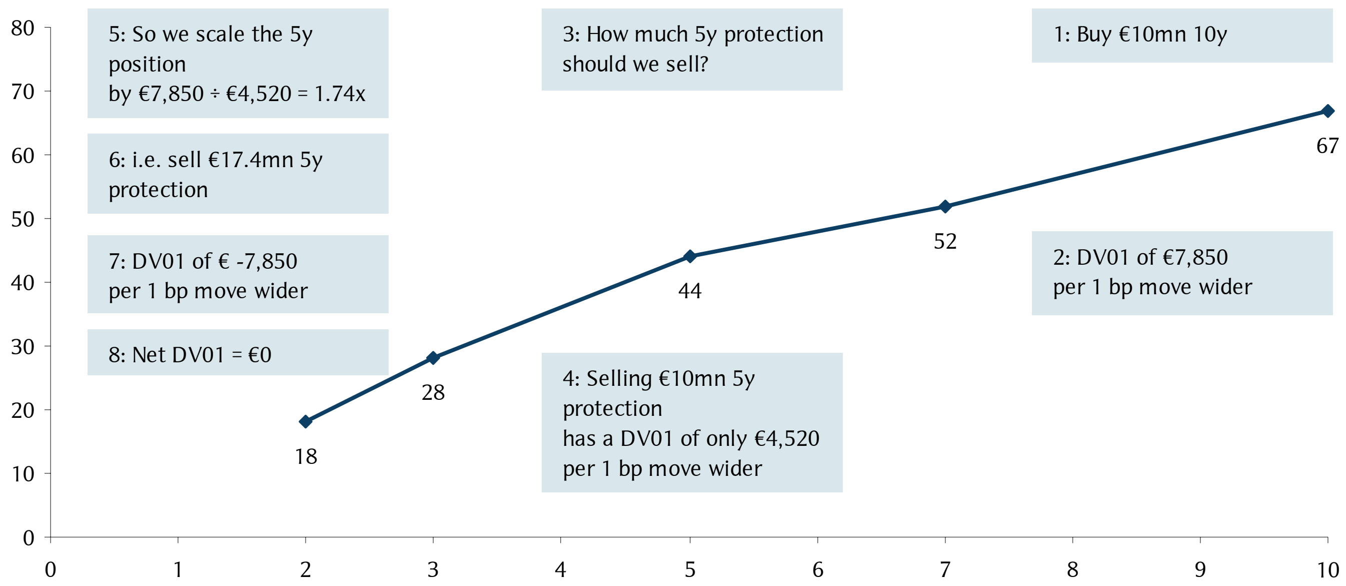
DV01-neutral 5s10s trade: 5 yr notional = DV01(10 yr) ÷ DV01(5 yr) x 10 yr notional

This simple formula is transferable to any part of the credit curve. For a 3s5s steepener, for example:

DV01-neutral 3s5s trade 3 yr notional = DV01(5 yr) ÷ DV01(3 yr) x 5 yr notional

Figure 44 illustrates the calculation for the example of Deutsche Telekom. Follow the numbered boxes to see the steps involved.

Figure 44: Constructing the standard DV01-neutral 5s10s steepener on Deutsche Telekom, 21 August 2007



Source: Markit, Barclays Capital

What are DV01s?

The term DV01 is used constantly in the context of CDS and curve trades in particular. In the context of credit default swaps, DV01 stands for Dollar change in the present Value of the contract, due to a 1 bp move in the spread.

DV01 = Dollar change in PV of the contract due to a 1 bp widening

It is also described as the value today of receiving 1 bp per year for the life of the contract, which is until maturity or until default, whichever occurs sooner. Note also that, similar to a bond's duration, the DV01 can be interpreted as the expected life of the contract.

In the DT example in Figure 44, buying €10mn protection in the 5 yr contract has a DV01 of €4,520. The DV01 is sometimes expressed in bp – eg, 4.52 bp is the fraction of the notional the contract's value increases by for every 1 bp the spread widens.

Visualising the DV01 calculation

The DV01 is calculated by discounting the stream of 1 bp payments by both the risk-free discount factor and the probability that the company has survived. As an example (see Figure 45 and Figure 46), suppose we wish to know the value today of a 1 bp stream for 5 years contingent on the survival of a risky entity. We assume uses a flat swap rate curve at 4.0% and a flat hazard rate curve set at 100 bp (this corresponds to a CDS spread of 60 bp when a recovery rate of 40% is used).

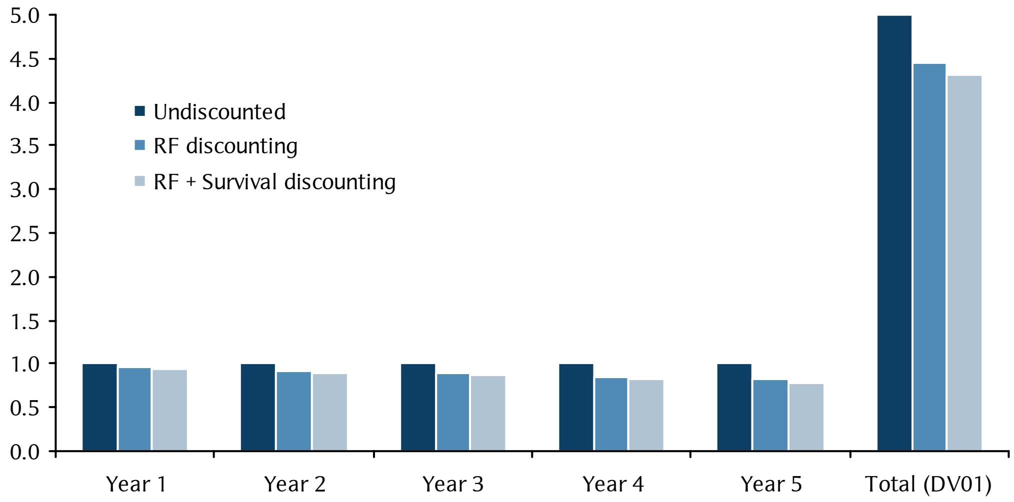
The value today is clearly not the full 5 bp – this ignores the possibility of default and the time value of that stream. Discounting the time-value of money gives us a total value of 4.442 bp for example. We then require one further level of discounting – the survival probability. Each 1 bp cashflow is multiplied by the probability that we actually receive it, which is (of course) always less than 1. In our example, this further discounting brings down the value today of this risky coupon stream to 4.314 bp. This is the CDS DV01.

Figure 45: DV01 illustration – what's the value today of receiving 1 bp per year, for five years?

Discounting	Year 1		Year 2		Year 3		Year 4		Year 5		Total
Undiscounted	1.000	+	1.000	+	1.000	+	1.000	+	1.000	=	5.000
Discounted using risk-free rates	0.961	+	0.923	+	0.887	+	0.852	+	0.819	=	4.442
Discounted using risk-free rates and weighted by the probability of the entity surviving until that year	0.951	+	0.905	+	0.861	+	0.819	+	0.779	=	4.314

Notes: The example here uses a flat swap rate curve at 4.0% and a flat hazard rate curve set at 100 bp. This corresponds to a CDS spread of 60 bp when a recovery rate of 40% is used. Source: Barclays Capital

Figure 46: DV01 illustration – what's the value today of receiving 1 bp per year, for five years?



Source: Barclays Capital

DV01 ratios – some typical values

The tables in Figure 47 and Figure 48 can be used as a rough guide to DV01 ratios. For exact calculations, a proper tool such as those described in Using Bloomberg, p. 47 should be used. The ratio depends, amongst other things, on the curve part (3s5s, 5s10s etc.) and shape, interest rates and the spreads involved.

Note that, on a day-to-day trading basis, changes in swap rates have negligible impact on DV01s.

Figure 47: Typical DV01 ratios, risk-free rates at 4.00%.

5 yr Spread in the region of	Curve shape	3s5s Curve	5s7s Curve	5s10s Curve
50	Upward	1.58	1.32	1.74
	Flat	1.59	1.34	1.79
200	Upward	1.52	1.26	1.55
	Flat	1.55	1.31	1.69
500	Upward	1.42	1.21	1.42
	Flat	1.49	1.26	1.54

Source: Barclays Capital

Figure 48: Typical DV01 ratios, risk free rates at 6.00%.

5 yr Spread in the region of		3s5s	5s7s	5s10s
50	Upward	1.55	1.30	1.67
	Flat	1.56	1.31	1.71
200	Upward	1.50	1.24	1.50
	Flat	1.53	1.29	1.63
500	Upward	1.40	1.19	1.38
	Flat	1.46	1.24	1.49

Source: Barclays Capital

Why DV01-neutral?

It turns out that there are a number of explanations for the use of DV01-neutral, all equivalent in some sense. The convention of using DV01-neutral weightings originates in the interest rate swap world and is analogous to the use of duration-neutral cash bond curve trades.

The most common explanation is that a DV01-neutral curve trade is immune to parallel shifts in the credit curve. That is, the trade has roughly zero mark-to-market when the all points on the CDS curve move in parallel. Why should we want such a property? There are two main reasons:

1) The trade is only exposed to changes in the shape of the curve, and not to parallel changes in the levels of spreads, and,

2) The trade is "hedged" against overall market moves, under the assumption that spreads move in parallel.

To phrase 1) differently, the P&L (ignoring carry) on a DV01-neutral curve trade is directly proportional to the change in the slope of the curve. In the Deutsche Telekom example, for every 1 bp the 10 yr increases we make €7,850, while for every 1 bp the 5 yr increases we lose €7,850. Therefore, the trade P&L is approximately €7,850 times change in 10 yr minus 5 yr spread. To see a more formal derivation of this, refer to Derivation of DV01-neutral weighting, p.143.

Do curves really move in parallel?

Empirically, curves move in parallel as an immediate reaction to market volatility…

Point number 2) above leads us to ask how good is the assumption that market moves will cause curves to move in parallel? In fact we find that curves rarely move in parallel, except in times of sudden market volatility. This was demonstrated in Figure 43 where we saw that curves in general do not move in parallel (the bars are rarely near zero).

When sudden volatility hits the market, the immediate reaction of curves does, however, seem to be a parallel shift, based on empirical observations. This may be simply due to this being the cleanest way to remark curves. Whether curves are tradable in such environments is not so clear. We also highlight in Convexity effects, p. 58, that convexity becomes a significant issue in such times, leading to a potential breakdown in this hedge even if curves move in parallel.

… but then adjust to the new environment after a short lag

In sustained periods of high market volatility, curves stop trading in parallel. This was demonstrated in the summer of 2007 and we discussed this in Curve reaction to spread-widening – a systematic test across time, p.36.

Nonetheless, DV01-neutral curve trades remain the convention and are thus the most efficiently executed format. In the next section we discuss alternative formats for trades.

Non-standard weighting schemes

The topic of weighting schemes for curve trades is a complex one and we will return to it in several chapters and trade examples. In this chapter we give an overview of some of the other options when considering curve weightings. A more formal treatment is given in Calculating weighting schemes, p. 110.

Figure 49 presents a comparison of four potential weighting schemes. In each case we give an example of the 5 yr and 10 yr notionals that would implement these trades on the Deutsche Telekom example of Figure 44.

Figure 49: Curve weightings on Deutsche Telekom, some examples

Weighting Scheme	Example trade weighting of DT 5s10s steepener	Description
DV01-neutral	Sell €17mn of 5 yr, buy €10mn of 10 yr	Take views on the absolute difference between the short and long and spreads. Weighted according to ratio of DV01s.
Notional Neutral	Sell €10mn of 5 yr, buy €10mn of 10 yr	Jump-to-default neutral, highly directional trade. 1-1 weighting of notionals.
Beta or % Neutral	Sell €26mn of 5 yr, buy €10mn of 10 yr	Take views on the slope as a proportion of the 5 yr. Weighted according to ratio of DV01s multiplied by ratio of spreads or ratio of betas.
Statistical Model	Sell €30mn of 5 yr, buy €10mn of 10 yr	Trade designed to be sensitive to pure curve movement in a non-directional fashion. Takes views on whether the curve should steepen or flatten relative to other credits of similar spreads. Weighted according to ratio of DV01s multiplied by ratio of spreads multiplied by time varying scaling factor.

Source: Barclays Capital

Altering the weighting format has many implications for the performance of the trade. These can be summarised as:

- Curve sensitivity: How does the P&L react to changes in slope?
- Trade economics: Carry, roll-down and convexity are all variable according to weights.
- Default risk: Some curve positions have large notional exposures, others can be weighted default-neutral.
- Market risk: Certain weighting schemes are better/worse protected in the event of market volatility.
- Execution: Typically, non DV01-weighted trades are more difficult to execute.
- Directionality: Closely related to market risk and curve sensitivity, directionality refers to the sensitivity of the position to changes in the underlying spreads. See next section.

We leave the calculation of notionals to Calculating weighting schemes, p. 110.

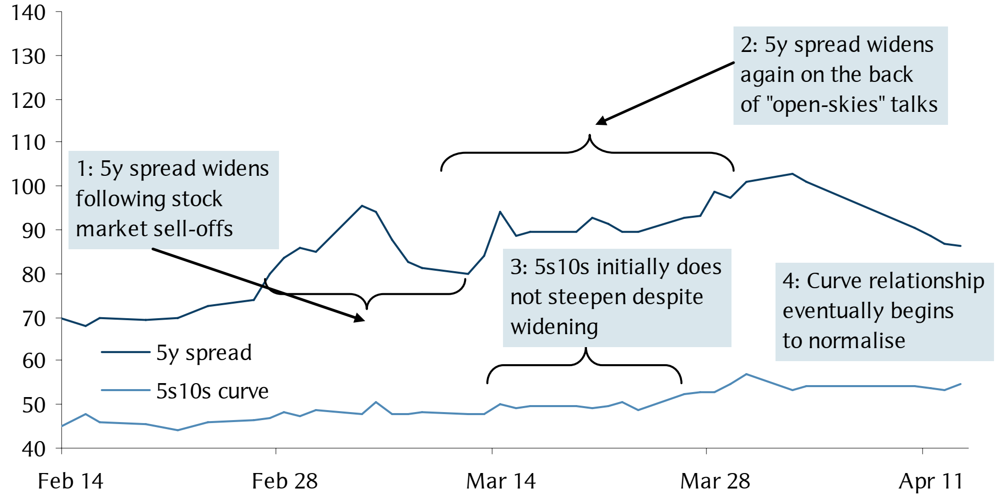
Directionality of curve positions

In several places we refer to the directionality (or, more often, "non-directionality") of curve positions. Directionality is a slightly fuzzy concept relating to the question: how does the curve position perform when the underlying credit spreads generally tighten or widen? The concept was first addressed in Single-name curve dynamics, p.22, where we discussed when and how DV01-neutral steepener positions are 'Bearish' – ie, when does it make sense to implement a bearish view on a credit by entering the steepener.

What if we wanted to take a view on the curve without taking a directional view on the name? For instance, suppose we thought that a curve was too flat, but did not have a view on whether spreads overall should tighten or widen. In such a situation, it is attractive to consider a non-directional format.

We use a statistical model to calculate weights which will be non-directional under certain assumptions. As an example, consider British Airways in March 2007. Figure 50 shows the time-series of 5 yr spreads and 5s10s slope around the time of the "Open-skies" talks.

Figure 50: Analysing British Airways 5 yr and 5s10s time-series - 2007



Source: Markit, Barclays Capital

When the 5s10s curve does not steepen despite the 5 yr widening, a potential trading opportunity arose. We could argue that one of two events was likely – either the 5s10s curve would steepen, to normalise for this new level of 5 yr spread. Or, the 5 yr would retrace back to its pre-news-story levels, leaving the 5s10s ok where it was. Figure 51 compares various payoff scenarios for two possible 5s10s steepener trades. The DV01-weighted trade makes money only in the first scenario while the trade weighted according to our non-directional weights would potentially profit in either scenario.

The risk of the non-directional weights is in the case of a further parallel shift wider.

Figure 51: Comparing payoff of DV01-weights to model weights

5s10s DV01 Neutral Steepener	5s10s Model Weights Steepener
Sell €17mn 5 yr at 92, Buy €10mn 10 yr at 142	Sell €22mn 5 yr at 92, Buy €10mn 10 yr at 142
Trade rationale: Hedged against parallel shifts Profits if 5s10s steepens absolutely	Trade rationale: Hedged against typical directional moves Profits if curve steepens *relative* to 5 yr
P&L Scenarios at 90 days	**P&L Scenarios at 90 days**
5 yr unchanged, 10 yr widens to 158 P&L €141,000	5 yr unchanged, 10 yr widens to 158 €168,000
5 yr falls to 70, 10 yr falls to 120 P&L €23,000	5 yr falls to 70, 10 yr falls to 120 €103,000
5 yr falls to 50, 10 yr falls to 93 P&L € -54,000	5 yr falls to 50, 10 yr falls to 93 €69,000
5 yr widens to 130, 10 yr widens to 180 P&L €32,000	5 yr widens to 130, 10 yr widens to 180 P&L € -32,000

Source: Barclays Capital

One assumption of non-directional weights is that the curve cross-section (see The curve cross-section, p. 23) remains stable during the life of the trade. As such, these trades are suitable for shorter investment horizons and in reasonably stable market conditions.

Curve weightings – some considerations

Figure 52 gives a simple outline of some of the factors that will affect the choice of curve weightings. Weighting schemes are often best understood in the context of actual trade examples. We recommend readers look at examples Curve weightings in practice – US Broker trades, p.46, Curve behaviour around LBO speculation – Alltel, p.71, Uncertain outcomes: Altadis, p.78, Illustrating the framework: Case study on British Airways, p.120

Figure 52: Factors affecting choice of weights

Considerations	Consider these formats
I have a directional view on the name	DV01 or notional
I want to trade on the curve shape - no directional view.	Beta or statistical
I want to minimise jump-to-default risk	Notional
Carry and roll-down are very important	Varies across all trade formats
I want to minimise my P&L in periods of sudden market volatility	DV01
I am concerned about transaction costs and execution	DV01 or notional
I want to position for a relative change in curve shape compared with the peers of this company	Statistical
I want to take a view on the ratios of points on the curve	Beta

Source: Barclays Capital

Figure 53: Summary of weightings – advantages and disadvantages

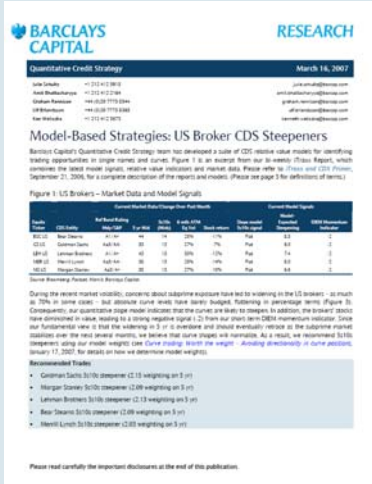
Weighting Scheme	Advantages	Disadvantages
DV01-neutral	Non-directional, but only on assuming curves move in parallel. P&L directly proportional to absolute slope. Simple to implement.	Residual jump-to-default risk. Parallel shifts model shown to be a poor representation of observed curve dynamics.
Notional Neutral	Default risk free up to end of shorter maturity. Allows curve and directional exposure. Similar to a forward contract. Simple to implement.	Not a pure curve trade. Payoff profile hard to separate between direction moves and curve moves.
Beta or % Neutral	Non-directional, assuming curves move in constant ratios. Works well in the lower part of the spread spectrum. P&L directly proportional to percentage-slope. Intuitive.	Residual jump-to-default risk. Constant ratios, although an improvement on parallel shifts, still not perfect.
Statistical Model	Non-directional, assuming curves move according to statistical model. This is the model of curves that best fits observed spreads across the spectrum.	Residual jump-to-default risk. More complex trade to understand and implement.

Source: Barclays Capital

Summary

Using non-standard curve weightings can be a powerful tool. Several examples in this handbook demonstrate this (see Uncertain outcomes: Altadis, p.78, Curve behaviour around LBO speculation – Alltel, p.71 and the British Airways example in Calculating weighting schemes, p.110). However, as with all trades, there is always a risk that events will play out against a position, even if well-motivated at inception. A good example of this is given below on the US Brokers.

Curve weightings in practice – US Broker trades



See ***Model-Based Strategies: US Broker CDS steepeners,*** **16 March 2007.**

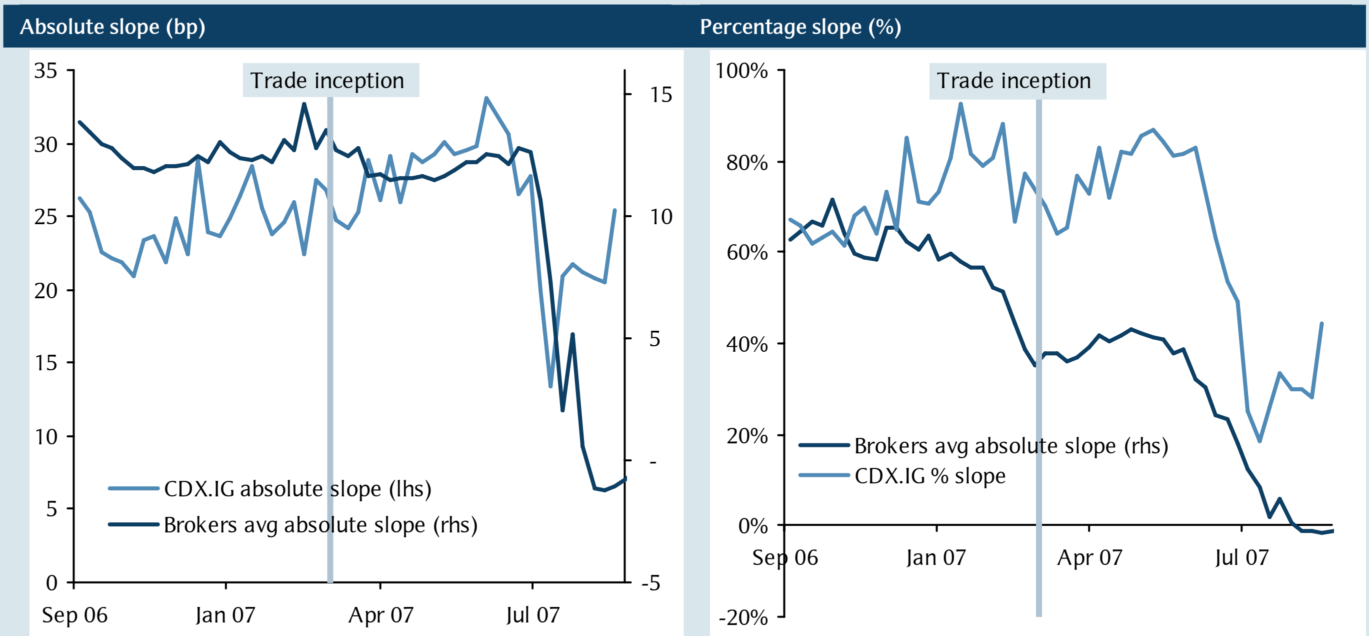
Trade motivation: Following the first sub-prime tremble in the credit markets in February 2007, the brokers widened out significantly but curves stayed very flat. We believed that there was potential for either i) a retracing of spreads on a fundamental good outlook, or, ii) a steepening of the curves to adjust to a wider level. In order to capture a steepening of the curve relative to the 5 yr point we proposed entering the trade in a way that would capture value if either spreads tightened and the curve remained constant, or if the 5 yr did not move and the curve steepened. In other words, we were looking to position for a percentage increase in the slope of the curve.

Trade format: Direction neutral 5s10s steepeners on GS, Merrill, Lehman, Bear, Morgan Stanley: sell approximately 2.1 times notional on the 5 yr versus notional bought on 10 yr.

Trade evaluation: this trade performed well in the first few months, thanks to 5 yr spreads retracing the ground they lost in February/March. However, as the credit crunch hit in the summer, the financial sector was hit particularly badly. 5 yr spreads widened considerably and the curves flattened or inverted. Although spreads have recovered since the height of the turmoil, curves remain inverted or close to inverted.

In retrospect on this trade, we underestimated the risk of severe curve inversion in financials, and the tendency of curves to start to flatten at fairly tight spread levels. With the hindsight of the summer period, we discussed this effect in Why are financials different?, p.33. Nonetheless, conceptually this trade example illustrates the motivation for using non-standard weights.

Figure 54: Broker 5s10s curves have flattened as spreads have widened



Source: Markit, Barclays Capital

Using Bloomberg

Execution of curve trades is straightforward and almost identical in process to any standard CDS trade. The only complication is that curve trades are usually quoted based on the difference in the spreads (eg, a 5s10s curve of 30 bp). In order to calculate actual P&L and other metrics, the precise strikes of the underlyings are required (eg, 5 yr=50 bp and 10 yr=80 bp).

The more complicated practical aspects of curve trades are in the calculation of metrics such as carry & roll-down, and in understanding and managing risks on individual and portfolios of curves.

This chapter discusses the use of Bloomberg tools for running simple calculations and scenario analysis.

Understanding trader runs

Typical trader curve runs quote the curve as the difference in spreads (see Figure 55 as an example). The quotes will be for DV01-neutral format – prices might vary for other weighting schemes (bid-offer will typically be larger). Note that the actual carry and roll-down on the trade will depend on the precise strikes used (ie, the actual 5 yr and 10 yr spread used). Actual strikes need to be confirmed with the trader.

Figure 55: Example trader 5 yr, 5s7s and 5s10s curve run

```
 1                                                              EquityMSG
1<GO>PURGE, 2<GO>REPLY, 3<GO>FWD, 11<GO>NEXT, 12<GO>PREV, 99<GO>MENU OF OPTIONS
         From:•ARUJUNA SIVANANTHAN, BARCLAYS CAPITAL                10/23  9:56:18
      Subject: EURO TELCOS - Pls. refresh
Attachment(s): None                                                   Page  1/  1
TeL: 7773 7899         TMT/Autos/Utils/Perps                  MoB: 07957556935
```

	5YR	5/7s	5/10s
BRITEL	37½ /38½	7/9	18/20
DT	38/39	7/9	18/20
FRTEL	29/30	6/8	16/18
KPN	38/39	8/10	24/26
OTE	43/45	8/10	23/25
PORTEL	46/48	10/12	26/29
TELEFO	37/39	7/9	18/20
TELNOR	31/32	6/8	21/23
TKA	29/31	7/9	18/20
TLIASS	25/27	6/8	17/19
TITIM	48/50	11/13	27/32
VOD	37/38	7/9	18/20

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Source: Bloomberg, Barclays Capital

CDSW screen

The Bloomberg CDSW screen remains the convention for calculating trade metrics and P&L. Although a powerful tool in itself, it is unfortunately very cumbersome for analysing curve trades, as each leg of the trade needs to be analysed separately.

Figure 56 highlights some of the useful parts of screens output in the context of one leg of a curve trade. Bloomberg provides detailed online help for the use of this screen.

Figure 56: Bloomberg CDSW screen: TEF SM Equity CDSW <GO>

```
 <HELP> for explanation.                                   EquityCDSW
1<GO> to save Deal, 2<GO> to save curve source
              CREDIT  DEFAULT  SWAP                          CPU:122
 Deal | Curves | View | Ref. Obligation | Bond Hedge | Forward CDS Matrix | ISDA Info | Amortization
 Deal  Information RED Pair:8FGCBAAC5        | Spreads         DDate
 Reference: Telefonica SA                    | Curve Date:10/23/07
 Counterparty:                 Deal#:        | Benchmark: S 45 AAsk
 Ticker: /      Series:     Privilege: F Firm| EU BGN Swap Curve
 Business Days: EUR         Settlement Code: EUR
 Business Day Adj: 1 Following     Currency: EUR
 B BUY  Notional:   10.00 MM  Amortizing:N   | Sprds:C Contributor AAsk
 Effective Date: 10/24/07     Knock Out: N   | 101450 EUR Senior    IMMI
 Maturity Date:  12/20/12     Day Count: ACT/360 | Par Cds Spreads  Default
 Payment Freq:   Q Quarterly  Month End: N   | Flat:N    (bps)   Prob
 Pay Accrued:    T True       First Cpn: 12/20/07 | 6/20/08   25.899 0.0029
 Curve Recovery: T True  Next to Last Cpn: 9/20/12 |12/22/08  25.899 0.0051
 Recovery Rate:     0.40  Date Gen Method: I IMM |12/21/09   32.900 0.0120
 Deal Spread:     40.400 bps  Debt Type: 1 Senior |12/20/10  36.900 0.0196
 Calculator              Mode: 1 Calc Price  |12/20/11   42.599 0.0299
 Valuation Date: 10/24/07  Model: J  JPMorgan |12/20/12   40.400 0.0347
 Cash Settled On:10/26/07                    |12/22/14   55.400 0.0675
 Price:          100.00000000 Repl Sprd: 40.400 bps |12/20/17 67.900 0.1170
 Principal:              0.00 Days:      0   | Frequency: Q Quarterly
 Accrued:                0.00 Sprd DV01: 4,587.06 | Day Count: ACT/360
 Market Val:             0.00 IR DV01:   .00 | Recovery Rate:    0.40
Australia 61 2 9777 8600    Brazil 5511 3048 4500    Europe 44 20 7330 7500    Germany 49 69 920410
Hong Kong 852 2977 6000 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2007 Bloomberg L.P.
                                                              G657-217-0 23-Oct-2007 10:20:15
```

Source: Bloomberg, Barclays Capital

HGCS curve analysis tool

At the time of writing, Bloomberg had just launched the new HGCS tool, with analysing curve positions in mind. Figure 57 gives an example screenshot of the tool, showing the calculation of useful metrics such as carry, roll and trade P&L.

Figure 57: Bloomberg HGCS curve screen: TEF SM Equity HGCS <GO>

```
 <HELP> for explanation.                                        EquityHG
99<GO> to rebalance
Telefonica SA                                               CDS Switch Analysis
CDS Deals                          Credit Default Spread Curve  21) Fwd Matrix
 CDS-1 Telefonica SA                Par CDS Spreads (bps)       Curve IMM I
 Protection  Buy    Notional (EUR)   10.00 MM   6 Mth  25.899        Curve Roll (bps)
 Term     5 Year    Deal Spread (bps)  40.400   1 Yr   25.899  6 Mth - 1 Yr    0.000
 CDS-2 Telefonica SA                            2 Yr   32.900  1 Yr  - 2 Yr    7.001
 Protection  Sell   Notional (EUR)   10.00 MM   3 Yr   36.900  2 Yr  - 3 Yr    4.000
 Term     7 Year    Deal Spread (bps)  55.400   4 Yr   42.599  3 Yr  - 4 Yr    5.699
Hedge Strategy Valuation                        5 Yr   40.400  4 Yr  - 5 Yr   -2.199
Method  Equal Notional  Change CDS-2 Notional   7 Yr   55.400  5 Yr  - 7 Yr   15.000
Model   B  Bloomberg       99) Rebalance        10 Yr  67.900  7 Yr  - 10 Yr  12.500

Current Valuation            Valuation Date 10/24/2007   Curve Date 10/23/2007
```

Security	Market Value	IR DV01	Sprd DV01	Default Exposure
Buy 5 Yr	0.00	0.00	-4,586.63	-6.00 MM
Sell 7 Yr	0.00	0.00	6,051.72	6.00 MM
Net	0.00	0.00	1,465.09	0.00

```
Forward Valuation   Curve Shift 5.00 %   Valuation Date 04/24/2008   Curve Date 04/23/2008
```

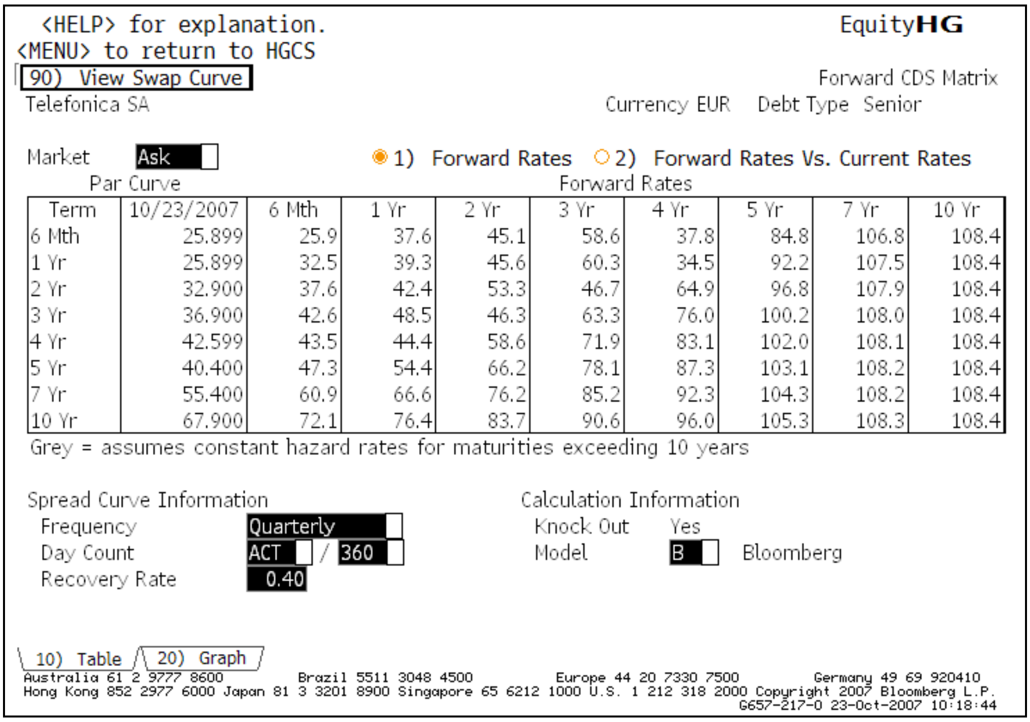
Show Value	Market Value	IR DV01	Sprd DV01	Default Exposure
Buy 5 Yr	27,303.08	7.07	-4,171.06	-5.97 MM
Sell 7 Yr	-27,720.52	-10.19	5,662.79	5.97 MM
Net	-417.44	-3.12	1,491.73	-1,875.78

```
 11) Trade Setup | 12) Scenario
Australia 61 2 9777 8600    Brazil 5511 3048 4500    Europe 44 20 7330 7500    Germany 49 69 920410
Hong Kong 852 2977 6000 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2007 Bloomberg L.P.
                                                              G657-217-0 23-Oct-2007 10:15:44
```

Source: Bloomberg, Barclays Capital

Further tools follow from this screen allowing, for instance the calculation of forward CDS spread for different maturities (see Figure 58).

Figure 58: Bloomberg forward CDS: TEF SM Equity HGCS <GO> 21 <GO>


<HELP> for explanation.
<MENU> to return to HGCS
90) View Swap Curve
EquityHG
Forward CDS Matrix
Telefonica SA
Currency EUR Debt Type Senior

Market Ask
1) Forward Rates 2) Forward Rates Vs. Current Rates

	Par Curve	Forward Rates							
Term	10/23/2007	6 Mth	1 Yr	2 Yr	3 Yr	4 Yr	5 Yr	7 Yr	10 Yr
6 Mth	25.899	25.9	37.6	45.1	58.6	37.8	84.8	106.8	108.4
1 Yr	25.899	32.5	39.3	45.6	60.3	34.5	92.2	107.5	108.4
2 Yr	32.900	37.6	42.4	53.3	46.7	64.9	96.8	107.9	108.4
3 Yr	36.900	42.6	48.5	46.3	63.3	76.0	100.2	108.0	108.4
4 Yr	42.599	43.5	44.4	58.6	71.9	83.1	102.0	108.1	108.4
5 Yr	40.400	47.3	54.4	66.2	78.1	87.3	103.1	108.2	108.4
7 Yr	55.400	60.9	66.6	76.2	85.2	92.3	104.3	108.2	108.4
10 Yr	67.900	72.1	76.4	83.7	90.6	96.0	105.3	108.3	108.4

Grey = assumes constant hazard rates for maturities exceeding 10 years

Spread Curve Information
Frequency Quarterly
Day Count ACT / 360
Recovery Rate 0.40

Calculation Information
Knock Out Yes
Model B Bloomberg

10) Table 20) Graph
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 920410
Hong Kong 852 2977 6000 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2007 Bloomberg L.P.
G657-217-0 23-Oct-2007 10:18:44

Source: Bloomberg, Barclays Capital

A Bloomberg User guide for the HGCS and other related curve functions is available by typing IDOC 2041725 <GO> in a Bloomberg screen.

Using Excel

Sometimes Excel is preferable for calculating simple curve trade analytics, and especially useful for handling multiple trades or portfolios of trades in a way that Bloomberg cannot.

Unless the user has built in CDS analytics for calculating fields like DV01s, approximations have to be made. This makes Excel inappropriate for use on detailed P&L calculations. But for general scenario analysis or to get reasonably accurate indications of economics, Excel works well.

For the calculation of DV01s, one simple option is to use the following approximate formula, which assumes flat spread, swap rate curves and continuous time and coupon accrual.

$$DV01(t) \approx \frac{1-\exp\left[\left(-1\times \text{SwapRate}(t)-\dfrac{\text{Spread}(t)}{1-\text{Recov}}\right)\times t\right]}{\text{SwapRate}(t)+\dfrac{\text{Spread}(t)}{1-\text{Recov}}}$$

Figure 59 shows a screenshot of an example CDS curve trade analysis spreadsheet for calculating:

- Trade weights
- Carry and roll-down
- P&L for different scenarios (including convexity effects).

For simplicity, we have set up this spreadsheet to analyse one trade at a time. By rearranging the sheet it can be made suitable for analysing many positions at once.

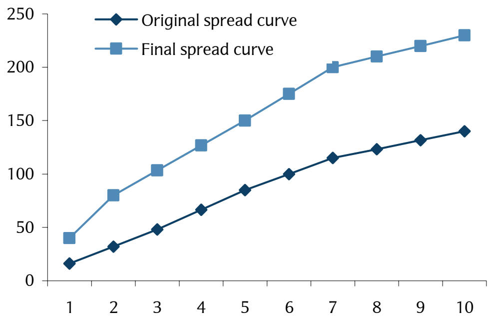
Figure 59: Example of a simple curve trade analysis tool in Excel

Using flat curve approximate DV01s, linear interpolation

BLUE CELLS ARE INPUTS

Recovery:	40%

Tenor	Spreads	Swap Rates	Approx DV01s	Rolldown bp/yr
1	16	4.75	0.98	
2	32	4.45	1.90	16
3	48	4.45	2.78	16
4	67	4.45	3.59	19
5	85	4.45	4.33	19
6	100	4.47	5.02	15
7	115	4.49	5.64	15
8	123	4.52	6.22	8
9	132	4.54	6.75	8
10	140	4.57	7.22	8



Curve trade		Horizon (Mths):	3	*Max 12 months*

Pre trade analytics

Positive notional indicates long protection

Tenor	Notional (€MM)	Carry	Rolldown
1			
2	0.0	€ 0	€ 0
3	0.0	€ 0	€ 0
4	0.0	€ 0	€ 0
5	-16.7	€ 35,417	€ 32,012
6	0.0	€ 0	€ 0
7	0.0	€ 0	€ 0
8	0.0	€ 0	€ 0
9	0.0	€ 0	€ 0
10	10.0	-€ 35,000	-€ 14,806
	Totals	€ 417	€ 17,206

Post trade analytics

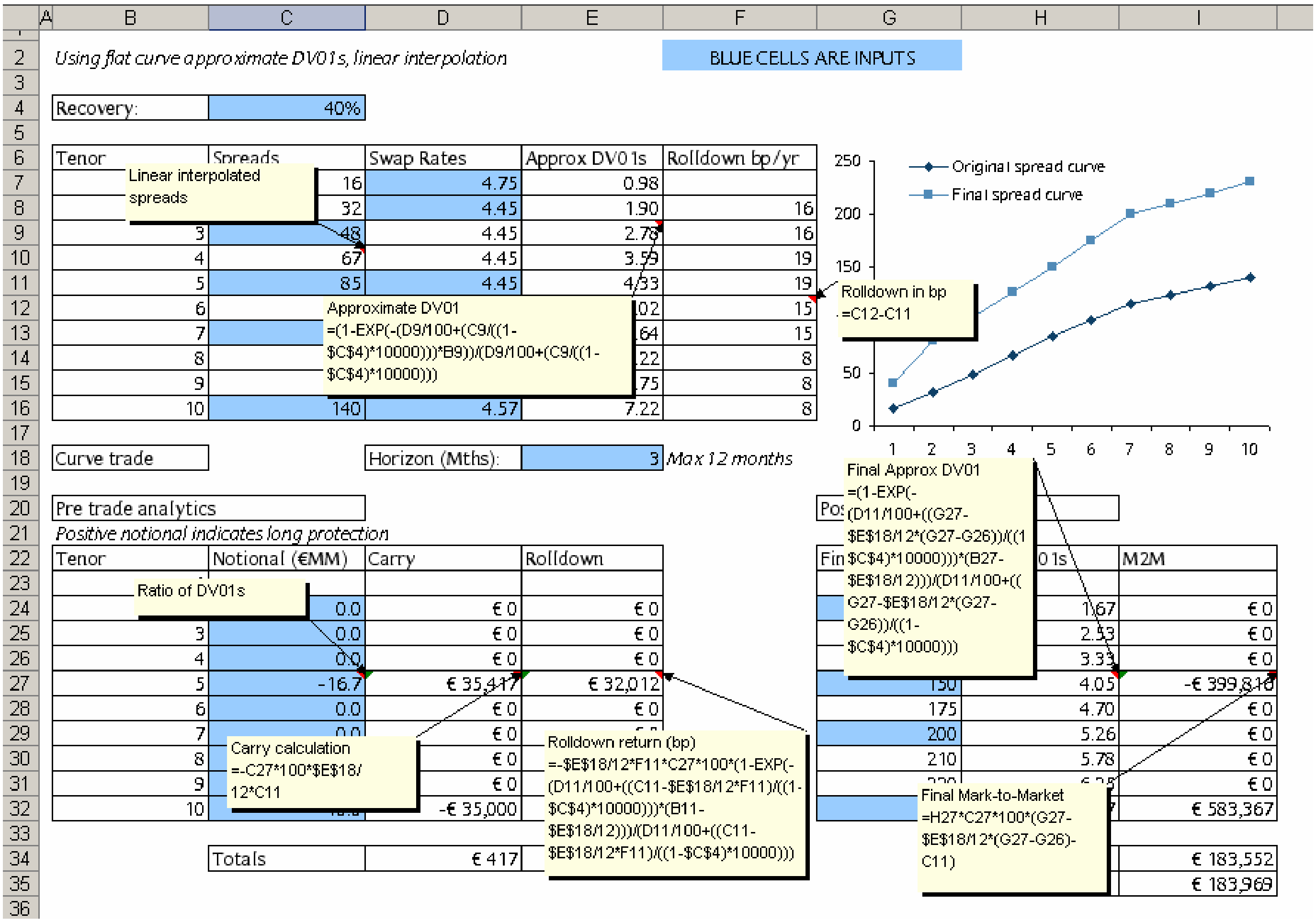
Final Spreads	Final DV01s	M2M
40		
80	1.67	€ 0
103	2.53	€ 0
127	3.33	€ 0
150	4.05	-€ 399,816
175	4.70	€ 0
200	5.26	€ 0
210	5.78	€ 0
220	6.25	€ 0
230	6.67	€ 583,367
	M2M	€ 183,552
	Total (inc carry)	€ 183,969

Source: Barclays Capital

Details of formulas

Figure 60 gives more details on the Excel curve calculator. Specifically, all the non-trivial formulas are explicitly given in this screenshot, using the usual Excel A1 notation. It should be straightforward to reconstruct such a spreadsheet from these formulas.

Figure 60: Details of calculations and formulas



Source: Barclays Capital

Curve trade economics

Factors affecting P&L

One of the most important aspects of curve trading is an understanding of all the factors that impact the economics of the trade. Omission of any factor can cause a trade to perform differently from expectations. Figure 61 summarises these factors. Each will be addressed in this chapter, or subsequent chapters. In trade ideas we recommend (see the many examples in this handbook) we try to address most, if not all of the points in Figure 61.

Figure 61: Factors affecting curve trade P&L

Change in the slope	Clearly, the intention of most (but not all) curve trades is to make money from a change in the shape of the curve.
Weighting of the trade	As we saw in the previous section, the weights used to set up the trade will affect the actual P&L
Carry	The fixed* component of P&L – the carry is fixed at inception
Roll down	In stable market conditions the effect of the decaying maturities on P&L can be significant
Convexity	With high spread volatility, idiosyncratic or systemic, the effect of changing duration ratios on P&L can be substantial.
Transaction costs	Can take out a significant part of P&L.

*Note: * Carry is fixed conditional on no default. Source: Barclays Capital*

Change in curve shape/trade weightings impact on P&L

Usually the most important P&L driver for a curve trade will be the change in the shape of the curve. As described in the previous section, the impact that changes in curve shape have on the P&L of the trade depends on the weighting scheme used. Figure 62 summarises these effects. A more formal derivation of these results is given in Appendix C: Derivations of weighting schemes, p.143.

Figure 62: Curve weightings and the P&L impact of curve change

Curve trade weighting scheme	P&L impact of curve shape change
DV01-neutral	P&L proportional to the absolute slope – slope measured as the *difference* in spreads
Notional-neutral	P&L is proportional to changes in the forward spreads
Percentage-weighted	P&L proportional to the relative slope – relative slope measured as the *ratio* of spreads
Statistical-weighted	P&L proportional to the slope error – slope error is related to the difference between the actual slope and the fair fitted slope

Source: Barclays Capital

Carry and roll-down

In stable credit market conditions, an important metric for analysing a curve trade is how much P&L will be made/lost over the trade horizon assuming the spread curve remains constant. This P&L number is calculated by adding the carry and roll-down.

Carry and roll-down are usually bunched together as a concept when discussing trades. In fact, they are two very different concepts, as illustrated in Figure 66. The key point is that roll-down is a pre-trade scenario analysis. It is the mark-to-market P&L expected if the CDS curve remains exactly as it is. Carry, on the other hand, is a more realisable concept as it is in fact a cash-flow that will be received unless there is a default.

Definition: Carry

Carry is simply the net premium paid or received each year from the different CDS legs that constitute the curve trade, taking into account the notionals on each leg. Carry is fixed at inception and is constant throughout the life of the trade. The only exception is if the trade is held beyond the end of one of the legs of the contract (eg, holding a 5s10s steepener for six years, the 5 yr part will have expired). Naturally, the carry then adjusts to the remaining legs of the trade.

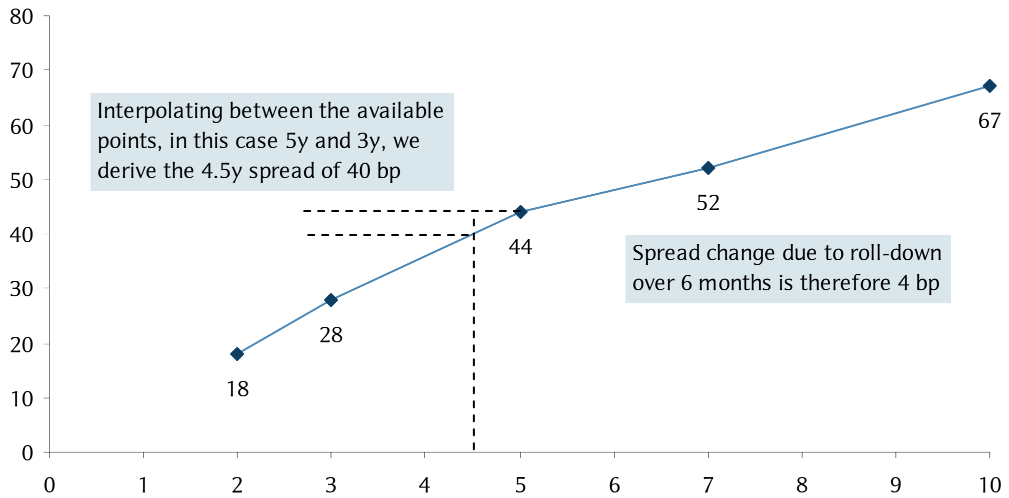
Definition: Roll-down

Roll-down measures the P&L that would be realised purely due to the decaying time-to-maturity of the different CDS legs assuming that the spread curve remains constant. Roll-down is just one potential P&L path. The roll-down is not linear with the horizon of the trade (unlike the carry) – the magnitude and sign of the P&L from roll-down can change with different trade horizons.

Calculating roll-down – an example

Roll-down has to be calculated for each leg of the trade separately. In Figure 63 we present an example calculation for the 5 yr roll-down over six months on Deutsche Telekom for a short €10mn protection position. The 5 yr spread rolls down 4 bp over six months. In order to calculate the return due to this roll-down, we need to know the DV01 after 6 months. Calculating this in Excel or from Bloomberg we get a 4.5 yr DV01 of €4,130. Final roll-down for the 5 yr position is €4,130 x 4 bp = €16,520.

Figure 63: Roll-down computation, Deutsche Telekom 5s10s steepener

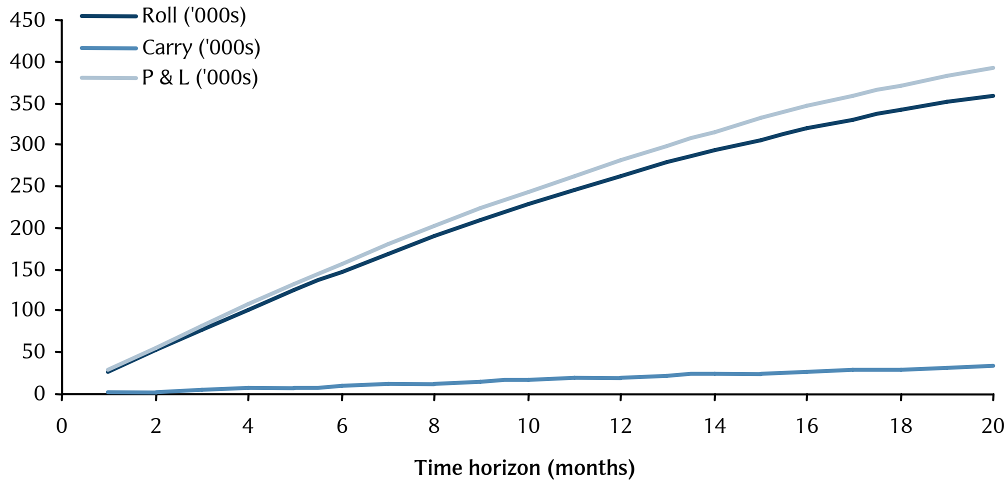


Note: Roll-down is a pre-trade metric of performance assuming the curve remains unchanged. Actual P&L will be based on the final spread curve at the trade horizon date. Source: Barclays Capital

Illustrating carry and roll-down

To illustrate the effects we look at two examples on the Grohe CDS curve from April 2007. Figure 64 shows the carry and roll-down separately, and the total of the two, for different horizons of the scenario. In other words, these are the estimated P&Ls standing at trade inception, due to carry and roll-down, over different horizons. Here we see clearly how the carry is linear and increasing, while the roll-down is also increasing but slightly non-linear (concave). This is due to the fact that the DV01 decays along with the spread.

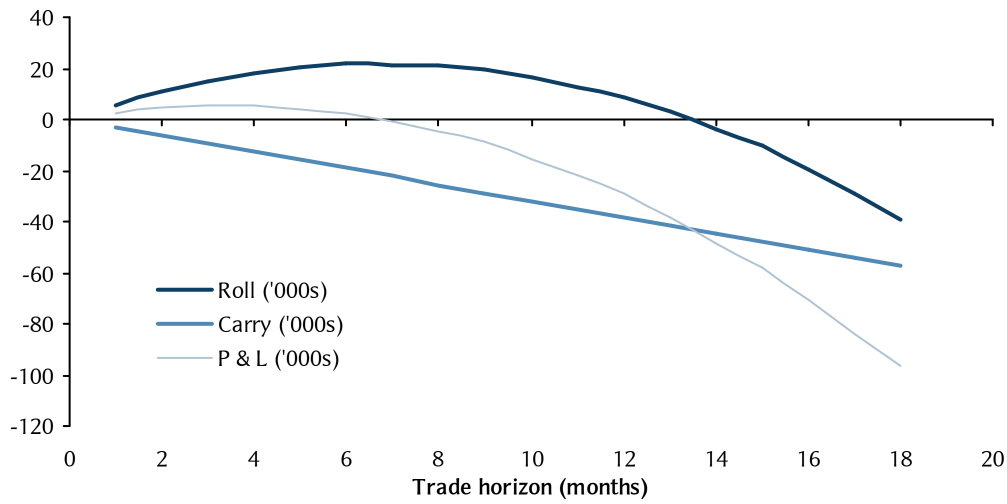
Figure 64: Grohe 5s10s DV01-neutral steepener – straightforward roll-down profile, €10mn position in the 10 yr



Source: Markit, Barclays Capital

In the 5s10s example, the non-linearity of the roll-down does not cause much concern. In other cases it can do. In Figure 65 we look at a 3s5s steepener on the same date. Here we see that the carry is again linear and negative (downward sloping). However, the roll-down varies dramatically, depending on whether we are looking at, for instance a 6 month horizon (positive roll-down) or an 18 month horizon (negative roll-down). The strong concavity here is again caused by the changing DV01s of the positions. Evidently, the overall P&L impact is non-trivial and needs to be calculated at the horizon of interest.

Figure 65: Grohe 3s5s DV01-neutral steepener – complex roll-down profile, €10mn position in the 5 yr



Source: Markit, Barclays Capital

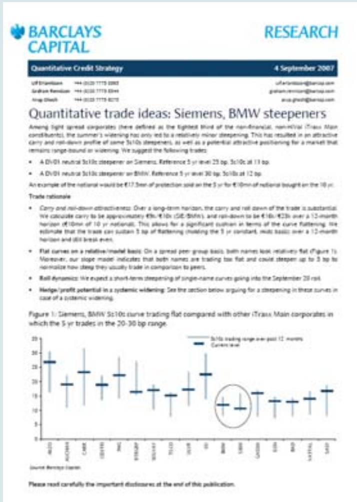
The main conclusion from these examples is simply that, when discussing roll-down on a trade, it has to be in the context of an anticipated holding horizon to be a useful measure.

Figure 66: Carry & roll-down summary

Carry	Rolldown
Fixed – will be realised unless there is a default	Simply the P&L in one scenario (no change)
Linear with the horizon of the trade (1 yr carry = 2 x 6 month carry)	Non-linear – 1 yr estimated roll-down may be different from 2x 6 month estimated roll-down
Relates to an actual cash flow	Only cash-flow realisation is on exiting the trade in the event that the scenario holds (ie, no change).

Source: Barclays Capital

Carry & roll motivation for trades: BMW, Siemens steepeners


BARCLAYS CAPITAL RESEARCH

Quantitative Credit Strategy 4 September 2007

Quantitative trade ideas: Siemens, BMW steepeners

See *Quantitative trade ideas: Siemens, BMW steepeners*, 4 September 2007.

Trade rationale: In certain circumstances, the carry and roll profile can be a central motivation for a trade. In *Quantitative trade ideas: Siemens, BMW steepeners*, 4 September, 2007, we recommended putting on 5s10s steepeners on both names due to attractive carry and rolldown, as well as a relative value call on the respective curve slopes.

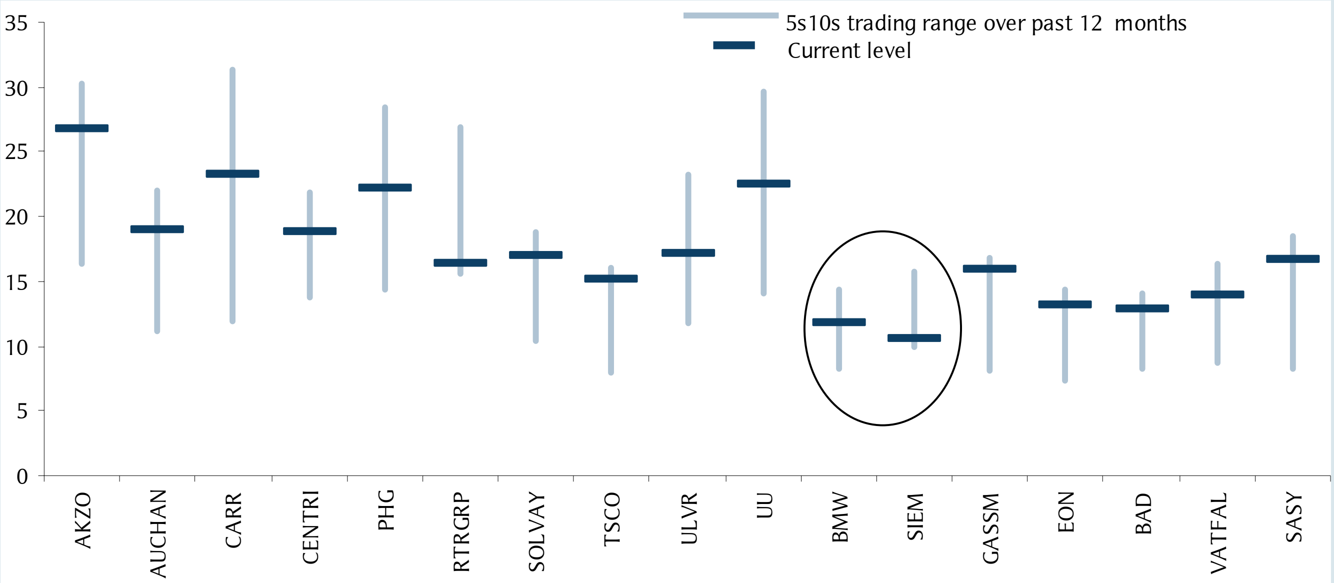
Trade format: DV01 neutral 5s10s steepener on Siemens and BMW, selling €17.5mn 5 yr against buying €10mn 10 yr. Siemens reference 5 yr level 25 bp, 5s10s at 11 bp, BMW, reference 5 yr level 30 bp, 5s10s at 12 bp.

Over a long-term horizon, the carry and roll down of the trade was calculated to be substantial. We estimated carry to be approximately €9k/€10k (SIE/BMW), and roll-down to be €16k/€23k over a 12-month horizon (€10mn of 10 yr notional). This would allow for a significant cushion in terms of the curve flattening. We estimated that the trade could sustain 5 bp of flattening (holding the 5 yr constant, mids basis) over a 12-month horizon and still break even.

On a longer horizon, the trade consequently appeared fairly well cushioned from substantial curve flattening. On the flip side, the steepener gave exposure to a potential normalisation of flat curves (see Figure 67) on a relative value basis.

On an idiosyncratic basis, positive news appeared likely to convert into only modest flattening, again to be assimilated by the roll-down cushion on a longer horizon. Negative news, however, would potentially give a fairly strong upside, as tight spread names experience relatively more steepening as they go wider compared with wider spreads names.

Figure 67: Siemens, BMW 5s10s curve trading flat compared with other iTraxx Main corporates in which the 5 yr trades in the 20-30 bp range

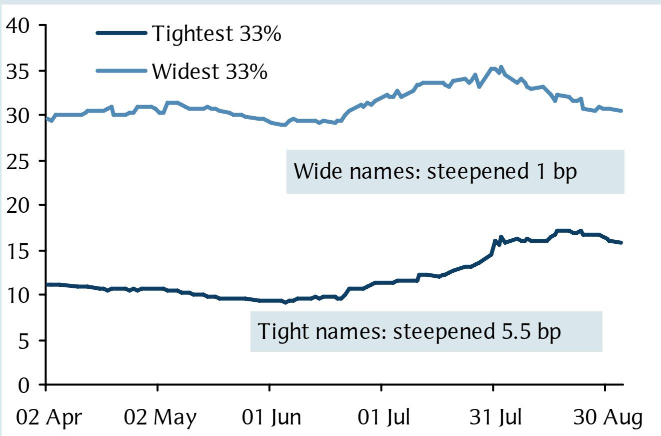


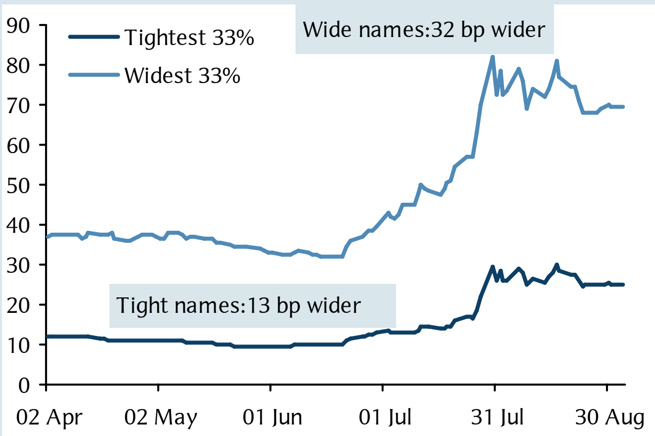
Source: Barclays Capital

A second concern was how these steepeners would perform in case of a renewed systemic widening. As we have shown, market curve flattening would in that case have been likely to reoccur. Again, the argument went that tight spread names, as shown in Figure 68, actually steepened a fair amount during the systemic widening but not as to fully offset the flattening that went on in wider spread names.

corporates steepened more than wider credit in the systemic widening

Average iTraxx Main corporate 5s10s curves, bp.	Average iTraxx Main corporate 5 yr spread, bp.





Source: Markit, Barclays Capital

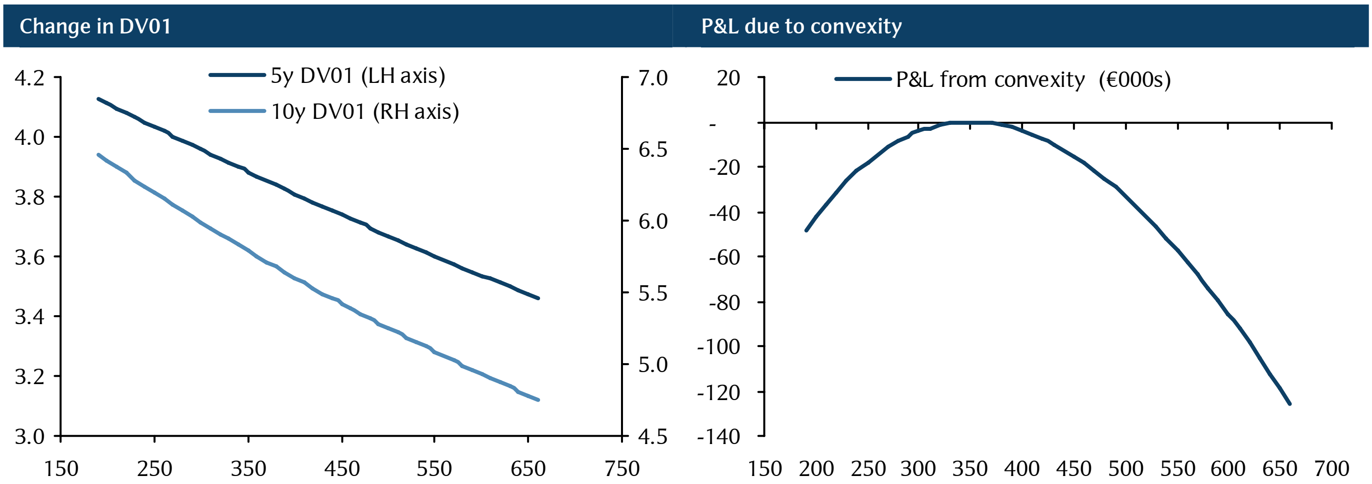
Trade evaluation: As a longer-term trade on low-beta credits, it was too soon to evaluate this trade at the time of writing.

Convexity effects

Convexity turns out to be an important effect in curve trades. The term “convexity” in the context of CDS trades refers simply to the fact that the DV01 of a contract changes as spreads change. This becomes important for curve trades as the DV01-ratio also changes, leaving positions potentially over- or under-hedged.

Convexity is sometimes thought of as a secondary effect in terms of P&L. In curve trades, however, convexity effects become much more pronounced compared with only selling or buying protection. The magnitudes for the iTraxx Xover index are given as an example in Figure 69. Convexity is also more significant for higher spread names/high volatility scenarios. As a rule of thumb, any P&L scenario that involves a 5 yr spread change of more than 100 bp, convexity should be taken into account.

Figure 69: P&L effect of convexity of a 5s10s steepener on the Xover Series 7



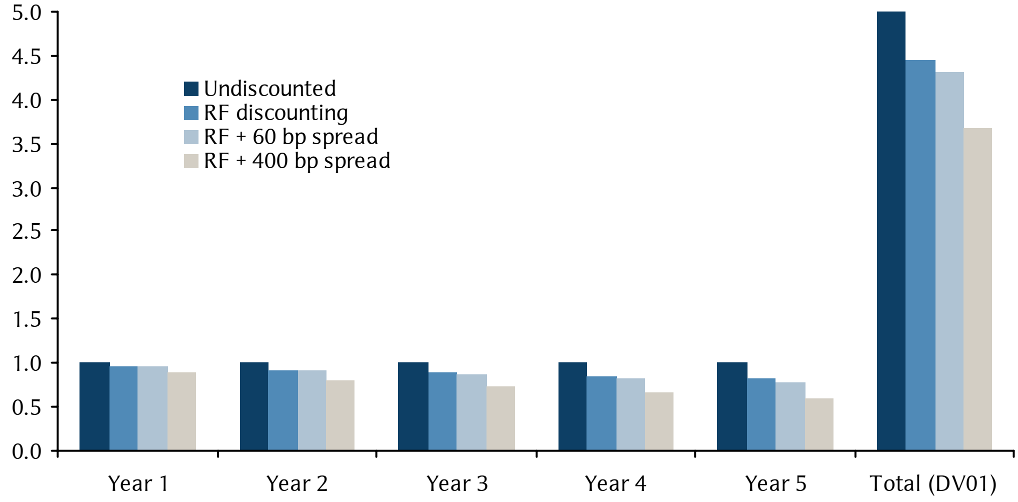
Notes: Struck at 86 bp (index 5 yr ref: 350 bp). Notional on the 10 yr is €10mn.The x-axis is the 5 yr spread, and we assume that the 5s10s stays constant.
Source: Markit, Barclays Capital

What is convexity and how does it affect P&L?

When spreads are volatile, convexity becomes a significant contributor to P&L. For curve trades in particular, the effect of convexity is sometimes not intuitive. Convexity refers to the change in the DV01 that results from changes in spread. The mark-to-market on a default swap is calculated by multiplying the change in spread by the DV01 *at the time of closing the trade*. This final DV01 is based on the final spread curve. The DV01 at trade inception (used, for instance, in calculating weights) is irrelevant in calculating the mark-to-market.

An illustration of the effect of change in spread on the DV01 is given in Figure 70. Increasing the spread reduces the survival probability and therefore increases the discounting of cash flows. This results in a lower DV01.

Figure 70: Understanding convexity – with a higher spread, the coupon stream is discounted at a higher rate, resulting in a lower DV01



Source: Barclays Capital

How does this affect P&L? This is best understood in the following worked example:

Convexity – worked example

Suppose we sell €10mn 5 yr protection on a name at 50 bp. The DV01 at inception is approximately €-4,660 (the loss per bp of widening).

Suppose the spread widens immediately to 500 bp, and we consider closing the transaction by buying back €10mn 5 yr protection at 500 bp.

This will lock in a loss of 500 bp minus 50 bp = 450 bp per year for the five years.

However, with spreads at 500 bp, the market implied probability of default has risen dramatically.

Therefore, there is a greater chance that the company defaults before year 5, and that we may not need to make all 5 of the 450 bp payments.

In fact, the new DV01 has fallen to €-3,900 per bp. The change is due to the extra discounting caused by the lower probability of the company surviving until year 5.

The P&L on the trade is then 450 bp x €-3,900 = €-1,755,000

Note that this is less than if we had used the original DV01:

450 bp x €-4,660 = €-2,097,000

Selling protection, therefore, is described as a positive convexity position.

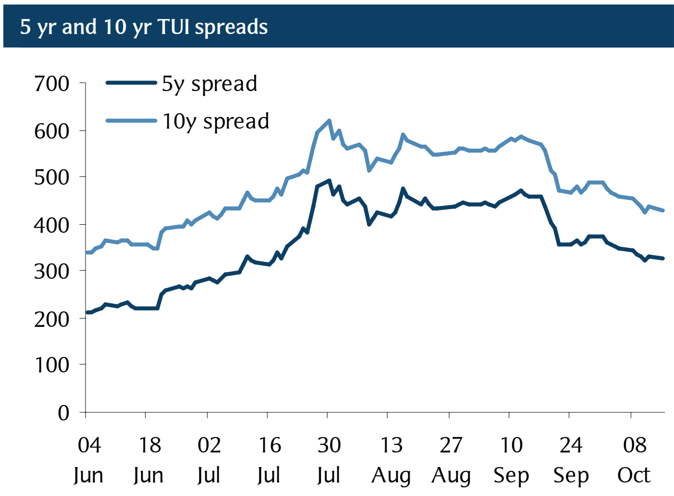
Convexity in curve trades

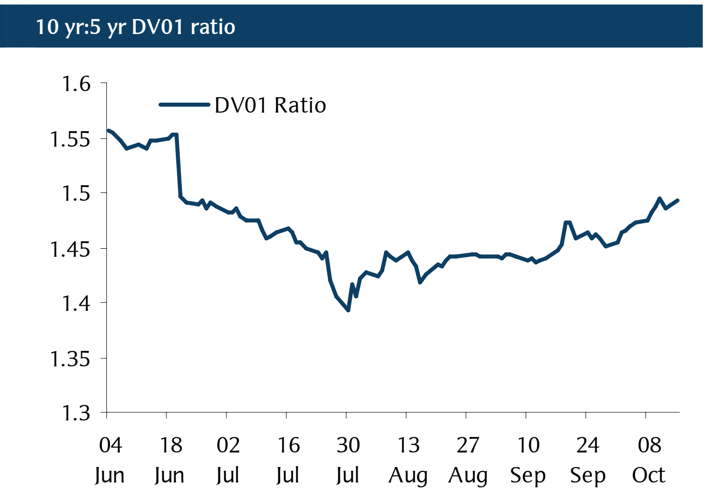
Convexity effects in curve trades can be complicated to understand. The sign and magnitude of the effect depends on the tenors involved in the trade, the direction (steepener or flattener) and the notionals used. We recommend using a scenario analysis to determine the effect of convexity (see previous section).

In DV01-neutral curve trades the effect of convexity is best understood in the context of a change in the hedge ratio – ie, the initial DV01-ratio used to weight the trade. Figure 71 demonstrates this by looking at TUI during the volatility of July/August 2007. A DV01-neutral 5s10s steepener trade initiated at the beginning of June would have been constructed with a hedge ratio of 1.56:1. However, at the peak of spreads on 30 July, that ratio had fallen to 1.39:1. The result of this is that we had sold too much 5 yr protection at inception.

To understand the P&L impact of this, suppose that the 5 yr and 10 yr spreads moved out by the same amount. The trade should have a zero P&L, as it is DV01-neutral, but in fact it does not, because the DV01-neutral hedge ratio changed. The residual P&L is due to convexity. Suppose we had a €10mn notional position on the 10 yr and €15.6mn on the 5 yr, then we would be over-hedged by €1.7mn (€1.7mn = €15.6mn - €13.9mn, where €13.9mn is the 5 yr hedge amount based on the new DV01 ratio of 1.39:1). What this means is that the loss due to the widening in the 5 yr is compensated by the gain in the widening on the 10 yr for all but this €1.7mn. So we take a loss equal to the final 5 yr DV01 x change in 5 yr spread since inception x €1.7mn.

Figure 71: Impact of convexity on the DV01 ratio – TUI CDS, Jun-Oct 2007





Source: Markit, Barclays Capital

Some general rules apply. For DV01-neutral trades:

A **flattener** typically has **positive convexity** – that is, losses from a steepening are dampened by convexity, gains from a flattening are exaggerated.

A **steepener** typically has **negative convexity** – that is, gains from a steepening are depleted by convexity, losses from a flattening are exacerbated.

Note on terminology:

Terminology involving convexity can be confusing, even just in the context of CDS. The concept of convexity we discuss here relates to the impact of change in DV01 on the mark-to-market of positions.

Convexity can also refer to the sensitivity of a CDS position to changes in DV01. This is then an ex-ante risk-measure and is calculated as the second derivative of the present value of the CDS with respect to the spread.

For example, selling €10mn 5 yr protection at 100 bp with a DV01 of €-4,338 has a convexity – as a sensitivity – of about €3. That is, for every bp the spread widens, the DV01 drops by €3.

Managing convexity

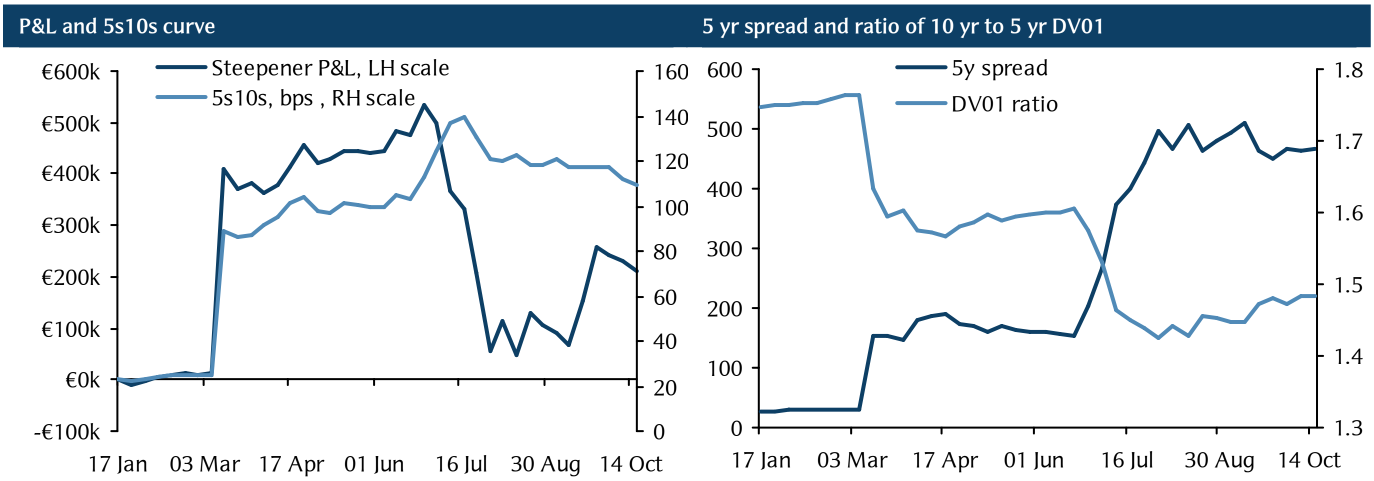
A first step in managing convexity in curve portfolios is to estimate the true aggregate exposure across positions. In particular, an accurate scenario analysis tool (a simple example of which is given in Using Excel, p.49) allows for stress tests on a portfolio to examine the convexity impact of large spread moves. Convexity on a macro-scale can be reduced through the use of carefully selected offsetting index positions (see Hedging curve portfolios, p.97). At an individual trade level, convexity is hard to eliminate. One option is to modify curve weights in anticipation of a specific large move (for example under-hedge a steepener when a move of 100 bp plus in the 5 yr is predicted).

Case study: Why convexity matters – Boots steepener

So how significant can convexity be in terms of realised P&L? The case of Boots provides a good example. In January, 2007, the 5 yr Boots CDS traded in the mid 20s, with a 5s10s curve in the low 20s. A common position was to put on a DV01 neutral steepener on the credit in order to benefit from LBO activity. In Figure 72, we show the time-series of P&L for the Boots steepener put on at these levels with trade inception 17 January, 2007, and on the March contract. As a pending LBO deal on Boots was announced in March, the 5 yr widened out to 150 bp overnight, with the curve steepening to the 90 bp region. At this point, a 10 yr €10mn notional DV01 neutral steepener would have generated roughly €400k of P&L, as illustrated in Figure 72, left hand panel. The curve continued to steepen through the first half of the summer, eventually making the trade reach €500k in P&L. At this point the 5 yr traded at 200 bp.

Now, with the market general widening throughout the latter half of July, Boots also widened, eventually reaching 500 bp in the 5 yr. The curve flattened marginally, but despite this marginal curve movement, P&L more than halved. At the peak of spread, as we show below, P&L was even down to €48k. This was a pure convexity effect: as we can see in the right hand panel of Figure 72, the ratio of DV01s dropped radically, from 1.75 when the trade was struck to below 1.5 as the 5 yr widened out.

Figure 72: The Boots steepener was highly affected by convexity



Source: MarkIt, Barclays Capital

Figure 73 provides more detail on each of the legs of the steepener trade: before the LBO widening, after the LBO widening but before the market widening and post the market widening. We can see, for example, that the although the curve steepened by 23 bp between 6 June and 15 August, the trade actually lost €400k due to the DV01 of the 10 yr leg decreasing much faster then the DV01 of the 5 yr.

Figure 73: Boots 5s10s steepener performance snapshots, trade struck at 23 bp, 17 January

	Sell 5 yr protection, €17.5mn notional			Buy 10 yr protection, €10mn notional			Curve		
	Spread	DV01	P&L	Spread	DV01	P&L	Spread	DV01 ratio	P&L
17 Jan 07	27	4.67	€0k	50	8.15	€0k	23	1.75	€0k
06 Jun 07	159	4.36	-€988k	259	6.97	€1432k	100	1.60	€444k
15 Aug 07	508	3.80	-€3045k	630	5.42	€3093k	123	1.43	€48k

Source: MarkIt, Barclays Capital

Curve trades as volatility plays: TUI flattener

See *Quantitative trade ideas: TUI 5s10s flattener*, 23 August, 2007.

Trade rationale: Following the general widening in the summer of 2007, we saw high spread iTraxx Xover names being pushed over the "hump" in curve dynamics, ie, they reached a point where significant curve flattening could be either bullish or bearish. For these names, curve trades tended to be more volatility positioning and less of a directional play.

Trade format: Put on the 5s10s DV01 neutral flattener, €14mn long 5 yr protection versus €10mn short 10 yr protection. Ref 5s10s level: 113 bp.

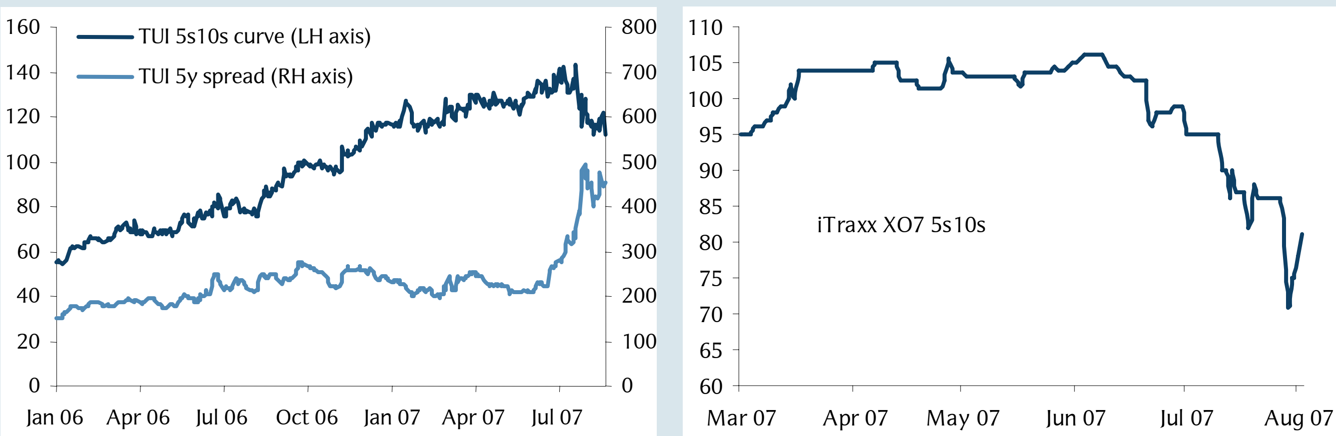
TUI was clearly trading in the spread range where idiosyncratic moves of larger magnitudes would lead to curve flattening. Moreover, a flattener at these levels had significant positive convexity, making the trade benefit from any volatility, which we held as likely.

Lastly, the index curve skew was at the time highly negative, ie, the index curve traded 14 bp flatter than the intrinsic curve. With general market dynamics geared towards more curve flattening, we saw little probability of a sharp steepening of the curve. Hence, the main downside of the trade was the cost of holding this position, calculated to be €87k over three months.

Trade evaluation: curves continued to flatten in September and October. The curve traded down to 101 bp, marking on 19 October.

Figure 74: TUI 5s10s still at historically steep levels – contrasting with the recent index flattening

Although the TUI 5 yr has widened, the 5s10s is still at steep levels – the flattener has limited downside therefore, in our view	Flattening momentum has been strong in the Xover index, especially in wider spread names



Source: Markit, Barclays Capital

Understanding curve trade P&L

This short chapter reviews the exact calculations of P&L, to complete the preceding chapters on curve trade economics. P&L on curve trades is simply computed from the P&L on the underlying CDS legs.

As an example, consider the following calculation for the P&L on a 5s10s DV01-neutral steepener, initiated at time 0 and closed after *T* years. Spr_t^M denotes the *M*-year spread at time *t*. $DV01_t^M$ denotes the DV01 for *M* years starting at time *t*. *N* is the notional on the 10 yr leg.

5 yr leg P&L = Hedge ratio x [Carry + Mark-to-Market] x Notional

$$= \frac{DV01_0^{10}}{DV01_0^5}\left[T \times Spr_0^5 - DV01_T^{5-T}\left(Spr_T^{5-T} - Spr_0^5\right)\right] \times N$$

10 yr leg P&L = Hedge ratio x [Carry + Mark-to-Market] x Notional

$$= -1 \times \left[T \times Spr_0^{10} - DV01_T^{10-T}\left(Spr_T^{10-T} - Spr_0^{10}\right)\right] \times N$$

The combined P&Ls give the total for the steepener. The important subtleties of these formulas are:

- The mark-to-market portion of the P&L depends on the DV01 at the time of closing the trade and not the DV01 at inception (which the hedge-ratio is based on).
- The spread used in the mark-to-market at time *T* is the “rolled-down” spread – ie, the spread with, for example 5-*T* years left to maturity, in the case of the 5 yr calculation.
- The carry component simply scales with the investment horizon *T*.

Transaction costs

The final part of curve trade economics picture is the transaction costs. Transaction costs can be a significant portion of curve trade P&L, especially for higher spread names. In stable market conditions, the bid-offer on DV01-neutral trades ranges from 1-2 bp on names in the 20-50 range of 5 yr spreads, increasing to 4-5 bp for names in the 50-150 bp range and then around 10 bp for the wider spread names. However, costs do vary across names and through time.

In many of our trade idea examples we specifically comment on the impact of transaction costs on the trade.

Execution issues

Related closely to the transaction cost issue is that of execution. The volatile period of summer 2007 showed that, despite the deepening of the CDS curve market, liquidity does still fall sharply during volatile or crisis periods. This can make certain positions difficult or expensive to exit from, especially on higher spread names and on less liquid parts of the curve (eg, away from 3 yr, 5 yr, 7 yr and 10 yr, typically).

Although liquidity should steadily continue to improve, we believe it is an essential part of the risk management of a curve portfolio to stress test for volatile conditions. Ideally, the portfolio will have some built-in hedges (see Hedging curve portfolios, p.97) to help avoid forced unwinds of positions at unfavourable levels. Such stress testing should certainly include the impact of convexity (see Convexity effects, p.58). As a second solution, one should investigate the possibility to proxy-hedge an illiquid point of the curve with a more liquid point.

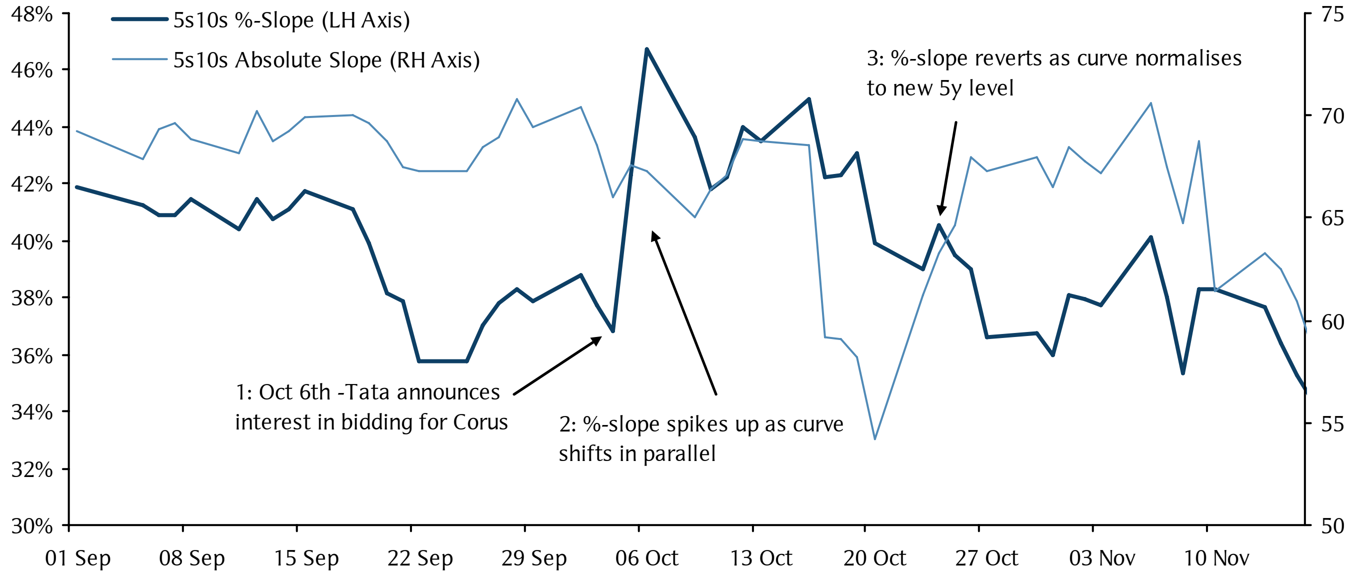
Curve weightings and P&L

This chapter is dedicated to two examples of hypothetical trades on Corus and RadioShack. The examples illustrate many of the ideas and calculations from the previous few chapters, in particular understanding the impact of different curve weightings.

Case study: Corus/Tata bid speculation, Oct-Nov 2006

Our first example looks at Corus 5s10s CDS around the announcement by Tata Steel about a potential bid for the UK company. Figure 75 shows a chart of the actual 5s10s slope (shown on the right-hand axis) over the period 1 September to 15 November 2006. Shown on the left-hand axis is the 5s10s percentage-slope (that is, 5s10s slope divided by 5 yr spread) over the same period.

Figure 75: Corus 5s10s slope and percentage-slope time series – 2006

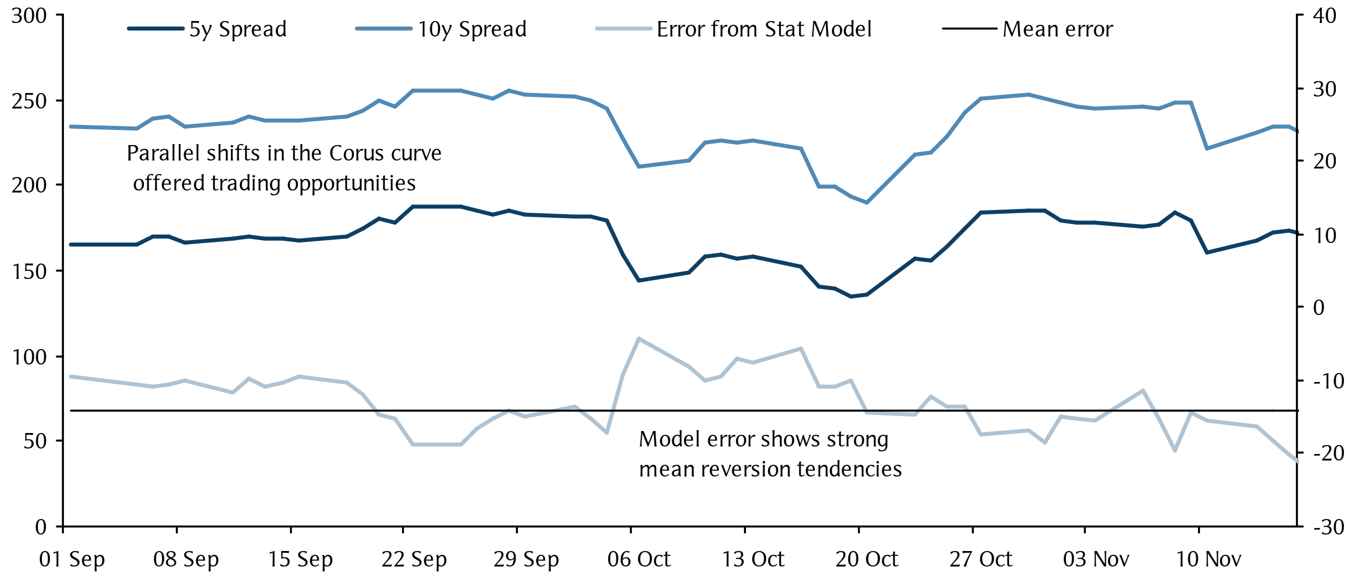


Source: MarkIt, Barclays Capital

We see a clear spike in percentage-slope around the announcement date on 6 October. But how do we actually monetize a reversion of percentage-slope? This is precisely where the curve weightings come into play. Before we examine this, the second line of Figure 76 shows the time series of errors of the Corus 5s10s curve from the statistical model estimated curve. The statistical model is introduced in more detail later but we clearly see the mean reversion tendencies of the error series.

Figure 76 shows the actual 5 yr and 10 yr spreads, and confirms that following the announcement, the 5 yr and 10 yr spreads gapped in – in parallel. On a percentage basis, therefore, we see a jump in slope (the numerator is unchanged and the denominator drops). This spike could have been used as a signal that the curve was too steep, on a percentage basis. In other words, the parallel shift in this case offered a trading opportunity.

Figure 76: Corus 5 yr and 10 yr spread time series and errors from Statistical Curve model compared with mean error – 2006



Source: MarkIt, Barclays Capital

Figure 77 reports a significant amount of information about possible flattener curve trade formats and P&L in different scenarios. We examine four weighting schemes and the performance of the trade from 6 October to 27 October, when the percentage-slope had reverted. We also look at five other possible scenarios on 27 October:

- Absolute slope change: 10 bp absolute flattening with 5 yr held constant.
- Absolute slope change: 10 bp absolute steepening with 5 yr held constant.
- Directionality: 20 bp tightening in the 5 yr, with the 10 yr moving according to our statistical model.
- Directionality: 20 bp widening in the 5 yr, with the 10 yr moving according to our statistical model.
- Instantaneous default.

Discussing each format in turn:

P&L profiles vary considerably across different curve trade formats

- Notional neutral: This first format has an attractive positive carry and small negative roll-down. It is also net-long the credit on a DV01-basis. However, the P&L on the trade was negative on 27 October since the spreads moved back out in parallel (correcting the percentage-slope anomaly). In other scenarios, we see that the trade performs well in either the case of a flattening with 5 yr spread unchanged, or an overall tightening. It is neutral to default.

- DV01-neutral: This format has small carry and roll but returns approximately zero P&L on 27 October, as in fact the 5s10s slope did not change. Other scenarios show almost symmetric positive and negative P&L for absolute slope changes (by definition of DV01-neutral – see later) while, in terms of directionality, we see that the trade is correlated to direction with a positive P&L on tightening and negative on widening. It is positive on default.

- Percentage-neutral: This format best implements the percentage-slope correction view. It has negative roll and carry and therefore should only be considered when a short-term reversion is expected. The trade makes a good profit (134 bp) when the percentage-slope reverts on 27 October. It has similar payoff to the DV01 trade in the scenarios of absolute flattening or steepening. However it has much less directional sensitivity.

- Model-weightings: Lastly, using model weightings also performs well, as demonstrated by the reversion of model error in Figure 76. Model weights are slightly less extreme than percentage-neutral weights, with less negative roll and carry. In this case we also see a good profit on error-reversion on 27 October, and similar behaviour to DV01-neutral on an absolute steepening or flattening. In terms of directionality, this trade has the least sensitivity, with minimal P&L in the two scenarios.

This example highlights the complexity of the weightings issue but demonstrates the importance of being precise with the actual view you wish to implement. In this case, the model-weights provide a true "error-correction" view, with minimal direction bias.

Figure 77: Trade metrics and scenario analysis – Corus 5s10s flattener

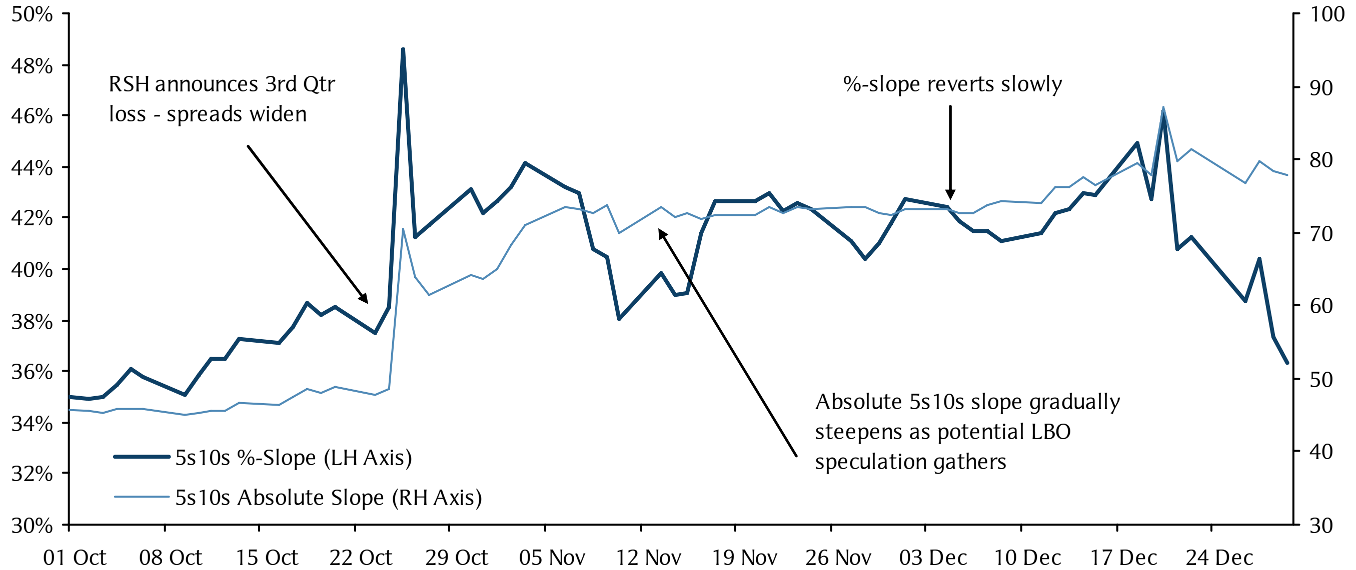
			Notional Neutral	DV01-neutral	Beta or %-neutral	Model-weights
5 yr Weight (Protection)			1.0	1.6	2.4	2.2
10 yr Weight (Protection)			-1.0	-1.0	-1.0	-1.0
Net DV01(1bp widening)			-2.9	0.0	3.5	2.4
Carry (bp/quarter)			16.8	-6.0	-33.6	-24.9
Rolldown (bp/quarter)			-14.7	-35.7	-61.1	-53.1
P&L Scenarios	**5 yr Sprd**	**10 yr Sprd**	**P&L (bp)**	**P&L (bp)**	**P&L (bp)**	**P&L (bp)**
06 Oct 2006 Actual	144	211	-	-	-	-
27 Oct 2006 Actual	184	251	-109.9	0.9	134.2	92.3
10 bp flattened	144	201	81.3	75.8	69.2	71.2
10 bp steepened	144	221	-68.5	-74.0	-80.6	-78.5
20 bp tighter (model)	124	184	115.9	52.2	-24.4	-0.3
20 bp wider (model)	164	238	-104.4	-51.8	11.6	-8.3
Default (units of 1-Rec)			0.0	0.6	1.4	1.2

Source: MarkIt, Barclays Capital

Case study: RadioShack – LBO speculation, Oct-Dec 2006

Our second example tracks the general spread widening of RadioShack associated with potential LBO speculation and poor results. Figure 78 and Figure 79 are analogous charts to those for Corus above. Figure 78 shows the initial steepening towards the end of October on negative operating performance headlines. Unlike with Corus, we see here a spike in absolute 5s10s slope as well as percentage-slope. However, tracking the chart to the right we find that the while the absolute slope shows no mean-reversion and continues to steepen, the percentage-slope does gradually revert as the curve normalises.

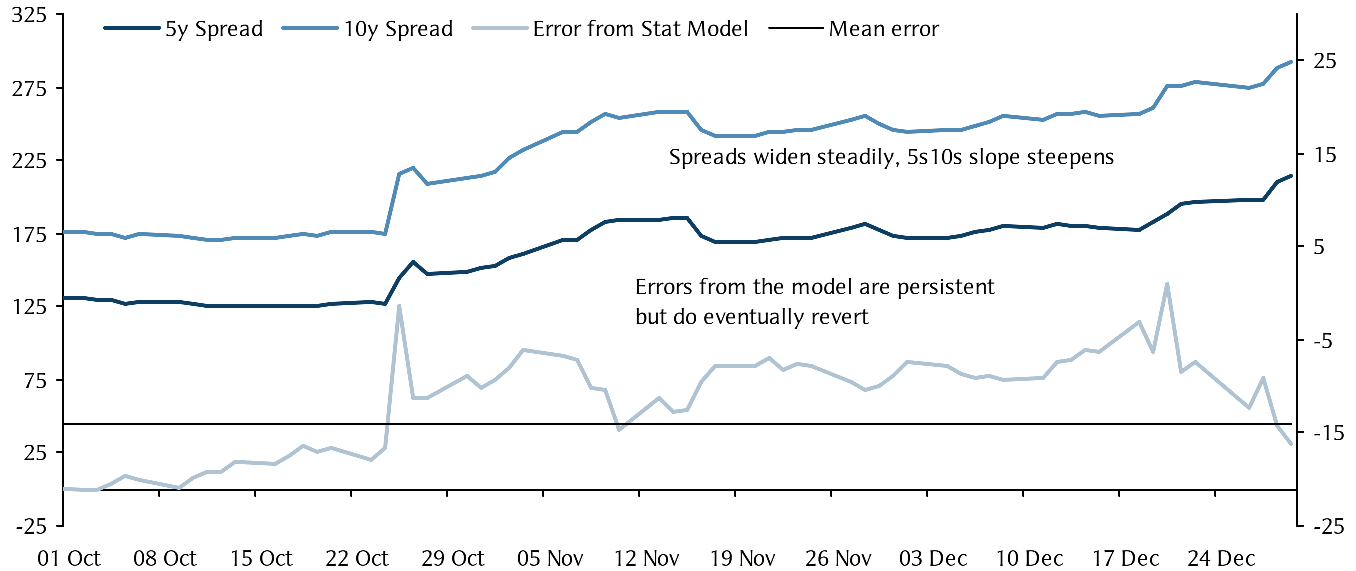
Figure 78: RadioShack 5s10s slope and percentage-slope time series – 2006



Source: MarkIt, Barclays Capital

This view is corroborated in Figure 79, where we see the model-error time series gradually revert back to the mean over a two-month period, while the 5 yr and 10 yr continue to widen on further negative headlines and LBO potential.

Figure 79: RadioShack 5 yr and 10 yr spread time series and errors from Statistical Curve model compared with mean error – 2006



Source: Markit, Barclays Capital

Consider now entering a 5s10s steepener position on 17 October in anticipation of the bad news. Figure 80 presents the same metrics and scenario analysis as Figure 77. Again, we discuss each trade format in turn:

- Notional-neutral: This format has a small negative carry but offsetting small positive roll benefit. The trade performs extremely well by 5 January. However, we argue that this was due to directional bias rather any curve dynamics. This can be seen through the huge asymmetry in the tighter spreads and wider spreads scenarios.

- DV01-neutral: This format performs reasonably well, with positive carry and roll-down. The P&L in the realised scenario is strong, but again we argue this is coming from an implicit directional view rather than a curve view, as demonstrated by the asymmetry in directional moves scenarios. The directionality is less extreme, though, than the notional-neutral case. Note that this trade runs jump-to-default risk.
- Percentage-neutral: This trade has strong carry and roll-down but performs only marginally in the realised scenario. This shows that, in this case, we didn't have a view on percentage-slope precisely – only on general widening and absolute steepening. Note that this trade format has minimal directionality but a significant jump-to-default scenario loss.
- Model-weights: Finally, the model weights are a compromise between DV01-weighting and percentage-slope weighting. They offer reasonable carry and roll and perform reasonably well on the error-reversion shown in Figure 79. In this case, the model-weights do not return zero P&L in the case of model shifts in the curve; however, this is likely due to roll-down and carry effects. Removing these effects, the trade is approximately direction-neutral.

The moral of this trade example is that sometimes it is desired that there is directional bias in the trade. In this case, the view was that the credit would weaken and the curve would steepen, making the DV01-neutral format attractive. However, we still find that the model-weights format is attractive on the grounds of the strong observed mean-reversion to theoretical curve shapes. We recommend that model-weightings be used as a base for all trade ideas, with modifications to the weightings to produce desired directionality and roll-down and carry metrics.

Figure 80: Trade metrics and scenario analysis – RadioShack 5s10s steepener

			Notional Neutral	DV01-neutral	Beta or %-neutral	Model-weights
5 yr Weight (Protection)			-1.0	-1.6	-2.2	-2.0
10 yr Weight (Protection)			1.0	1.0	1.0	1.0
Net DV01(1bp widening)			2.7	0.0	-2.7	-1.7
Carry (bp/quarter)			-11.9	7.5	26.6	19.6
Rolldown (bp/quarter)			15.8	32.7	49.4	43.3
P&L Scenarios	**5 yr Sprd**	**10 yr Sprd**	**P&L (bp)**	**P&L (bp)**	**P&L (bp)**	**P&L (bp)**
17 Oct 2006 Actual	126	173	-	-	-	-
05 Jan 2007 Actual	210	292	464.0	254.6	46.9	122.7
10 bp flattened	126	163	-81.4	-64.4	-47.6	-53.7
10 bp steepened	126	183	60.5	77.5	94.4	88.2
20 bp tighter (model)	124	171	-19.9	1.9	23.6	15.7
20 bp wider (model)	164	225	186.7	100.5	14.9	46.1
Default (units of 1-Rec)			0.0	-0.6	-1.2	-1.0

Source: Markit, Barclays Capital

Capital treatment: Leveraging curve trades

Capital treatment for credit derivatives is a complex topic and a thorough analysis is beyond the scope of this guide. However, one of the many motivations for curve trades can be a leverage argument – under certain capital allocation systems, curve trades can be very efficient on a ROC basis with potentially high leverage.

Ordinary curve trades – especially on investment grade CDS or indices – often have relatively small returns in comparison to outright buying or selling of protection. In order for these trades to be interesting for an investor, therefore, they have to be efficient either in terms of leverage or balance sheet usage.

Figure 81 gives some typical profit and loss examples on hypothetical curve trades. We use the example of a 5s10s steepener (€10mn in the 10 yr) on Deutsche Telekom, 21 August 2007, as introduced in Figure 44. In this example we assume that a fully-funded version of this trade would use €27mn of capital - €17mn in the 5 yr and €10mn in the 10 yr. This is certainly a worst-case method – more likely, at least some of the capital can be offset, given that the investor is both long and short the credit at different tenors.

For leveraged investors, it is not uncommon to be able to lever 5 to 10 times or even higher. Some sample ROC numbers are provided based on 1x, 5x, 10x and 20x leverage.

Figure 81: Sample curve trade P&L and Return on Capital (ROC)

Scenario after 6 months	Un-levered P&L	Un-levered ROC	5x Leverage	10x Leverage	20x Leverage
Carry & roll-down	€14,100	0.05%	0.26%	0.52%	1%
20 bp steepening	€139,800	0.52%	2.59%	5.18%	10%
10 bp flattening	€-48,900	-0.18%	-0.91%	-1.81%	-4%
Distress: Flat curve at 900 bp	€-1,128,000	-4.18%	-20.89%	-41.78%	-84%

Source: Barclays Capital

Default neutral trades

Certain types of capital allocation policies penalise default risk but not curve risk specifically. In such cases it can be extremely efficient to design curve trades that are default neutral, allowing potentially high leverage.

As discussed at length in previous chapters, notional-neutral trades can be attractive in certain circumstances but not in others. In cases where, for instance, the ideal choice of weighting scheme is a DV01-neutral steepener, the trade can still be made default neutral by offsetting the residual default exposure from the short leg (exposure will be ratio of DV01s minus 1). This can be done by buying very short-dated (1 yr or even 6 mth) protection. While this can alter the payoff profile and affect the carry and roll economics on a trade, these side-effects may be compensated for by their greater ROC efficiency.

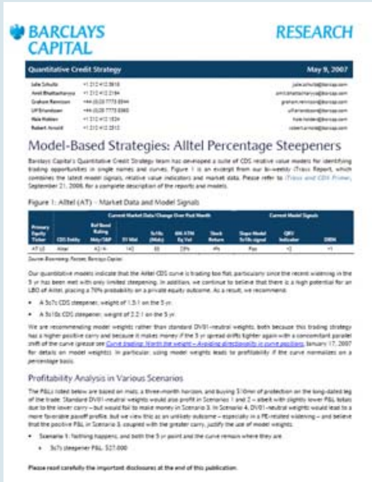
Curve behaviour around events

Corporate events drive curve dynamics

Many opportunities for trading curves occur around forecasted or announcement corporate actions. As corporate events change the perception of a company's creditworthiness, the shape of the CDS curve also evolves. Events are often detrimental to bondholders – such as leveraged buyouts or major share buybacks, but some events, such as M&A, can be either positive or negative for a credit. As a result, fundamental analysis is needed to assess potential outcomes. Even when the probability of an event is deemed high, however, the timing is often uncertain.

Curve trades can be more attractive than outright positions around events, thanks to the variation in payoff profile available. The majority of this chapter is dedicated to examples and case studies of actual trade recommendations and corporate events.

Curve behaviour around LBO speculation – Alltel



See *Model-Based Strategies: Alltel Percentage Steepeners*, 9 May 2007.

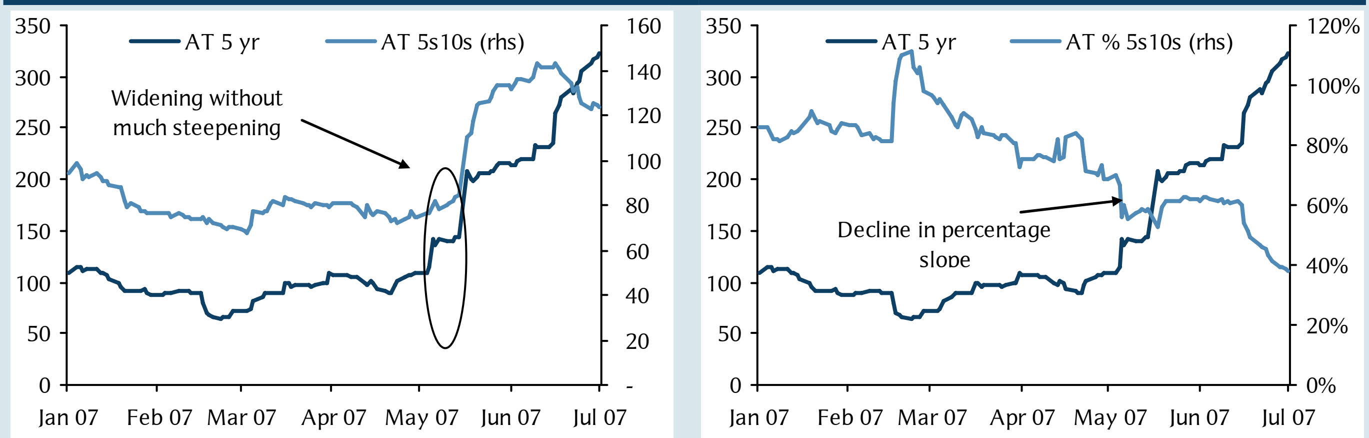
Trade rationale: In early May, we noticed that, although AT spreads had widened on LBO speculation reported in *The Wall Street Journal*, the curve had shifted out in a parallel fashion rather than steepening as would be expected (Figure 82). At the same time, our fundamental analyst was placing a 70% probability on a private equity outcome. However, timing was uncertain – LBO speculation had surfaced before with concomitant spread widening followed by retreat. As a result, we believed that the curve was just as likely in the near term to parallel shift tighter as the reported speculation faded as to steepen on an actual announcement. In either case, we believed the curve was likely to steepen in percentage terms. Accordingly, we recommended CDS steepeners using non-standard, model-based weights rather than the typical DV01-neutral weights (see Non-standard weighting schemes, p.42).

In addition to profiting if the 5 yr spread drifted tighter with a concomitant parallel shift of the curve, this strategy also stood to benefit from a higher positive carry than using standard weights.

Trade format: A 5s10s model-weighted steepener, sell $22mn 5 yr protection against buying $10mn 10 yr protection.

Figure 82: The Alltel CDS curve behaved peculiarly in early May

The absolute slope didn't initially respond to 5 yr widening (bp)	The decline in percentage slope helped prompt our recommendation

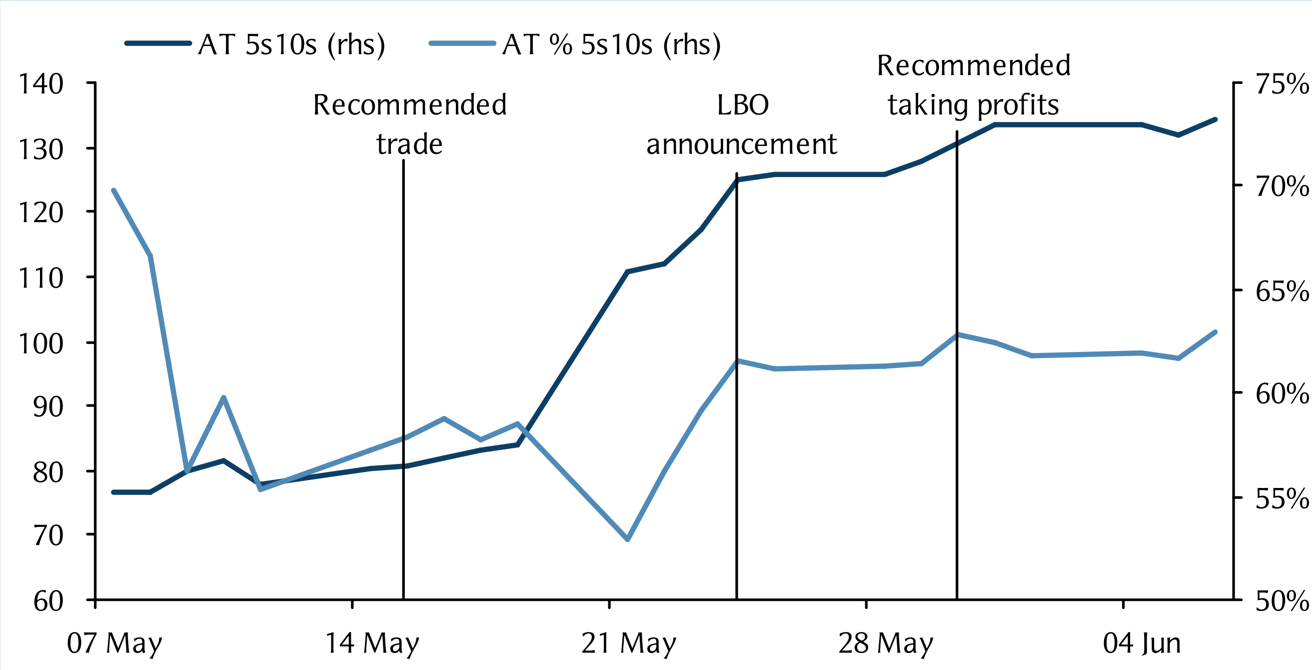


Source: Barclays Capital

Trade evaluation: Although timing is always key to trade performance, it was particularly crucial in this case because the actual LBO announcement occurred so quickly (less than two weeks) after the initial recommendation. The curve steepened slightly in percentage terms as the spreads widened (Figure 83). Our model continued to show that the curve was too flat on a relative basis, even at this point. We therefore recommended holding the trade for a further couple of weeks, during which time 5 yr spreads remained relatively unchanged, but the curve continued to steepen (see A study of LBO curves post-announcement, p.79 for a full study of this phenomenon).

It is interesting here to contrast the performance with a conventional DV01-neutral steepener. The conventional trade would indeed have outperformed the model-weightings given what happened. However, the DV01-weighted trade would have underperformed had our other scenario (of the LBO rumour dying away) materialised. This example therefore illustrates the trade-off in payoff profile offered by non-standard weightings.

Figure 83: Alltel 5s10s curve, absolute and as a percentage of 5 yr



Source: Barclays Capital

M&A risk around CenturyTel (CTL)

See ***Model-based strategies: CenturyTel 5s7s steepener***, 31 May 2007.

Trade rationale: In May we wanted to position a trade for a potential substantial acquisition by CTL that would, we believed, be credit negative for the company. The timing of any M&A event, however, was uncertain, and therefore buying outright protection a possibly expensive strategy in terms of carry and roll-down. Our slope model signalled that the 5s7s slope was statistically too flat. As a result, both fundamental reasoning and model outputs were pointing towards a 5s7s curve steepener as an attractive way to express our views.

Trade format: DV01-neutral 5s7s steepener.

Trade evaluation: Since the expected M&A transaction has not occurred – or been announced – and the probability of another leveraging transaction is deemed to be low in the near future, spreads of CTL have tightened since we recommended this trade, and the curve has concurrently flattened. As a result, this trade has underperformed.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RESEARCH

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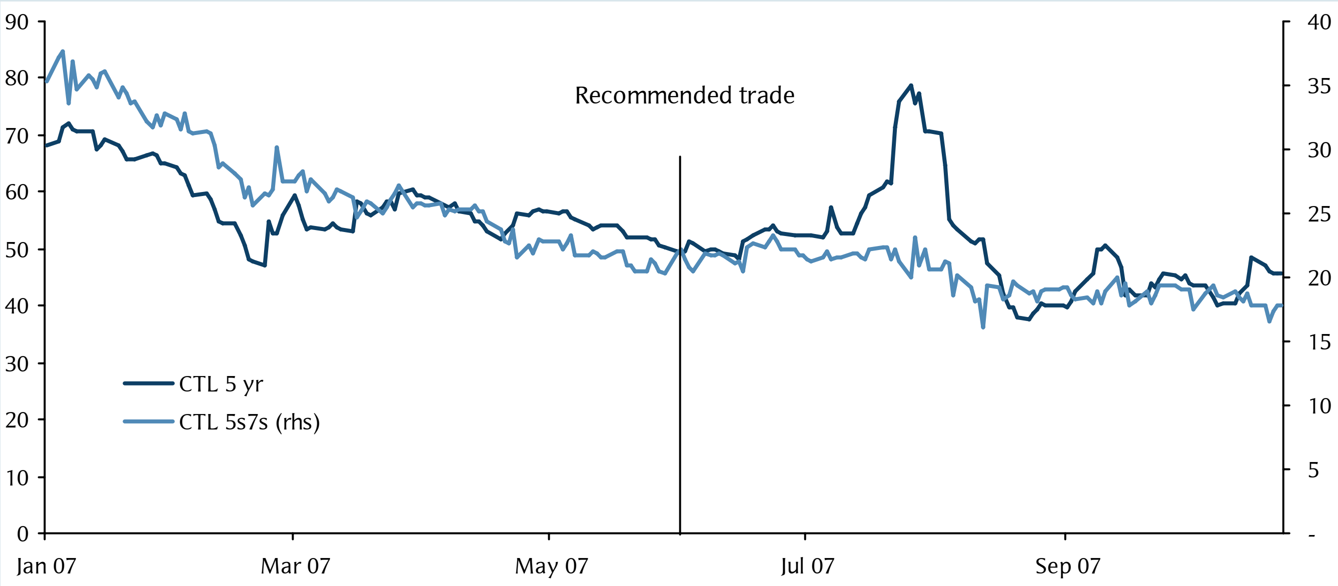
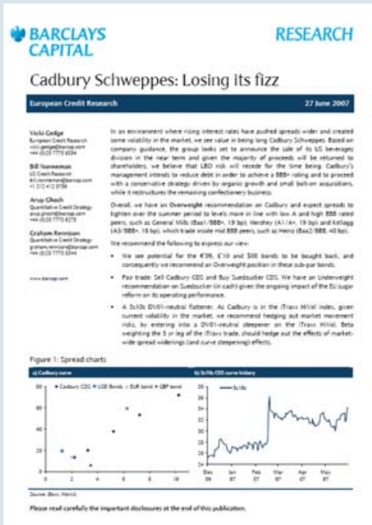
Model-Based Strategies: CenturyTel 5s7s Steepener

Figure 84: CenturyTel 5s7s steepeners have underperformed as M&A risk has failed to materialise (bp)



Source: Barclays Capital

Curves in a divestiture scenario: Cadbury's flattener



See *Cadbury Schweppes: Losing its fizz*, 27 June 2007.

Trade rationale: The Cadbury Group looked set to announce a sale of its US beverages division at the end of June 2007. Barclays Capital credit research view, at the time, was that the majority of proceeds would be returned to shareholders, and that LBO risk would recede, at least in the near term. Additionally, the quantitative slope model indicated all parts of Cadbury Schweppes credit curve were too steep, with the 5s10s part of the curve indicated as the steepest. The model estimated the 5s10s curve could flatten by up to 5 bp on pure curve normalisation, while the fundamental view was for a flattening of up to 15 bp.

We recommended a 5s10s DV01-neutral flattener trade to express these views. Furthermore, as Cadbury's was in the iTraxx HiVol7 index, and given the volatility in the market at the time, we recommended hedging out market risks by entering into a DV01-neutral *steepener* on the iTraxx HiVol, beta weighting the 5 yr leg of the iTraxx trade.

Trade format: Buy €17mn 5 yr protection, and sell €10mn 10 yr protection on Cadbury Schweppes. Index hedge: Sell €14.5mn 5 yr protection, and buy €7.5mn 10 yr protection on the iTraxx HiVol.

Trade evaluation: Due to the credit crisis that followed this trade recommendation, Cadbury's was unable to find bidders for its US beverages division. However, the curve did flatten on the expectation that the unit would eventually be sold. The HiVol market hedge steepener lost money, however, as curves more generally flattened in the volatility. Net, this trade was modestly positive at the time of writing, but with possible further upside in the medium term.

FS Funding – mitigating downside risk with a notional neutral 5s10s flattener


BARCLAYS CAPITAL RESEARCH

FS Funding (ISS)

Positioning for an exit

High Yield Research 26 September 2007

See *FS Funding (ISS) – positioning for an exit*, 26 September, 2007.

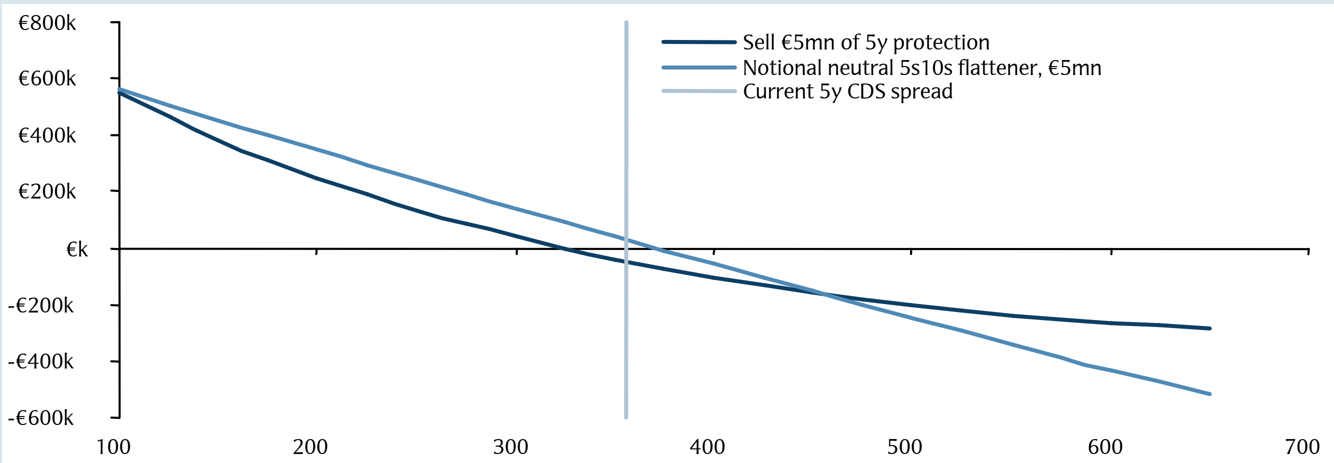
Trade rationale: Our HY research team expressed a fundamental positive view on FS Funding, recommending selling 5 yr protection outright, or – to trade in a curve format – to implement a notional neutral flattener. We believed that the notional neutral 5s10s flattener offered a compelling format to express the fundamentally positive view. At the time, the 5s10s was trading at 110 bp (mids), which was among the steeper names in the Xover universe.

The flattener can achieve a different risk-profile as it is able to mitigate some downside risk – especially in more distressed scenarios, and retain the lion's share of the potential upside P&L.

The key factors for making the flattener attractive are:

- Jump-to-default neutral trade: no notional default exposure in the first 5 yr of the trade. This can be a more capital efficient way to go long risk in the name.
- Net long convexity: The 10 yr DV01 will increase/decrease at a higher rate than the 5 yr DV01 of the 5 yr leg as spreads tighten/widen. In effect, this will boost P&L. and have a larger impact the bigger spread moves we see.
- Spread widening and curve flattening: as FS Funding was trading as wide as it was, any substantial widening was likely to lead to a marked flattening of the curve.
- Relative value on the curve: our Quantitative slope model indicated that the curve was trading in the 75th percentile of curve steepness. This could potentially give arise to a few bp of flattening. Hence, this could generate some P&L which would not be achievable in the vanilla sell 5 yr CDS protection position.

Figure 85: P&L profiles for alternative trade formats, 3 month horizon.



Source: Barclays Capital

Figure 85 shows the P&L profile of a €5mn notional neutral flattener for idiosyncratic spread moves at trade inception. We can see how the flattener was estimated to perform better in the downside scenarios compared with the plain 5 yr position. The trade off for this was that the carry of the flattener was to be substantially smaller but still positive at approximately €14k over three months (at mids). Also, with a steep front-end of the curve, the roll-down on the flattener was negative, and we expected this effect to amount to €45k over three months, pulling the P&L into negative territory without a move in spreads.

On the downside, for moderate spread widening, we did not expect the potential flattening of the curve and positive convexity effects to have more than a marginal impact on the net long credit position inherent in the trade.

Trade format: A notional neutral 5s10s flattener: buy €10mn 5 yr protection and sell €10mn 10 yr protection.

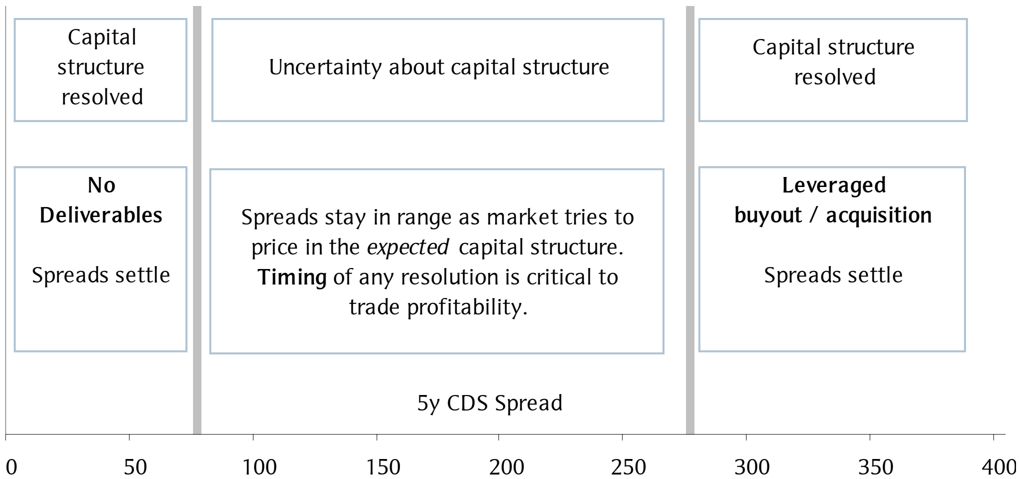
Trade evaluation: At the time of writing, the curve had flattened around 12 bp, with the 5 yr staying approximately where the trade was struck.

Bid-related events – exploiting unusual CDS payoffs

Bid-related events were key drivers of idiosyncratic behaviour in 2006 and the first half of 2007. Although the credit turmoil of summer 2007 may lead to a drop in large-scale private-equity bids, we nonetheless present here some analysis and recommendations around positioning in bid situations.

Every situation involving a confirmed or potential bid by private equity or trade-buyers is highly complex, from the relative likelihood of acquisition success to the intricacies of financing. However, we find it is helpful to implement a simple but powerful framework for analysing each individual case for the purpose of putting together the optimal CDS position to implement a view on the likelihood of different scenarios.

Figure 86: Three factors in determining CDS trades: Leverage, deliverability and timing



Source: Barclays Capital

Figure 86 shows a schematic of our framework. The factors that we find are common to each bid-related event situation are:

- Leverage implications: If a levered acquisition is successful with deliverables remaining for the outstanding CDS, the leverage of the final entity is key in determining final spread levels. The CDS position should either benefit from such an outcome or have limited downside if it is considered likely.
- Deliverability issues: If an acquisition goes through but deliverable debt is taken out, the CDS may tighten substantially or even become worthless. This is a key concern for many, though not all, European bid situations. Again, if there is a significant likelihood of this eventuality, it is key to design the position to either profit or not lose too much.
- Event resolution timing: Different events vary dramatically in terms of timing of announcements that will lead to firm spread movement. In some cases, a clear announcement date makes a binary payoff attractive even at the cost of negative carry and roll. In less clear situations, carry and roll effects cannot be ignored.

Each of the event case studies below examines scenarios based on these factors and recommends a trade accordingly.

Innovative payoffs using CDS

CDS curve positions can generate a surprising range of payoff profiles allowing more precise implementation of views

We show in each of the trade ideas presented in this piece how CDS can be used to generate a surprising array of pay off profiles that relate to the factors above. In particular, we note that:

- In many potential acquisition events, a pure credit positive or credit negative directional view is insufficient to capture uncertainty in outcomes.
- Different parts of the CDS term structure behave in different ways, allowing more sophisticated payoffs. For example, 3s5s curves tend to react more dramatically than 7s10s curves in most LBO-related widenings.
- CDS convexity – a poorly understood effect whereby the credit duration of a position falls with widening spreads, especially on longer maturity tenors – can be used to boost the trade P&L in certain scenarios.

Case study: Sainsbury's, 30 March 2007

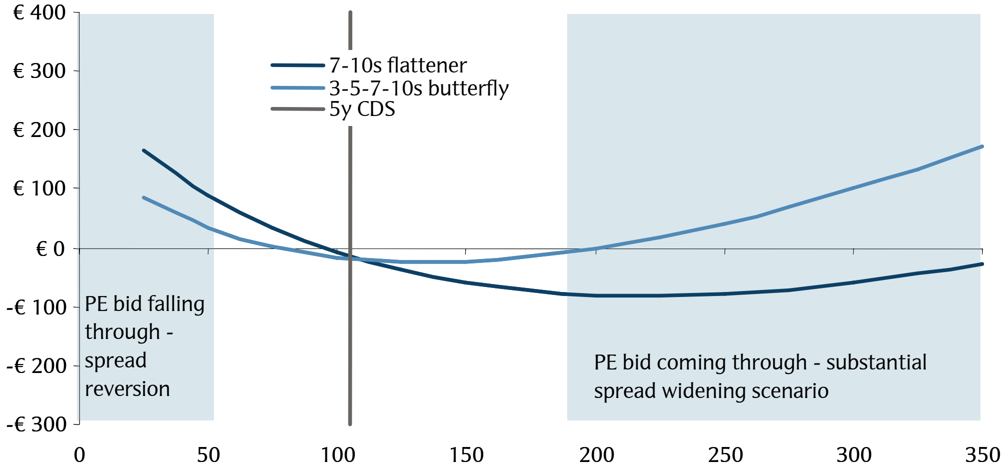
Sainsbury's provided an excellent example of a trading situation with a binary outcome within a set time-frame. By the end of March this year, there were two weeks until the CVC-led consortium had to make a formal bid for the company. Our analysts suggested that there was a high likelihood that the bid would fall through, which would have a very significant spread-tightening effect. Still, the tail risk of the bid actually succeeding, and spreads consequently widening significantly, made simply selling protection outright a risky trade.

In order to capture a positive P&L in both outcomes, we believe the following two trades made sense in such a set-up:

- A DV01-neutral 7-10s flattener; eg, sell €13mn of protection on the 7 yr leg and buy €10mn of protection on the 10 yr. This trade takes a more constructive view on spreads, with a larger downside in case the bid falls through. Still, the position has an attractive risk/reward profile compared with selling 5 yr protection outright.
- A net DV01-neutral 3-5-7-10s butterfly; eg, sell €8mn of protection on the 3 yr, buy €5mn on the 5 yr together with the DV01-neutral 7-10s flattener above. This trade tilts the bias of the P&L towards the case where the PE bid would succeed.

P&L profiles are plotted in Figure 87. The 5 yr CDS was trading at 105 bp at the time, and both trades had a negligible negative carry and roll-down effect over the time horizon considered. The key element of these trades is the convexity effect in the 7-10s part of the flattener. This allows for a payoff profile in which the trade benefits in either the case of flattening because of tightening spreads, or because a very substantial DV01 reduction in the 10 yr if spreads widen out to 200+ bp.

Figure 87: P&L profiles for Sainsbury's trades, 29 March



Source: MarkIt, Barclays Capital

As the situation played out, the CVC consortium was unable to complete the bid as the Sainsbury family considered the potential premium too low. CDS spreads came crashing, and by 25 April the 5 yr CDS was trading at 68 bp. Hence, our analyst's most likely scenario had played out, with substantial flattening of the 7-10s part of the curve (going from 31 bp to 24 bp).

The realised P&L, if the trades were taken off on 25 April, would have been €55k for the outright flattener, and €43k for the butterfly for the notional described above. This should be compared with a "maximum" downside for the flattener of €83k and for the butterfly of €24k, according to our analysis (not taking jump-to-default risk into account).

Uncertain outcomes: Altadis

See Positioning for bid-related events, *European Alpha Anticipator*, 11 May 2007.

Current bid-related event situations

Altadis

Abigail Harrison

CVC and PAI submitted a preliminary offer at €50 per share for Altadis on 4 May 2007. This follows several months of speculation around a potential acquisition by Imperial Tobacco, which has made two offers for Altadis (the last offer was at €47 per share). This week, Altadis has opened its books to both CVC/PAI and Imperial. We continue to believe that the most feasible outcome is that Imperial will succeed with a higher offer, as we think it is keen to secure the last major tobacco acquisition that competition regulations will allow. Please see The battle for Altadis, 4 May 2007 for further details.

Current 5 yr mid trading level: 90 bp.

Scenarios in order of likelihood (BarCap view):

Scenario 1: A confirmed bid is made by CVC and PAI. Given the implied leverage in the current €50 per share offer, spreads could widen significantly from current levels. Altadis' bonds do not contain change-of-control language, and the maturity of two (out of three) bonds extends beyond five years, meaning a repurchase of all three bonds is less certain.

Scenario 2: Imperial Tobacco makes a counter-bid. Imperial has previously stated that it would not raise its offer (of €47 per share, which Altadis rejected) without having access to Altadis' books, on the premise that it needs evidence for value extraction. Assuming Imperial can see potential for value extraction in Altadis' books, there is a strong chance that the combined entity retains an investment grade rating. Imperial has consistently reiterated its commitment to an investment grade rating, given its large funding requirements. Imperial has a good track record of cost cutting and has successfully delevered following prior acquisitions; therefore, we believe the rating agencies will be prepared to grant Imperial a degree of leeway, providing it gives them a credible de-leveraging programme. In this scenario, we would expect 5 yr CDS on Altadis to tighten to the mid to high-40s range.

Scenario 3: Both bids fail and Altadis trades back to original levels. We do not believe this scenario is feasible given Altadis' shareholders are supportive of a bid completing and are unlikely to be keen to see the share price fall back to pre-bid levels (around €37 per share). Furthermore, in our view, a takeover of Altadis is inevitable and necessary in a consolidating industry, as we do not believe Altadis is viable as a standalone story given its lack of pricing power and lack of economies of scale.

Timing: Clarification of actual bids is likely in the short term but finalisation of any structures or deliverability issues will take longer.

Recommended trade

Given the likelihood that spreads will be volatile but that very significant widening or tightening is unlikely in the short term, we require a trade pay-off that has a broad positive region around current levels. Our quantitative slope framework indicates that the 5s10s part of the Altadis curve is currently trading too flat. This leads us to recommend:

- A 5s10s model-weighted steepener: Sell €24mn protection on the 5 yr and buy €10mn protection.

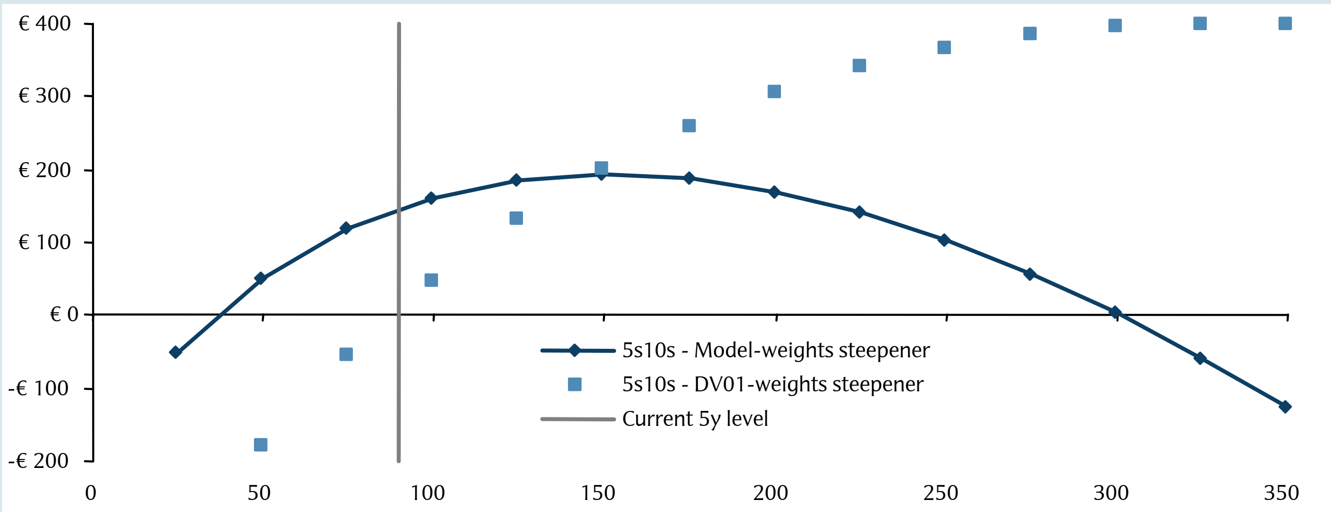
Alpha Anticipator Europe   Barclays Capital

Trade rationale: Following a bid from private equity firms CVC and PAI on 4 May 2007, Altadis 5 yr spread jumped to around 90 bp. Our fundamental analyst's opinion at this time was that one of two outcomes was likely. Scenario 1: a confirmed bid would be made by CVC and PAI causing spreads to widen significantly and the curve steepen. Scenario 2: Imperial Tobacco makes a counter-bid and the 5 yr CDS on Altadis would tighten to the mid to high-40s range. At the same time, our Quantitative Slope Model identified the 5s10s as trading too flat at 60 bp. By using non-standard curve weights, (Non-standard weighting schemes, p.42) the payoff profile of a 5s10s steepener could be change from being bearish (and hence underperforming in scenario 2) to being less directional (performing in either scenario, but giving up some upside). This is illustrated in Figure 88, where the estimated payoff profiles of the two weighting schemes are compared.

Trade format: A 5s10s model-weighted steepener: Sell €24mn protection on the 5 yr and buy €10mn protection.

Trade evaluation: Over the short term, the market began to price in that scenario 2 would be realised; that is, Imperial Tobacco would win the contest. The 5 yr spread drifted back in and the 5s10s curve normalised roughly in line with the model forecast.

Figure 88: Payoff profiles (€000's) for Altadis – comparing 5s10s steepeners, model-weights and DV01, versus 5 yr spreads, (3 mth horizon)



Source: Barclays Capital

A study of LBO curves post-announcement

As we have discussed previously in ***How Steep Can You Go? Continued Post-LBO Steepening in 5s10s Curves, US Alpha Anticipator***, 24 May 2007, it is well-accepted that the 5 yr spread jumps and 5s10s curves steepen immediately after an LBO announcement to reflect the increased leverage once the target company has been acquired. More interestingly, we find that 5s10s continue to steepen appreciably in the days following the immediate surge.

Re-hedging by investors who have sold delta-hedged equity protection is a potential explanation of this phenomenon. The delta of an equity tranche with respect to a single name increases as a single name spread widens in an idiosyncratic manner (ie, in the case of an LBO or other event that does not affect the spread of the overall portfolio). During this type of widening, a delta-hedged equity investor needs to buy more protection on the single name to remain hedged. The majority of equity is in the 7 and 10 yr maturities – reflective of the demand for bespoke mezzanine tranches from buy-and-hold investors – leaving equity investors net buyers of longer-dated protection after an LBO.

In light of these results, we recommend:

- Putting on steepeners immediately following an LBO announcement on continued expected steepening in the four weeks after.
- Continue to hold percentage steepeners because we expect percentage-slope to normalise to pre-LBO levels within two weeks of the announcement.

Using a sample of the 23 largest recent LBO announcements, we examined the curve steepening behaviour by first considering the initial jump in spreads and 5s10s curve on the day of the announcement. 5s10s curves steepen 16 bp and the percentage slope flattens 11%, on average. Furthermore, in the month following there is, on average, an additional 15 bp of 5s10s steepening (Figure 89, left). In *none* of the 23 LBOs examined did the 5s10s spread actually decrease following the initial steepening. Certainly, there is a broad range of curve responses to LBO announcements that take into account the individual target company's credit story. HCA (maximum additional absolute steepening) and Equity Office Properties (minimum) are also displayed in Figure 89, left, showing the range of potential responses.

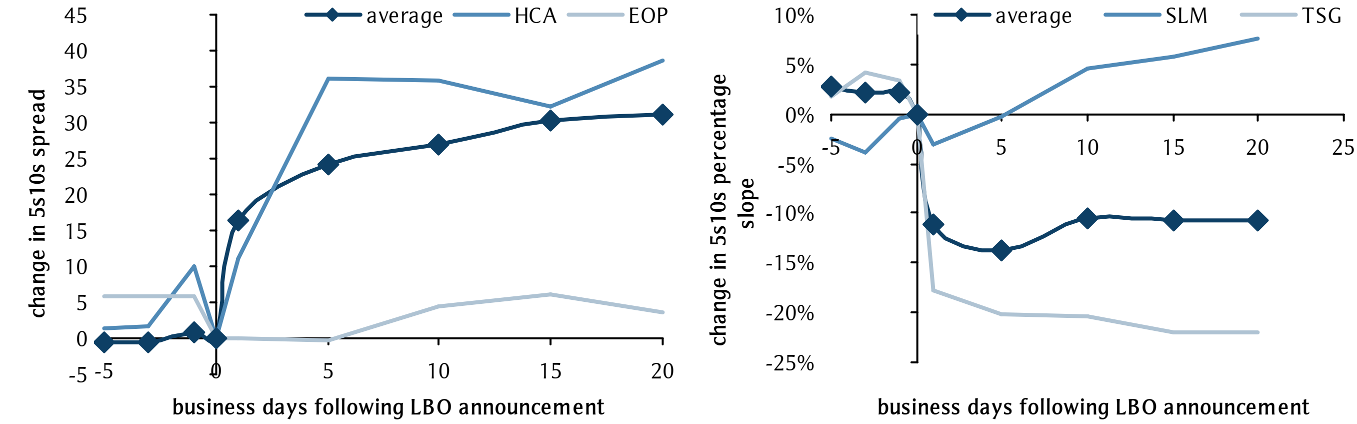
Given this track record, we recommend buying DV01-neutral steepeners on names immediately following an LBO announcement to take advantage of further steepening in the subsequent four weeks.

It is worth examining the 5s10s percentage slope as well, because the curve relationship changes as the 5 yr spread widens. In general, one expects the percentage slope (ratio of 5s10s to 5 yr spread) to decline and eventually trend to zero as the curve begins to flatten or invert (see Inflection points and the cross section best-fit line, p. 31). While this tendency is more pronounced in high yield names, it is generally the case for investment grade names, as well. The initial decrease in percentage slope on the day following is about 11% as curves steepen, but they do not do so in proportion to the move in 5 yr spreads. We find, however, that in the five days following the initial absolute steepening, the curve flattens in percentage terms an additional 3% (Figure 89, right). Furthermore, the additional percentage flattening retraces to the 1-day post-LBO level within two weeks after the LBO. Again, we show the percentage slope change in two individual names, Sallie Mae (SLM) and Sabre Holdings (TSG) in Figure 89, right as a way to frame the risk involved in holding a percentage steepener in the face of an LBO. While in most cases the result is favourable, there are situations such as TSG in which the curve flattens on a percentage basis and never retraces.

For investors holding percentage steepeners at the time of LBO announcement, we recommend keeping the position because we expect the flattening in percentage terms to retrace within two weeks.

Figure 89: Differing 5s10s behaviour in absolute and percentage terms in the weeks following an LBO announcement

5s10s continues to steepen in absolute terms for several weeks following an LBO	5s10s percentage slope flattens, then retraces within two weeks of an LBO



Source: Barclays Capital

In Figure 90, we compile the 5s10s spread movement of notable recent LBOs individually to see that this trend is borne out in specific cases. SLM is a notable exception to the trend in flattening in percentage terms because its initial low spread and flat curve are comparable to other financials. Additionally, Blackstone's interest in it was public the day before the announced LBO, which is why we use the pre-LBO 5 yr spread at 36 bp, not 80 bp.

Figure 90: Behaviour of 5s10s Following LBO Announcement in Select Recent Transactions

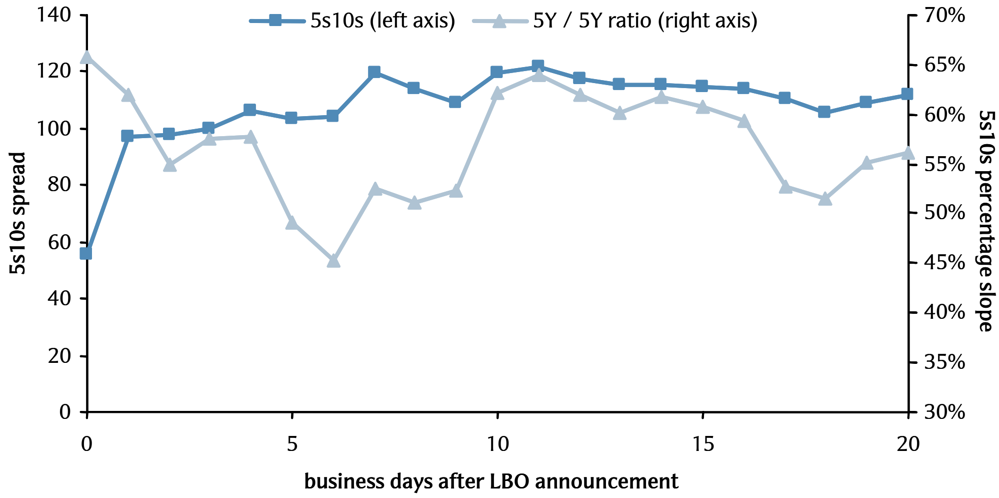
Ticker	Name	Date	Pre-LBO			Absolute Change in 5s10s since LBO Announcement			Percentage Slope Change in 5s10s since LBO Announcement		
			5 yr spread	5s10s	percent slope	1 day	5 days	10 days	1 day	5 days	10 days
HCA	HCA	21 Jul 06	273	55	20%	11	36	36	-5%	1%	0%
HET	Harrah's	29 Sep 06	113	51	45%	28	28	34	-15%	-14%	-10%
TSG	Sabre Holdings	8 Dec 06	99	64	64%	64	78	76	-18%	-20%	-20%
TXU	TXU	23 Feb 07	85	56	66%	42	48	64	-4%	-17%	-4%
FDC	First Data	30 Mar 07	104	64	61%	45	59	66	-9%	-8%	-9%
SLM	Sallie Mae[1]	12 Apr 07	36	15	41%	16	60	61	-3%	0%	5%
AT	Alltel	18 May 07	144	84	58%	26	41	49	-6%	3%	3%
Average (23 recent LBOs)						**16**	**24**	**27**	**-11%**	**-14%**	**-10%**

Note: [1] Sallie Mae LBO date is one day prior to actual announcement. Source: Barclays Capital

The 5s10s spread movement in TXU following its announced acquisition on 23 February 2007, typifies the behaviour in most LBOs. The absolute 5s10s spread has up to an additional 25 bp of steepening, then stabilises at 12 bp of additional steepening within 20 business days (Figure 91). On the other hand, the percentage slope drops by 21%

within six business days following the LBO, subsequently retracing to pre-LBO levels by the tenth business day.

Figure 91: Continued TXU steepening in the backdrop of percentage flattening



Source: Barclays Capital

Macro events: Industry-wide curve effects

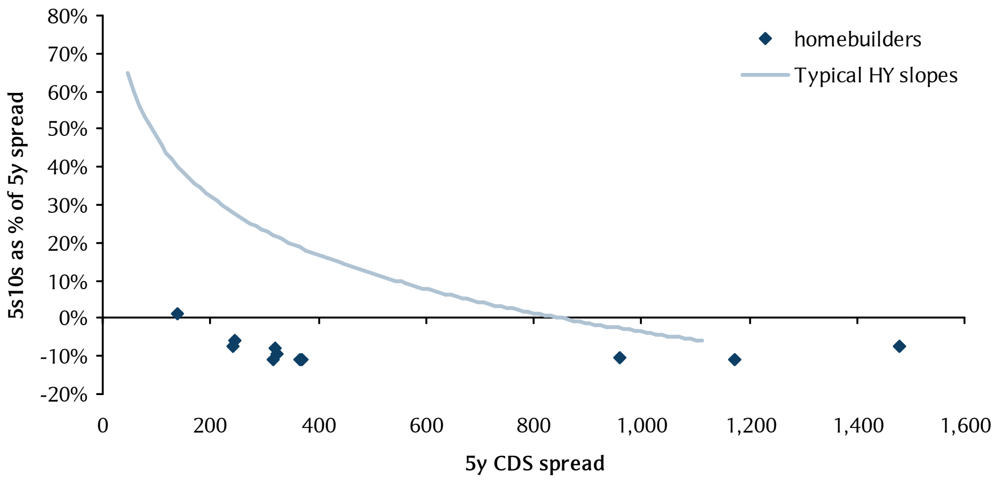
Although LBOs are generally idiosyncratic events, macroeconomic conditions can cause events that affect the curves of not only specific credits but also entire industries. Changes in consumer preferences – such as those that led to pressure on the autos and auto parts sector in 2005 – are one example. More recently, the US housing market, particularly the subprime slice, has been another example, with its direct effects on both financials and homebuilders. When industry-wide events occur, concerns often transcend worries about profitability and focus instead on viability and the possibility of default. This means that recovery expectations become important to curve shapes, as the next example illustrates.

Distressed curves and recovery rates: Case study on US homebuilders – September 2007

Liquidity concerns and a further deterioration in the housing sector have led to significantly wider spreads and inverted curves in the US Homebuilders sector over the summer 2007. Most IG builders are trading in ranges more consistent with HY names. We find that the IG builders are particularly flat relative to the broader market, while HY builders are more differentiated due to individual circumstances (see Figure 92). As we seek explanations as to how curves have behaved in this sector, we focus on recovery rates as part of our understanding.

One aspect that differentiates the IG homebuilder sector from the rest of the HY universe is our estimate of high potential recovery rates – derived by comparing each builder's debt level with an adjusted estimate of the value of its land and inventory holdings. We develop a framework to derive a market-implied recovery rate for the builders based on the shape of their credit curves. The implied recoveries of the IG builders are higher than those of the broader market and generally consistent with our fundamental estimates. Via this framework, we develop a thesis for where we expect IG builders to trade if they are downgraded and able to put a theoretical ceiling on Z-spreads for HY names that are already trading at very wide levels.

Figure 92: Current Homebuilder curves relative to the broader HY universe



Source: Barclays Capital

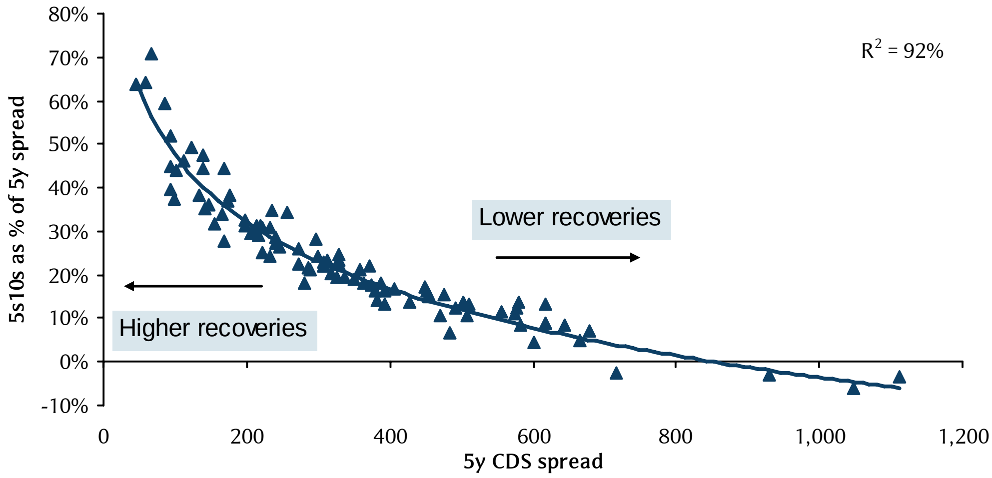
The effect of recovery on credit curves

To understand the importance of recovery rate on the shape of a credit curve, we break a credit spread into its component parts. Spread measures expected loss, which comprises the probability of default and the likely losses given default. As the recovery rate increases, the probability of default must rise in order to maintain the same spread. In other words, a name with a high recovery rate has a higher market-implied probability of default than a name with a low recovery rate but the same 5 yr CDS spread.

We analyse the effect of recovery rates on credit curves under the assumption that the slope of a credit curve reflects the probability of default accurately, relative to the rest of the HY universe. Spread levels must then be adjusted for the potential recovery rates. In other words, we assume that the credit curve of a specific name has a shape similar to those curves of other HY names with similar probabilities of default.

This allows us to calculate a *market-implied recovery rate* for a given name, based on a 40% recovery rate for the broader HY universe. We first estimate the relationship between the level of spread and the percentage slope of the credit curve for the HY universe, as shown in Figure 93. The curve slopes downward because curves flatten on a percentage basis as spreads widen.

Figure 93: Effect of recovery rates on HY curves



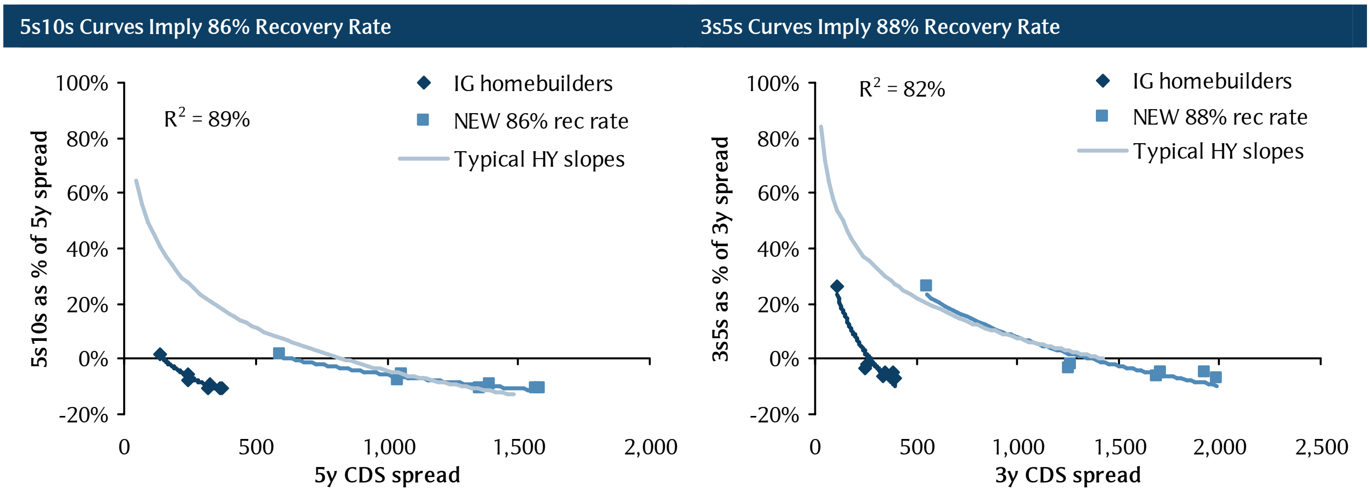
Source: Barclays Capital

Next, we compare an individual credit with the regression line for the HY universe. We compute the recovery rate necessary to move the credit onto the line while keeping the shape of the curve constant. In other words, we find the change in the recovery rate necessary to shift the credit horizontally onto the regression line. This is equivalent to assuming that the probability of default for the credit is the same as those with the same percentage slope, but that the recovery rate of the name is different and, thus, its spread is different. This allows us to compute a "market-implied" recovery rate for the specific credit. Names with 5s10s that are flat relative to the typical HY name (ie, names on the left of the regression curve) have market-implied recovery rates above 40%: their 5 yr spread is too low for the shape of the curve; thus, the losses in the event of a default are lower. Similarly, credits with steep curves (ie, to the right of the line) have implied recovery rates below 40%.

Implied builder recovery rates

To compute the implied recovery rate of the builders under our framework at different points of the curve, we compare the IG builder curves to the curves of the rest of the HY universe at 5s10s and at 3s5s (Figure 94). At both points, the builders are flatter than the rest; this result holds for 1s3s and 1s5s also. We compute the adjustment to the builder recovery rates required to align their curves with the rest of the HY market and find that the IG builders are pricing in a roughly 85% recovery rate; with this adjustment the entire IG builder sector sits at or near the HY universe line. A similar analysis for HY builders is more challenging in the current environment, given the disparate pressures they face. It is more meaningful to compute individual implied recoveries for them than a global average.

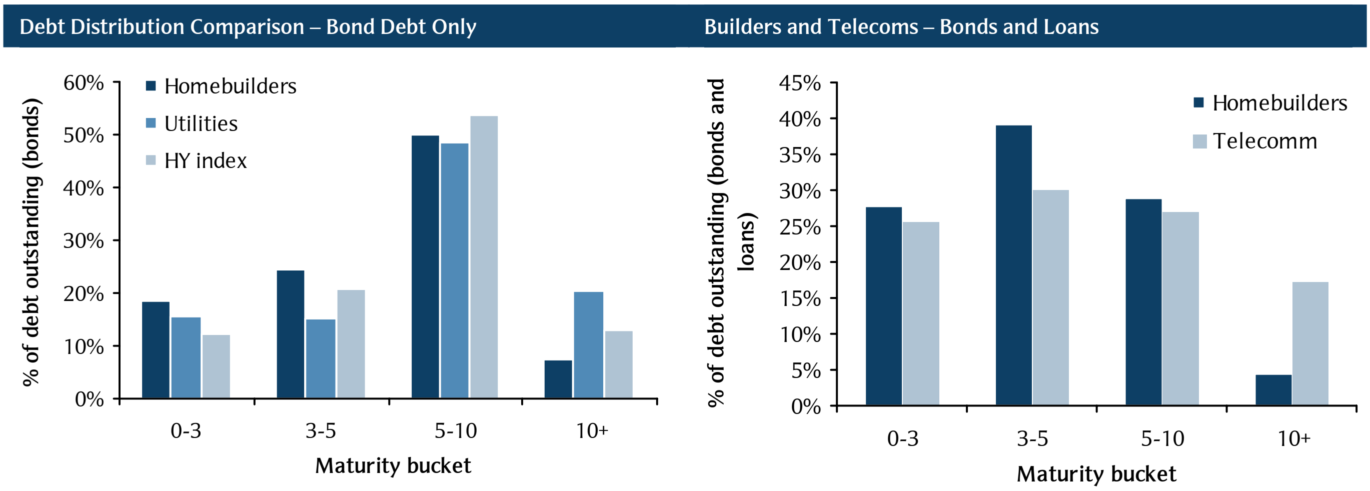
Figure 94: Implied recovery of IG builder curves



Source: Barclays Capital

Another explanation for curve shapes are maturity profiles of the outstanding debt. Maturity profile is relevant because a company with significant short-term maturities should have a flatter curve than a name with only long-term debt, which needs only to cover interest payments over the short term. Although maturity profiles vary across individual names, the overall homebuilder sector has a debt distribution similar to the broader HY universe. Figure 95 (left) contains the distribution of bond maturities for the builders, the utilities, and the HY universe. Builder maturities are slightly shorter, but the differences are too small to explain the dramatic differences in curve shapes, in our view. Furthermore, the homebuilder sector has almost no debt coming due through the end of 2008. We have ignored the portion of debt in loan form, since these data are hard to find on an aggregate basis. However, we know from our individual homebuilder models that revolver and term loan maturities will also be minimal in the coming two years. When we compare the builders with other individual sectors beyond utilities, we find that the differences in the distribution of total debt are also small. For example, Figure 95 (right) compares the builders with the telecom sector.

Figure 95: Debt distribution of builders is not materially different from other sectors



Source: Barclays Capital

Builder recovery analysis

One major factor differentiating the homebuilders from other sectors is our expectation of stronger asset coverage and higher recoveries in the event of default. This is the result of a business model that requires the builders to carry large land and in-process or finished inventory positions. The value of these assets typically exceeds the amount of debt used to finance them, which is especially true at present, given that many builders are only a portion of the way toward reducing their land supply to reflect the current market realities of lower home starts and sales in the coming few years.

Using a basic approach to estimating builder asset coverage in the event of a possible default, we assume that each homebuilder fully draws the entire amount of its revolver before defaulting (excluding the accordion), which, along with its currently outstanding debt, comprises the total debt load carried at the time of default. To be as conservative as possible, this ignores the fact that in many cases, borrowing base restrictions have made the full amount of the revolver unavailable. We then assume that land and inventory values (excluding joint venture assets, which are not wholly owned, and land options, which we assume would have a 0% recovery) receive a haircut of either one-third or one-half, given that the environment for executing major land-related asset sales near the depth of a housing downturn would likely be difficult. We do not include other assets and liabilities in the analysis, as these largely offset in most cases. This leads us to the estimated recovery rates by individual homebuilder names depicted in Figure 96 and Figure 97.

As illustrated, the average HY homebuilder recovery rate using this analysis is 90%, applying a one-third land haircut, and 67%, applying a one-half land haircut. Within this universe, HOV appears to have the lowest recovery rates, at 73% and 55%, while KBH seems to have the highest, at 106% and 80%, due mainly to the company's larger balance sheet and recent moves to reduce debt.

Among the IG cohort, the average recovery rate (slightly skewed by much higher recovery for Toll Brothers due to the company's much longer land position) equals 112%, applying a one-third land haircut, and 84%, using a one-half land haircut. Most of the larger names have recoveries near or above 100% in the less-severe scenario, while a smaller name such as Ryland is just above 80%, given its smaller land and inventory position. In the more severe case, recoveries are lower, but all the larger names are well above 70%, with Ryland again the lowest among the peer group at 61%. Additionally, we find that the market-implied recovery for IG builders, at 80-90%, is roughly in line with our fundamental estimate of 84% for the more severe land haircut scenario.

Figure 96: Estimated HY homebuilder recovery rates

	BZH	HOV	KBH	MTH	SPF	Average
Financial Statement Date	**30 Jun**	**31 Jul**	**31 May**	**30 Jun**	**30 Jun**	
Fully Drawn Revolver	500	1,500	1,500	850	900	1,050
Senior Notes – Homebuilding	1,522	1,650	2,066	479	1,450	1,433
Total Senior Homebuilding Debt	2,022	3,150	3,566	1,329	2,350	2,483
Cash	123	20	272	52	8	95
Net Senior Homebuilding Debt	1,899	3,130	3,294	1,277	2,342	2,388
Land and Housing Inventory	2,861	3,446	5,238	1,620	2,940	3,221
Land and Housing Inventory (33% Haircut)	1,907	2,297	3,492	1,080	1,960	2,147
Land and Housing Inventory (50% Haircut)	1,431	1,723	2,619	810	1,470	1,611
Recovery Rates – Senior Unsecured						
Recovery at 33% Land Haircut	100%	73%	106%	85%	84%	90%
Recovery at 50% Land Haircut	75%	55%	80%	63%	63%	67%

Source: Company reports, Barclays Capital

Figure 97: Estimated IG homebuilder recovery rates

	CTX	DHI	LEN	PHM	MDC	RYL	TOL	Average
Financial Statement Date	**30 Jun**	**30 Jun**	**31 May**	**30 Jun**	**30 Jun**	**30 Jun**	**31 Jul**	
Fully Drawn Revolver	2,085	2,500	2,700	1,860	1,250	1,100	1,890	1,885
Senior Homebuilding Debt	3,849	3,867	2,473	3,478	997	900	1,142	2,387
Total Senior Homebuilding Debt	5,934	6,367	5,173	5,338	2,247	2,000	3,032	4,272
Cash	233	5	234	75	668	85	772	265
Net Senior Debt	5,701	6,362	4,939	5,263	1,578	1,916	2,260	4,007
Land and Housing Inventory	8,671	10,436	7,299	9,478	2,335	2,350	5,957	6,626
Land and Housing Inventory (33% haircut)	5,781	6,957	4,866	6,319	1,557	1,567	3,971	4,418
Land and Housing Inventory (50% haircut)	4,336	5,218	3,650	4,739	1,167	1,175	2,979	3,313
Recovery Rates - Senior Unsecured								
Recovery at 33% Land Haircut	101%	109%	99%	120%	99%	82%	176%	112%
Recovery at 50% Land Haircut	76%	82%	74%	90%	74%	61%	132%	84%

Source: Company reports, Barclays Capital

Trading implications

We examine the macro implications of our hypothesis on the drivers of the builder curves under two scenarios for housing: that the housing outlook remains unchanged and that it deteriorates further.

Housing outlook unchanged: In this scenario, the outlook for homebuilder recovery rates remains unchanged, but that for individual builders can deteriorate, due to downgrades based on individual operating performance and/or expected credit deterioration or due to idiosyncratic events (eg, the Beazer Homes (BZH) SEC investigation). We expect the builders to shift along the recovery curve in these cases, allowing us to use it to predict the curve implications of spread widening.

First, we examine the implications of downgrades in the IG builders. Figure 98 shows the implied 3s5s and 5s10s credit curves for the IG builders assuming 100 bp and 200 bp of spread widening. We conclude that there is room for modest absolute steepening of 3s5s curves, while we expect 5s10s curves to invert. On a percentage basis, we expect the slopes to flatten or invert as an individual name deteriorates, consistent with the generic IG homebuilders curve.

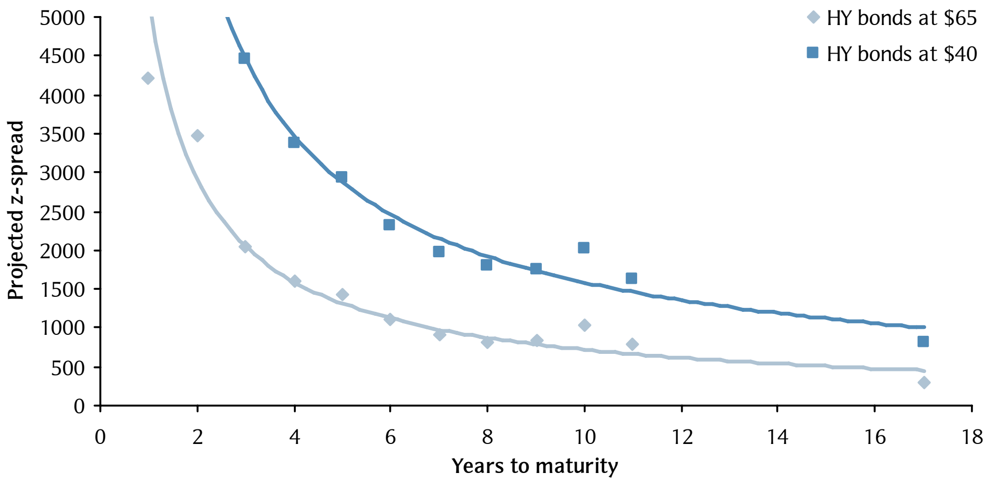
Figure 98: Potential curve moves on IG builder downgrades

Data as of 13 Sep 2007	3s5s	3s5s % slope	5s10s	5s10 % slope
IG average	57	28	0	1
Average with 100 bp move wider	65	21	-19	-4
Average with 200 bp move wider	67	17	-42	-8

Source: Barclays Capital

Second, we compute potential ceilings on the spreads of the HY builders as they become more distressed. Assuming that the potential recovery rates remain high, the floor on the dollar price of the builder debt should be about $65. In Figure 99, we translate this dollar price into a Z-spread for select bonds of the HY builders: those of 5 and 10 yr maturity bonds are capped at about 1300 bp and 1000 bp, respectively. These ceilings are in line with current 5 and 10 yr spreads of BZH at 1175 bp and 1040 bp, respectively.

Figure 99: Equivalent Z-spread for HY homebuilder bonds trading at $65 and $40 recovery values



Source: Bloomberg

Housing outlook deteriorates: If the housing market takes another leg down, the builders will likely widen. This could come from two sources: an increase in default probabilities and a decrease in likely recovery rates as the value of their land assets decreases further. If the likely builder recovery rates drop to 40%, spreads would probably widen significantly, as the IG builders shift toward the right and onto the typical HY curves, ignoring the effect of likely higher default rates. This change in recovery rate would be worth 500-800 bp for the IG names and 0-550 bp for the HY names, in addition to any increase in the probability of default. The further widening in HY builders may actually be limited since spreads have already widened considerably and given the upper bounds on spreads computed on the previous section.

We review the methodology that we employ in making several specific trade recommendations based on our analysis.

Curve trades: We compare the implied recovery rates we compute with our own fundamental estimates of recovery for each homebuilder. On average, individual implied recovery rates are 2% above and 14% below the fundamental recovery rates for IG builders and HY builders, respectively. We recommend flatteners on those names with an implied recovery further than average from the fundamental recovery and steepeners on names with an implied recovery rate closer than average to the fundamental recovery. We are neutral on curves that are close to the average distance from the fundamental recovery. Figure 100 contains a summary of these recommendations.

Figure 100: Differences in the implied versus fundamental recovery rates determine recommended curve positioning

Name	Implied Recovery	Fundamental Recovery	Recommendation
IG builders	**86%**	**84%**	
CTX	85%	76%	Steepener
DHI	86%	82%	Steepener
LEN	84%	74%	Steepener
MDC	90%	74%	Steepener
PHM	84%	88%	Neutral
RYL	87%	61%	Steepener
TOL	88%	135%	Flattener
HY builders	**52%**	**68%**	
BZH	49%	80%	Flattener
HOV	58%	59%	Steepener
KBH	84%	80%	Steepener
MTH	42%	61%	Neutral
SPF	25%	58%	Flattener

Source: Barclays Capital

Pair trades: We use this analysis to position pair trades along the curve. For example, we recommend selling 5 yr protection on names with a steepening bias, and buying 10 yr protection. In contrast, for names with a flattening bias, we prefer selling 10 yr protection and buying 5 yr protection. These pair trades begin with fundamental views on specific credits and use the results of the recovery analysis to determine the best positioning for the trade along the curve.

Advanced topics on curve trades

Index curve trades

Index curve behaviour was discussed in detail in Curve dynamics: Indices, p.19. In this chapter we look at ways of trading based on this behaviour.

Index curve trading is generally motivated on one or more of the following:

- As a way of expressing market direction views with different risk-reward profiles.
- Carry and roll-down reasons.
- Hedging purposes – both cash and CDS underlying portfolios.
- Relative value trades between indices.

Expressing market direction views through curves

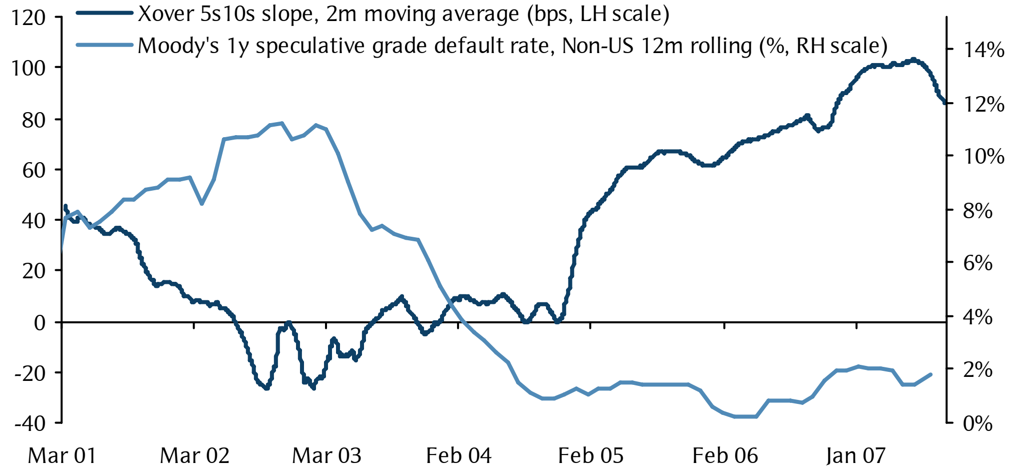
This is itself a wide topic. As just one example, we revisit the relationship between iTraxx Xover 5s10s curve and default rates in Figure 101. Clearly, curves tend to flatten in periods of higher default rates, and tend to be steep in periods of low default rates.

Suppose an investor wishes to express a bearish view that default rates will be rising over the medium term. At the time of writing, the iTraxx XO8 index was trading around 330 bp with a 5s10s of around 80 bp. There are several arguments for why trading a 5s10s flattener may be an attractive alternative to buying 5 yr protection in this scenario. These include:

- Lower carry and roll cost for the flattener, allowing for a potentially longer holding period.
- Convexity benefit: the flattener is a positive convexity position that will benefit from volatility. Outright long protection is negative convexity.
- Downside is limited, given the point in curve shape cycle shown in Figure 101. The curve is unlikely to steepen back to its peak of around 105 bp unless the market recovers substantially.
- Curve behaviour over the medium term is very persistent – all the reasons given in What drives changes in cross section?, p. 32, on why curves should be flattening in this environment continue to hold, even if there is a short-term recovery in spreads.

The disadvantage of an index flattener is that it is clearly a lower-beta short on the market, and would need to be scaled appropriately. Additionally, transaction costs are typically higher.

Figure 101: Index curves and link to the credit cycle; iTraxx Xover 5s10s versus speculative grade default rate



Source: Markit, Barclays Capital

Index curve relative value: iTraxx Xover versus CDX HY

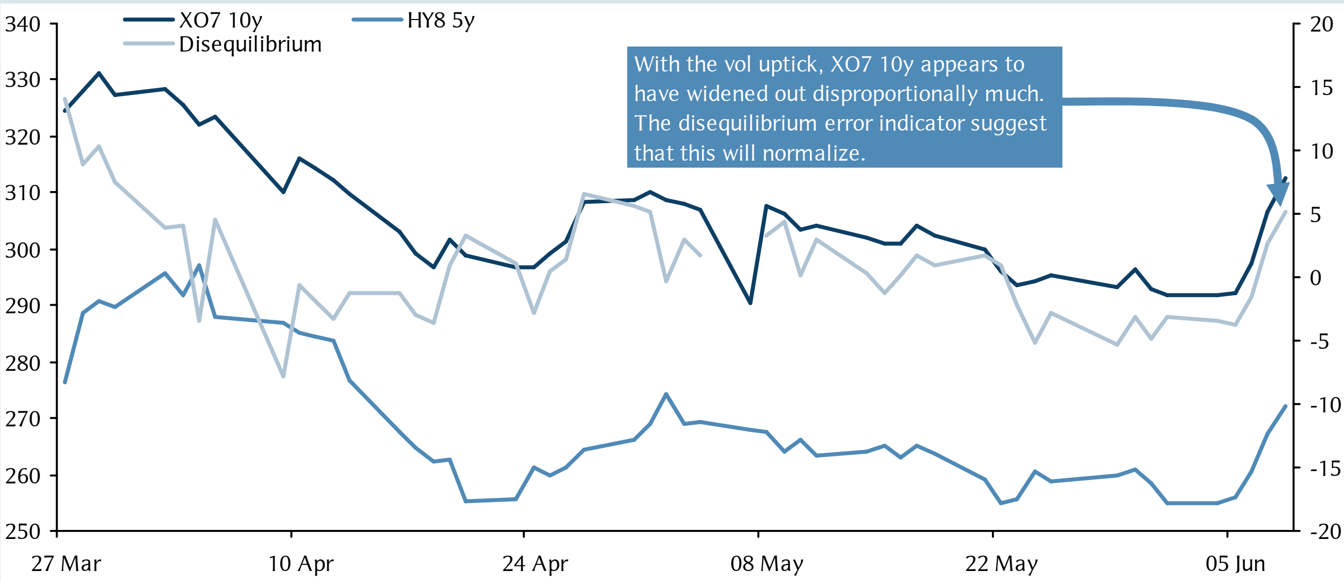
This trade recommendation provides a simple example of an index relative value trade, using different curve points to express a view.

See *CDX HY vs iTraxx Xover opportunities in the volatility*, 11 June 2007.

Trade rationale: A combination of fundamental views and model signals suggested an opportunity to short risk in CDX HY and go long risk in iTraxx XO7. We used a cointegration model to determine that (i) the Xover and HY indices have a "true" statistical relationship and (ii) the volatility at the time put the indices out of sync with each other. This is shown in Figure 102.

Trade format: Sell 10 yr iTraxx Xover series 7 protection and buy 5 yr CDX HY series 8 protection. We suggest a carry-flat weighting of 0.9:1. This format is approximately beta x DV01 neutral (for example, calculating betas to Xover 5 yr).

Figure 102: Our statistical model anticipates the gap between Xover 10 yr and HY 5 yr to close.



Source: Markit, Barclays Capital

We chose to implement this trade as a cross-index curve flattener (see Diagonal curve trades, p.93) for a combination of convexity profile reasons and a view that curves could flatten in volatility.

Trade evaluation: Although this trade experienced dramatic mark-to-market volatility in the July/August 2007 period, including times when the relationship in Figure 102 broke down completely, the trade began to perform modestly into the October 2007 rally. We believe there is further upside in the trade if curves continue to flatten and if fundamentals begin to deteriorate in the US HY market.

Trading single-names versus an index

A key component of relative value trading, or general credit portfolio management, will be to focus any index hedging on the actual risk that sits in the portfolio, or which the trade is subject to. For example, during the summer months of 2007, many market participants had negative experiences with index hedging as a consequence of mismatches between investment grade/financials exposure and hedging in the iTraxx

Xover index. With a very strong underperformance in the investment grade space relative to high yield, portfolios tended to be under-hedged for the market widening.

Picking the investment grade/HY indices for hedging is just one dimension. For European investors, the investment grade sub-indices offer the additional dimensions of relevant exposure:

- The Financials index allows pure exposure to the financials curve, but also allows us to hedge out financials exposure in iTraxx Main.
- HiVol index allows us to further separate out more event-risk-likely names: much of a concern in the period running up to the sub-prime volatility.

Specifically, we find the iTraxx Non-Financial, Low Vol index an interesting alternative for general hedging purposes. This index can be constructed by, for example, selling Main protection and buying Sen Fin and HiVol protection. See below for an example. Alternatively, as we have found less distinction in the behaviour of the Main versus the HiVol, we find iTraxx Non-Financial index to be useful for relative value trades involving investment grade, non-financial credits. This is even simpler to construct: for a given long risk position in a single name, we would buy a bit more protection on iTraxx Main compared with a vanilla hedge, and use the proceeds to buy some SenFin protection.

Index selection example: Paper shorts

See *Quantitative trade ideas – Knock-on-wood derivatives*, December 5, 2006.

Trade rationale: This trade was motivated by strong negative directional signals from our QRV and DIEM models combined with a negative view from our fundamental analyst. To isolate the anticipated relative underperformance in a strong market environment, we chose to put on shorts versus the iTraxx Non-Financial, Low Vol index.

Trade format: Buy €5mn of protection on each of Stora, SCACAP, UPM, versus selling €43mn of protection on Main, buying €10mn of protection on HiVol and €8.5mn on the SenFin index (all on the 5 yr).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Quantitative trade ideas – Knock-on-wood derivatives

Figure 103: Approximate trade metrics, broad hedge

Trade	5 yr Protection Notional	Current spread	Carry and roll-down (€'000s over 3 months)
Buy 5 yr STORA protection	5	41	-€10.3
Buy 5 yr SCACAP protection	5	21	-€5.4
Buy 5 yr UPM protection	5	36	-€9.0
Sell 5 yr iTraxx Main protection	-43	25	€55
Buy 5 yr iTraxx HVOL protection	10	48.5	-€24.2
Buy 5 yr iTraxx SenFin protection	8.5	8.5	-€4.0
NET TRADE	0	n.a.	€2.1

Source: Markit, Barclays Capital

Trade evaluation: this trade proved to be particularly interesting, with the names underperforming the index over the course of a few weeks. They widened on an absolute basis, but by the beginning of January, they became quite CSO efficient (see CDO technicals and curves, 102) and quickly retraced. When exiting the trade on 24 April, the performance of the trade was attributed to the index leg tightening, whereas the single name spread was close to the trade inception. We iterated the trade in *Quantitative trade ideas: Paper shorts*, 24 April, 2007.

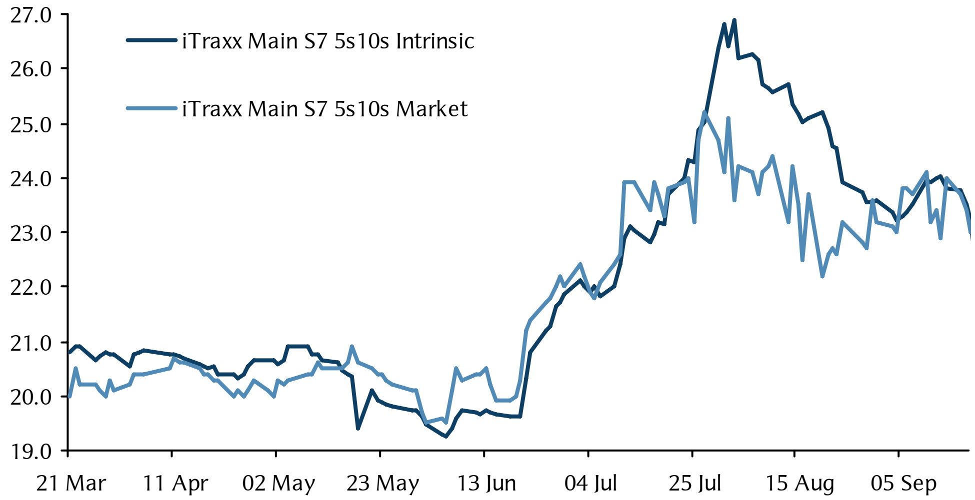
Index skew and curve implications

One aspect of trading both index curves and single names versus an index is the index intrinsic skew. This is the difference between the market spread on the index, and the intrinsic fair-value of the index based on the spreads of the underlying single-names.

The index skew is relevant in curve trades as one of many additional factors to be taken into account that may provide a technical support or impedance to a trade. In a simple case, if the difference in intrinsic values for the 5 yr and 10 yr iTraxx Main is 19 bp, while the market 5s10s is trading at 21 bp, then there should be a natural flattening technical impact driven by potential index arbitrageurs (see Appendix D: Replicating a CDS index, p.145).

Although trades will rarely be well-motivated on the sole grounds of a skew-based argument such as this, it is a factor that nevertheless should be monitored. Figure 104 shows the 5s10s skew on iTraxx Main series 7 during its six month on-the-run period. The skew varies over this period, but is especially significant during the height of the volatility in July and August 2007.

Figure 104: iTraxx Main S7 5s10s curve intrinsic and market



Source: Markit, Barclays Capital

Diagonal curve trades

This chapter introduces an alternative to the typical pair-trade. Diagonal curve trades are pair trades executed using the most efficient tenors. The “diagonal” format – buying protection on a name in one maturity and selling protection on another name in a different maturity – allows the simultaneous implementation of both directional and curve views. It is also a simpler and less costly alternative to full DV01-neutral curve trades on each name. The trade-off is reduced hedging accuracy in the event of parallel shifts in the curves, although this can be mitigated by weighting the trade to create a position that is beta*DV01-neutral to the appropriate CDS index. The following trade example illustrates the idea.

Diagonal flattener

See *Diagonal Flattener: Out of BorgWarner, Into Transocean*, 8 December 2006.

Trade rationale: In early December 2006, model signals flagged both BWA and RIG as too steep in the 5s10s part of the curve (Figure 105 and Figure 106). In addition, both analyst opinions and quantitative signals supported a negative view on BWA – an auto parts supplier facing difficult industry headwinds – and a positive view on RIG – an energy company unduly (according to our analysts) believed to be a likely LBO candidate.

Trade format: Buy 5 yr protection on BWA, Sell 10 yr protection on RIG, 2.2:1 weights.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Diagonal Flattener Pair Trade: Out of BorgWarner, Into Transocean

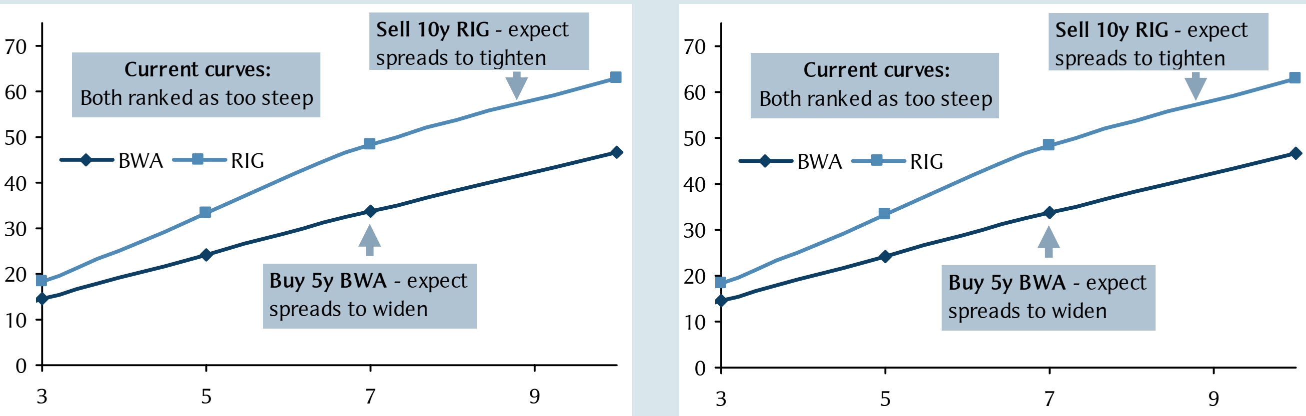
Figure 105: BorgWarner and Transocean – Market data and model signals

		Current Market Data/Change Over Past Month					Current Model Signals		
Equity Ticker	CDS Entity	Rating Mdy/S&P	5 yr Mid	5s-10s (Mids)	6M Eq Vol	Stock Return	Slope signal	QRV Indicator	DIEM Indicator
BWA US	BorgWarner, Inc.	Baa2/A-	24/-4	22/1	27%	1%	Steep	-1	-2
RIG US	Transocean Inc.	Baa1/A-	33/0	30/2	35%	6%	Steep	+2	+2

Source: Bloomberg, Factset, Markit, Barclays Capital

Figure 106: Current and model target curves at the time of trade recommendation (Dec 8, 2006)

Both BWA and RIG were flagged as too steep (bp, mids) | Model target curves (bp, mids)



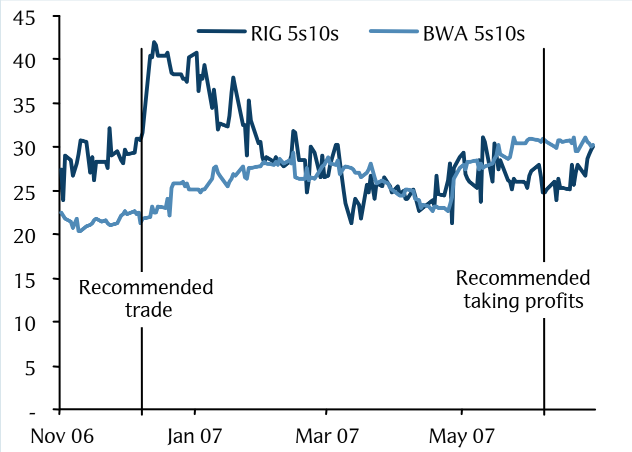
Source: Barclays Capital

The diagonal format: The diagonal format allowed both the directional views – short BWA, long RIG – and the curve views – bearish flattening of BWA and bullish flattening of RIG – to be implemented. The weighting gives an approximately zero carry + roll-down cost to the trade while making the position essentially neutral to parallel shifts in the underlying curves in the same way that a DV01-neutral flattener on a single name is neutral to parallel shifts in that curve. This is accomplished using the beta of each name to the CDX IG index and multiplying by the DV01. Adjusting for the beta helps alleviate the reduced hedging inherent in the diagonal format (versus full curve trades on each name), but it should be noted that the hedge is only against parallel movements in curves and that betas are not stable in all market environments.

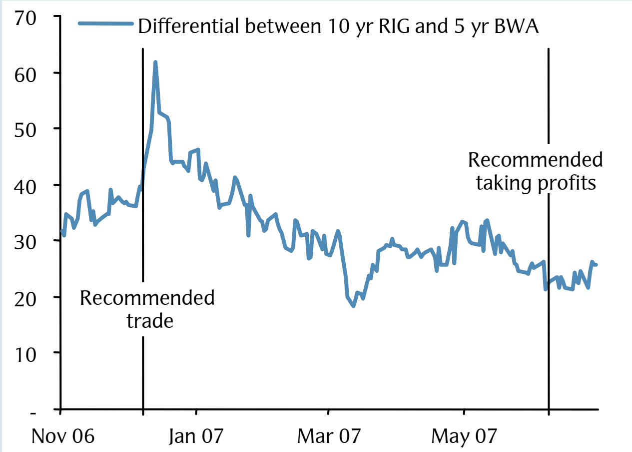
Trade evaluation: This trade performed on both sides over the life of the trade (we recommended taking profits on June 7, 2007). The BWA curve steepened and the RIG curve flattened (Figure 107), with the diagonal format allowing a pair trade expression of these two curve views.

Figure 107: The diagonal format – a pair trade expression of curve views

Both curves behaved as predicted



The pair trade performed well



Source: Barclays Capital

Curve positions in capital structure trades

We have recently begun to publish research in the capital-structure trading area together with Barclays Capital Equity Derivatives research team. In this context, the topic of curves is still relevant, as shown in the next example on Aegon. Here, we select the 10 yr part of the curve to execute the trade on, for a combination of reasons including: i) increased convexity; and ii) downside protection in terms of typical financials cross-section behaviour showing that further widening would lead to curve flattening.

Capital structure opportunity on Aegon

See **Aegon: Capital Structure Opportunity**, 10 August 2007.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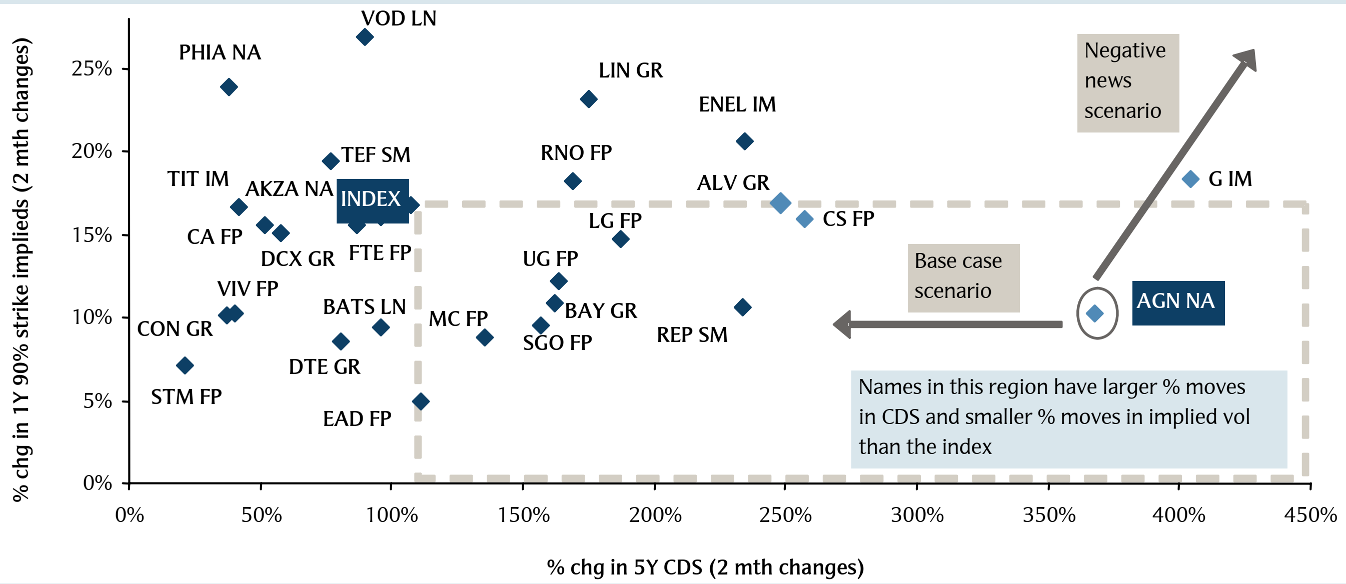
Equity Derivatives and Quantitative Credit Strategy
10 August 2007
Aegon: Capital structure opportunity
Long equity protection versus short credit protection
The rationale

Trade rationale: The existence of a significant disconnect in changes in single name credit spreads versus equity volatility was highlighted in our publication **The capital structure disconnect**, 2 Aug 2007. One name that stood out in the analysis was Aegon (see Figure 108). Our fundamental credit analyst's view was that the extreme widening of Aegon's credit spreads was overdone and that this trade allowed an investor to potentially benefit from a partial tightening in spreads while mitigating losses due to further spread widening. Our belief, at the time, that the increase in Aegon's equity volatility suggested that further spread widening based on idiosyncratic or macro driven news flow would likely be reflected in the equity and equity derivatives markets.

Trade format: We recommended purchasing €8mn stock notional of €10 strike, Aegon Jun 08 equity puts at 2.76% (stock ref €13.05) versus selling €10mn, 10 yr Aegon sub credit protection at 80 bp (indicative prices).

Figure 108: Change in implieds versus change in credit spreads over past two months (% terms)



Source: Bloomberg, Markit, Barclays Capital

Trade evaluation: The trade played out well, closely matching one of the scenarios we were looking for. We recommended exiting the trade on 25 September 2007, at a point where the sub 10 yr spread had tightened by 30 bp. The equity put dropped in value as a result of a modest rally in the stock. However, the net position was still comfortably positive.

Hedging curve portfolios

The topic of hedging portfolios including CDS curve exposure is another highly complex one on which we are currently researching. In this chapter we look at some of the key issues and some example solutions – we present most of the solutions in the form of an actual example of a recommended trade.

What do we actually want to hedge?

We focus on methods to hedge against changes in the curve cross-section

First we need to clarify what we mean by hedging curve portfolios. For the purposes of this section, we return to the concept of the CDS curve cross section, as introduced in The curve cross-section, p.23. We will assume that single-name curve positions are intended broadly as idiosyncratic trades and that we want to hedge these against market risk. In this context, we define market risk to be changes in the shape of the curve cross-section.

To understand this definition we refer readers back to Idiosyncratic events – Curves track the cross-section, p.24, where we describe how curve trades based on idiosyncratic motives can be effectively modelled with the curve cross-section tool, but then remain exposed to changes in the cross-section.

How do we hedge against changes in cross-section?

There is no straightforward answer to this question. Instead we present a number of alternative ideas, illustrated with examples.

Using CDS index hedges

Clearly, a natural hedging instrument is an index curve that matches reasonably the spreads of the underlying names. The index curve represents, to some extent, the shape of the cross-section. However, significant basis risk is still present as well as beta risk – curves of CDS with very different betas may behave differently, and therefore make an index hedge ineffective. See Trading single-names versus an index, p.91.

Using curve weighting schemes

Curve weighting schemes used on curve positions dramatically affect the view that is being expressed and the robustness of positions to changes in cross-section. DV01-neutral weighting schemes are designed to hedge against small parallel shifts in the curve. This is useful for hedging against moderate market volatility, and moderate shifts in the curve cross-section. Because of the effect of convexity, though, they are less effective at hedging large movements. In these cases, under or over hedging may be required to avoid losses, depending on the spread level of the name.

Other weighting schemes, such as our statistical scheme (which fits to the cross-section), can be used to hedge against spread directionality, but not cross-section volatility. See Directionality of curve positions, p.43.

Using balanced curve portfolios

Finally, the best solution to cross-section hedging is to run a balanced curve portfolio. That is, form a portfolio with reasonably balanced weightings of steepener and flattener positions for each spread bucket. This leaves the portfolio relatively well insulated, but may remove upside from many positions.

As an example of a balanced curve position, with market cross-section hedging in mind, see Aligning signals: Fiat flattener, p.130.

Risk management of portfolios including curve risk

Most credit derivative portfolios contain some form of curve risk. Even those not containing intentional curve trades still have positions that have been added across time and therefore have varying maturities. Risk managing the curve risk embedded in any such portfolio is a complex task. In this chapter we focus on just one aspect of the topic – that of modelling likely curve behaviour as part of stress testing or simulation/scenario based analysis.

Modelling curve behaviour

At a basic level it is extremely important to understand the P&L impact of changes in spreads. For instance – as well as typical risk management measures such as VaR – the P&L generated by a 1 bp move wider in the market is a key number to have to judge a portfolio. Unfortunately, we argue there are many issues with such a number.

- Betas: How do you translate a 1 bp move in the market into a likely move for each name – in particular names with very high or low spreads? Betas are usually used to make such a mapping (a discussion of beta calculation is an equally interesting problem, but one that is beyond the scope of this piece). Betas are normally calculated in spread space, not total-return space, and therefore do not take into account curve risk.
- Curve risk: Unless betas are constructed for each part of the curve, the implication is that each point on the curve is equally impacted by a market move. In other words, curves are assumed to parallel shift.
- Convexity: Critically, both the pure spread level and curve P&L impact depends on the size of the move in the market (or the single-name, see next point). While most risk management systems do take into account convexity in the theoretical sense (that introduced in Convexity effects, p.58), there is a broader meaning with respect to curves. Specifically, curve behaviour alters dramatically for big moves – and the impact for big moves is also different depending on the spread levels of the names involved.
- Market vs idiosyncratic: A final point that links us back to the discussion in Single-name curve dynamics, p. 22, is that curve behaviour is very different depending on whether curve changes are induced by idiosyncratic or market spread changes. A comprehensive risk management system should differentiate between market curve risk and idiosyncratic curve risk, in our view.

Dealing with these issues requires more sophisticated models of curve behaviour.

Constant ratio curve dynamics

One more advanced system could use constant ratio curve dynamics. That is, curves are assumed to keep a constant ratio to, say, the 5 yr spread. For example, suppose a CDS is trading at 50 bp in the 5 yr and 75 bp in the 10 yr. The 5 yr:10 yr ratio is 1:1.5. If the 5 yr spread jumps out to 80 bp, the constant ratio model would give a 10 yr of 120 bp, maintaining the same ratio. The 5s10s would therefore steepen from 25 bp to 40 bp. Such a model could be applied to all curve positions. Precisely, all 5 yr points can be bumped by their beta amount and non-5 yr points moved according to constant ratios.

This model is certainly an improvement over parallel shifts. Figure 37 and Figure 38 show, however, that the accuracy is limited to small moves. In other words, curves as a proportion of 5 yr spread are different at different spread levels.

Therefore, we find that the constant ratio model is sufficient for small moves in spread – in fact, we argue below that it should be used for curve modelling only for small *idiosyncratic* moves in spread.

Curve cross-section modelling

We believe that our curve cross-section technique introduced in The curve cross-section, p.23, can model both small and large spread movements, and also distinguishes between idiosyncratic and market-driven curve widening.

Modelling idiosyncratic events

We showed in Idiosyncratic events – Curves track the cross-section, p.24, that when spread widening/tightening is driven by idiosyncratic events, curves do typically follow the curve cross-section (splitting the cross-section into financial and non-financials). Since we have a best fit cross-section formula (usually a log-fitted regression line), we can directly calculate an estimate of the curve impact of any spread change.

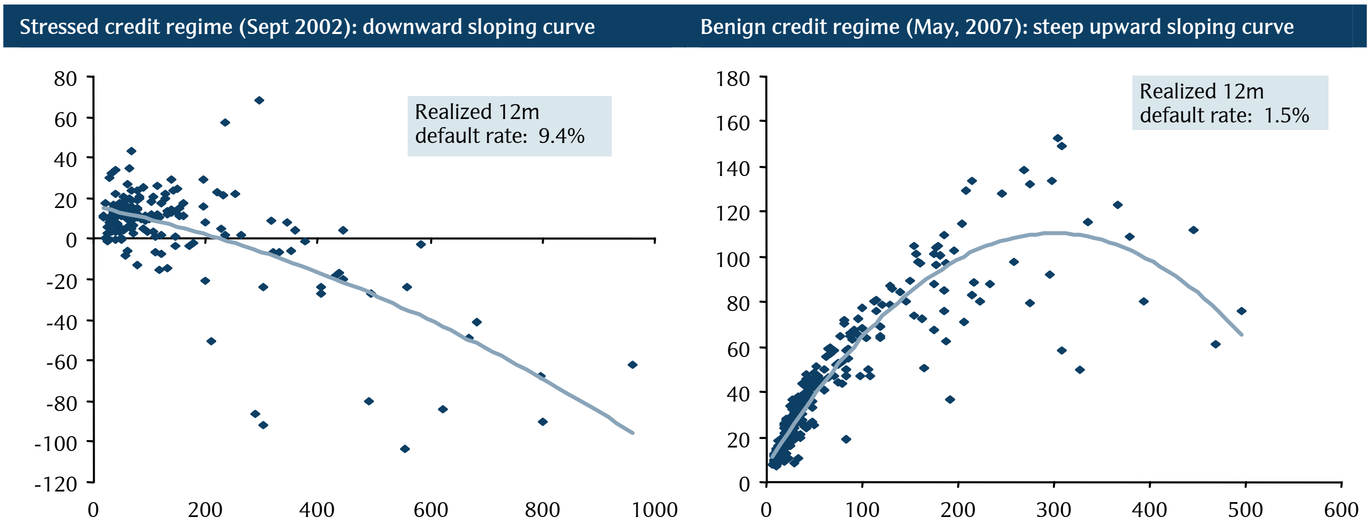
Furthermore, we can take into account curve idiosyncrasies (eg, differentiating names of the same 5 yr spread with dramatically different debt maturity profiles and hence well-founded minor differences in curve shape – see Debt maturity profile, p.17). One way to do this is to assume that the error of a particular curve to the curve cross-section best-fit line will remain constant (or perhaps constant ratio – eg, trades at 105% of the best-fit). This concept is discussed in more depth when we introduce our Quantitative Slope model in Slope model framework, p. 120.

The cross-section model can also handle distress events if it is suitably specified. This may require a polynomial fit line rather than a log-fit to allow for the inflection point. Note that there are significant estimation issues with this (discussed in Inflection points and the cross section best-fit line, p.31).

Modelling changes in cross-section

In order to effectively model large market-driven changes in spread (and better model small market-driven changes), we also need to model the dynamics of the cross-section. This is certainly a trickier problem, simply due to the relatively small number of data points we have through the CDS history back to 2001.

Figure 109: Changes in the market wide credit curve, variation with fundamental credit regime, 5 yr spread (x-axis) vs 5s10s slope (y-axis)



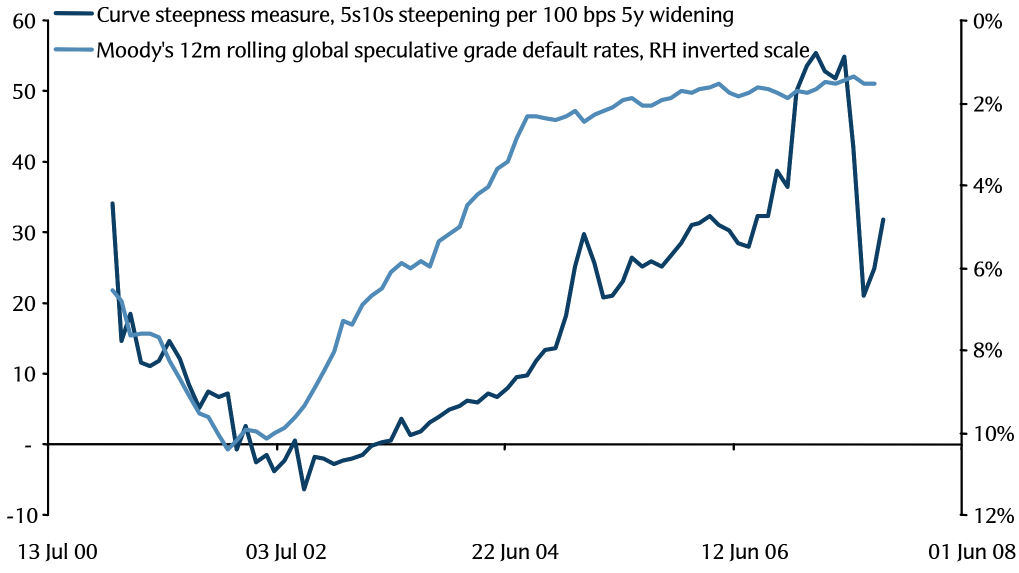
Source: Markit, Barclays Capital

At a basic level, we can use a purely statistical approach to this problem. An example could be to model the changes in the parameters of the curve cross-section best-fit model. The parameters can be assumed to be time varying and a function of overall market spread levels. Such a system would capture, for instance, the general flattening of the cross-section that occurs in stressed times (see Figure 109). However, this approach tends to be more descriptive than forward-looking: if we do not have a clear picture of whether spreads are widening or not, we will also not have a clear perspective on future curve behaviour.

Instead, we believe that linking the curve shape to fundamental projections of, for example, default rates should prove to be a fertile ground. As we saw in Figure 109, in periods of high default rates, the impact of spread widening on the cross-section can even be a flattening compared with periods of low default rates where widening is more likely to lead to steepening. Figure 110 plot a cross-section curve steepness measure together with 12mth rolling default rates on a global level. There is a clear, although not one-for-one link between rising default rates and a flattening of the curve. Interestingly, the curve flatness appear to be backward looking in terms of default rates: we see for example how the peak of speculative grade default rates in mid 2002 was followed by a sustained period of inverted curves, despite default rates actually starting to decrease fairly quickly.

We also discuss the direct theoretical link between default rates and the shape of the curve in Default rates, p.16.

Figure 110: The cross-section curve steepens in conjunction with changes in the default cycle



Source: Moody's, Markit, Barclays Capital

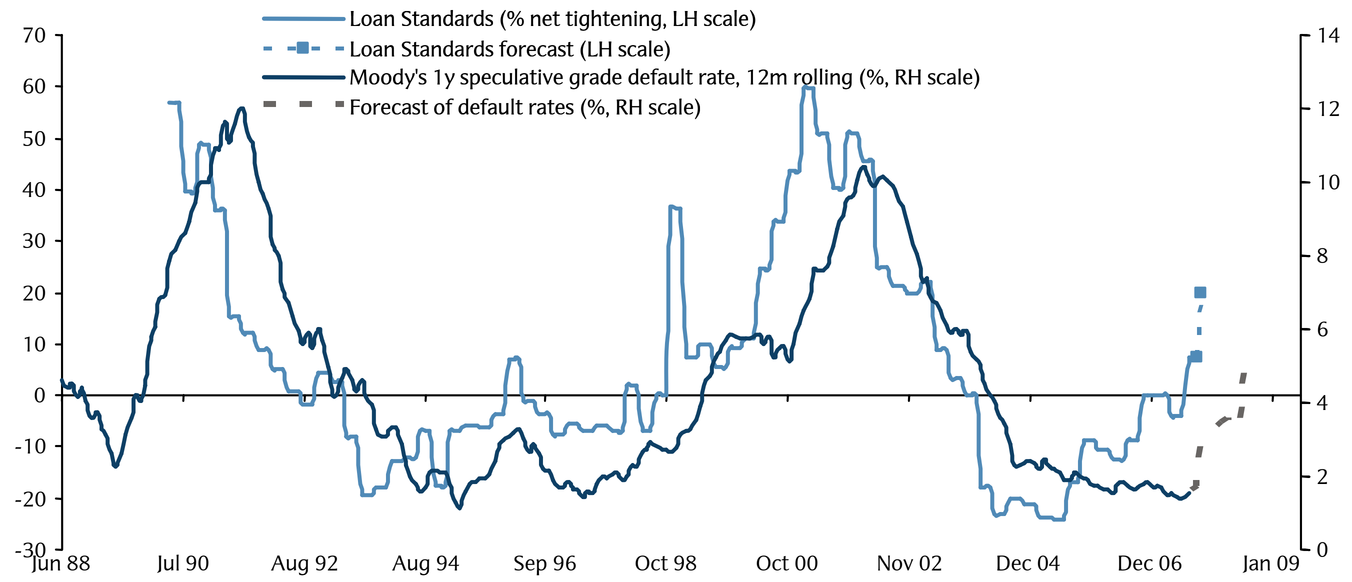
Forecasting the default cycle

See *European Alpha Anticipator: Implications of tightening lending standards for default rates*, 12 October 2007.

Key findings: We find an empirically strong link between the degree of willingness of banks to lend to enterprises, as tallied by the Federal Reserve and ECB surveys, and forward default rates. With a recent tightening of such lending standards, a projected continued tightening due to housing market weaknesses, we make projections of increases in speculative grade default rates


BARCLAYS CAPITAL
RESEARCH
European Alpha Anticipator
European Credit Research
12 October 2007
European lending standards and impact on credit

Figure 111:The link between lending standards and default rates



Source: Federal Reserve, European Central Bank, Moody's, Barclays Capital

Summary – Modelling curve risk

Although some issues still remain – especially in the estimation and robustness of the cross-section dynamics estimation – we believe the methods in Figure 112 can significantly improve risk management of curve portfolios.

Figure 112: Modelling curve dynamics – suggested methods

	Small moves in spread	Large moves in spread
Idiosyncratic driven movement	Constant ratio is fine – better model is constant cross-section based model	Only accurate choice is constant cross-section based model
Market driven movement	Parallel shifts are fine, a better model is an empirically fitted cross-section dynamics model	Only accurate choice is an empirically fitted cross-section dynamics model

Source: Barclays Capital

CDO technicals and curves

There are many technical forces at work in the credit derivatives market that drive both spreads and curve shapes. Typically such effects are hard to model or quantify. The effect of CDO-related technicals, however, is a topic which we can analyse further and derive conclusions that may help position trades around such dynamics.

Bespoke CDO issuance has been one of the driving forces behind CDS spread movements in the past

CDS vary in their attractiveness to be included in bespoke portfolios

The hedging of synthetic CDOs has been a much-discussed technical driving force of CDS spread levels over the past few years. This continued well into the first half of 2007 which saw a continued surge in volumes of transactions and a significant shift from 5 yr deals to longer-dated 7 yr and 10 yr. The period of market volatility over the summer of 2007 led to a significant reduction in trading in the structured credit market, but at the time of writing activity is beginning to show signs of picking up. The return of liquidity to the market will in most likelihood be followed by a pick-up in the trading of structured products in general and the issuance of synthetic single-tranche bespoke CDOs in particular. This will make it important again for investors using CDS, either long-only or more active long-short strategies to consider such technical effects when analysing potential trades.

What is the CDO technical effect on CDS?

Dealers hedging a long protection position on a tranche need to hedge the single-name spread risk by directly selling protection in variable amounts on each of the underlying single-names in the CDO portfolio. This is done through bid lists being sent to single-name dealers. A bid list is merely a list of names and notionals on which the CDO-hedging desk wishes to sell protection. Given the volumes of tranches that have been printed, this leads to significant pressure on single-name spreads in benign market conditions, as there is often not an equal flow of other investors taking the other side of the trade.

In liquid credit markets CDS users need to be aware of CDO-related technicals

Not all CDS names are equally affected by this technical effect. Some names possess characteristics that make them more likely than others to be included in bespoke CDO portfolios. Such names are loosely described as “efficient”. Naturally, spreads of efficient names will come under more pressure than those of inefficient ones, and therefore – all else being equal – should tighten on a relative basis.

Although this is a complex concept, we find it is useful to use an efficiency metric that gives an indication of the likelihood of names appearing frequently in CDOs.

CDO “portfolio-independent efficiency”

Many factors contribute to the “efficiency” of a name

Within the limitations placed on the collateral portfolio, CDO investors look for the highest potential premium on a tranche for a given rating and subordination. This in turn creates the concept of the efficiency of single-name CDS in CDOs – an often-used but vague notion.

Many factors combine to determine which names get included in bespoke portfolios, including sector, country, rating, recovery assumptions and, of course, current spread level. The final rating of a tranche depends in part on these characteristics, both on a name-by-name basis as well as in a portfolio context where diversification is important.

In terms of understanding the efficiency of single-name spreads, we separate these factors into portfolio-independent and dependent factors.

- “Portfolio-independent” factors relate to a comparison of the expected loss of a single-name CDS contract as measured by the rating agency and the credit market.

Single-names are more "efficient" if the market prices a higher risk than the rating agency. This measure of efficiency is essentially a first-order approximation as it neglects the fact that the names will be gathered in a portfolio.

- "Portfolio-dependent" factors relate to the fact that the final CDO will refer to a portfolio. Portfolio diversification (ratings, sectors and geography) is therefore a key factor in determining which names get included – both from the point of view of the investor being comfortable, and in terms of the rating that the tranche attains.

CDO efficiency metric based on ratio of expected losses

In this version of our analysis we focus on portfolio-independent efficiency as we are interested in which names tend to be included most often, rather than consider a particular portfolio. The metric we use is based on a ratio of the market to the rating-implied expected loss, and is defined in more detail in the later sections of this report.

Efficiency as a criterion for trades

We argue below that the CDO effect can affect spreads directly. In considering investment-grade trades, we believe that the efficiency of names is an important factor. For instance, even when fundamentals are negative, buying protection on an efficient name may be a painful trade unless there is some catalyst event or speculation in the news to move spreads wider. If there is little news and low market volatility, we typically find that such names gradually tighten.

Efficiency of names is an important aspect of a trade but is not a justification by itself

We believe efficiency is generally not a strong enough justification itself to implement a trade. It can, however, be an important criterion for trade selection. A strong fundamental view or model-signal, which indicates a particular trade, can be strengthened further if an efficiency argument backs it. Likewise, in an environment of strong structured credit issuance, a weakly-justified trade (fundamentally or by a model) can be killed if efficiency works the wrong way.

An example of the technical effect on spreads

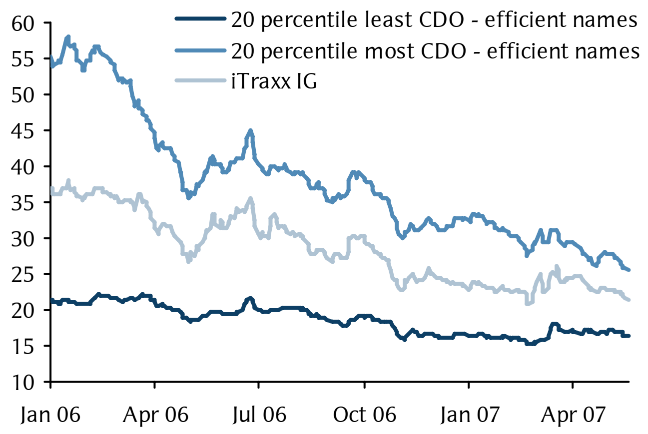
So what evidence is there that the CDO technicals can affect spreads directly? To answer this question, we investigate the behaviour of efficient and inefficient names from the beginning of 2006 to mid 2007. In our analysis, we also take into account the effects of market-wide spread compression over this period.

Despite the portfolio-dependent factors involved, we can expect CDO bids to preferentially hit the spreads of names that are ranked as most CDO-efficient by our metric. This excess demand for credit risk will tend to drive spreads tighter, leading to a convergence of spreads between the most- and least-efficient names.

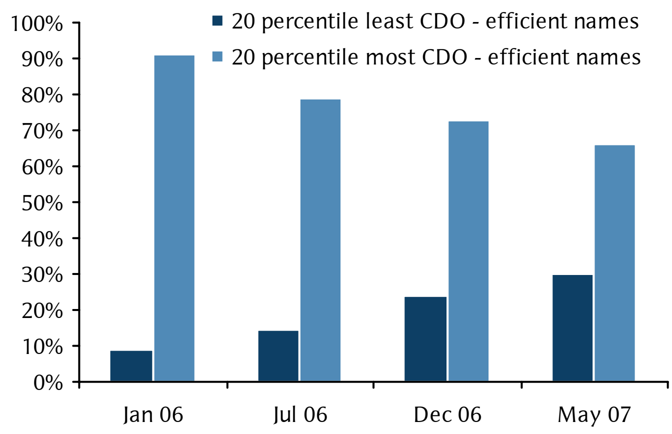
Figure 113 plots the average performance of the European IG names that were in the top or bottom quintile of efficiency in January 2006. The left hand plot indicates how the average spreads for these two sets changed over the next 18 months. The most efficient names saw their spreads tighten dramatically, much more so than the market (as represented by the iTraxx index). The least-efficient names, on the other hand, saw only a modest tightening over the same period.

Figure 113: Performance of 5 yr names that were the most and least CDO efficient in January 2006

a: Change in average spreads vis-à-vis the index



b: Change in average percentile CDO – efficient rank



Source: Markit, Barclays Capital

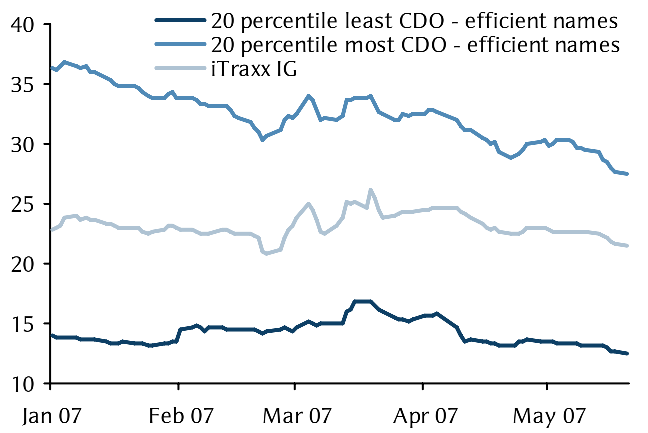
Of course, there is a beta-related explanation to this argument as well, since high-spread names will typically tighten more than tight-spread names. However we find in each of the examples here that the effects we note are more significant than could be explained by betas alone. Specifically, if we remove the beta-adjusted movement in spreads attributable to the index tightening, the top 20% efficient names tightened by an additional 6.5 bp on average over this time period. The bottom 20% of names widened by an additional 1 bp on average.

The bars in the right-hand plot indicate the average percentile rank at different points of time for these two sets of names. As one would expect from the movement of spreads, the most CDO-efficient names saw their average efficiency rank drop from the 91st percentile to the 66th, while the least-efficient names saw their rank increase from the 9th percentile to the 30th.

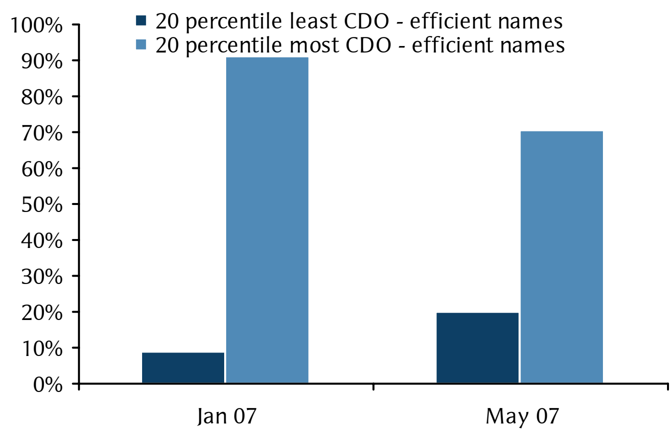
Figure 114 indicates the same pattern of spread and efficiency movements repeated for credit entities that were ranked the most and least efficient in January 2007, over a period extending to May 2007.

Figure 114: Performance of the most and least CDO efficient 5 yr names in January 2007

a: Change in average spreads vis-à-vis the index



b: Change in average percentile CDO – efficient rank



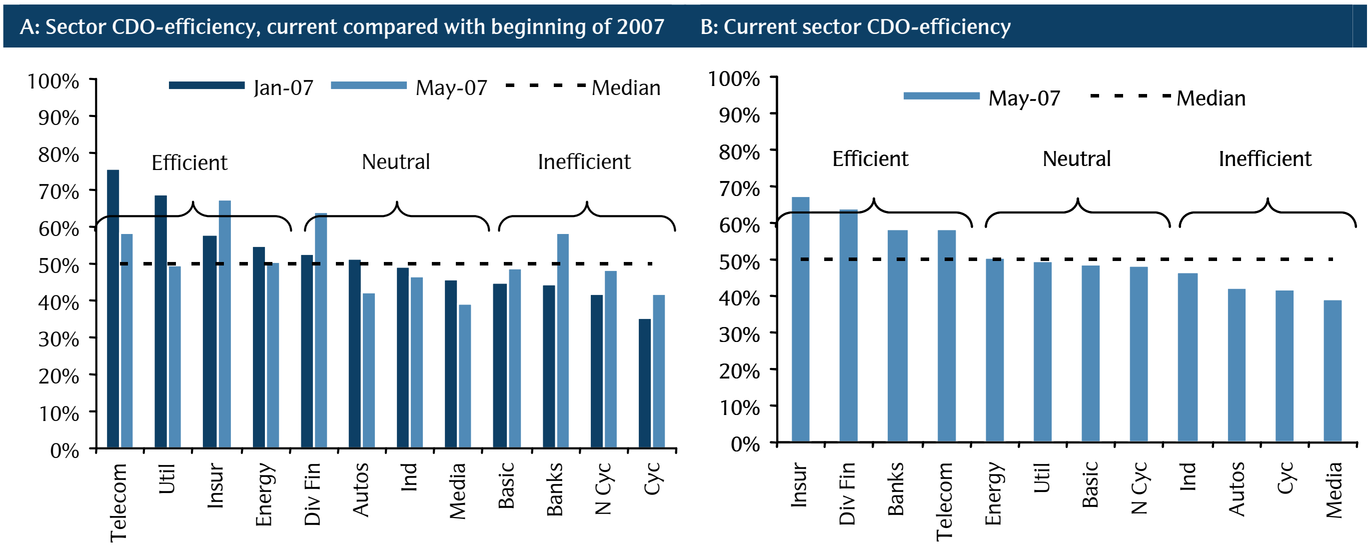
Source: Markit, Barclays Capital

Efficiency by sector

Efficiency has exhibited a strong sector correlation in the past, due to a number of factors. Fundamental concerns regarding a sector that have yet to be reflected in ratings, or sector-based patterns of financing (such as European Telecom long-dated bonds) are examples. Interestingly, this effect is dynamic, with sectors exhibiting a tendency to converge towards the mean.

Figure 115a shows the movement of sectors over 2007. The deep blue bars represent the average efficiency of names in a sector in January 2007 and are arranged in descending order. The light blue bars represent the average efficiency of these sectors in May 2007.

Figure 115: European, sector CDO-efficiency; January 2007 and May 2007



Source: S&P, Markit, Barclays Capital

Marking the 50th percentile as the median rank, we observe a convergence effect over the January to May 2007 period. The most efficient sectors such as Telecoms and Utilities saw the biggest slide in their rankings, with their average spreads tightening about 36% and 31% respectively. Conversely, the least-efficient sectors such as Consumer cyclical and non-cyclicals had the greatest gain in rankings, with average spreads widening about 13% and 9%, respectively. As we would expect, sectors such as Autos, which ranked close to an average of the 50th percentile, barely moved.

Case study: The European telecoms sector

The behaviour of the European telecoms sector in regards to CDO-efficiency-driven tightening has been quite significant. At the beginning of 2007 it was the most CDO-efficient sector overall (Figure 115a). Figure 116 shows the constituents of the sector.

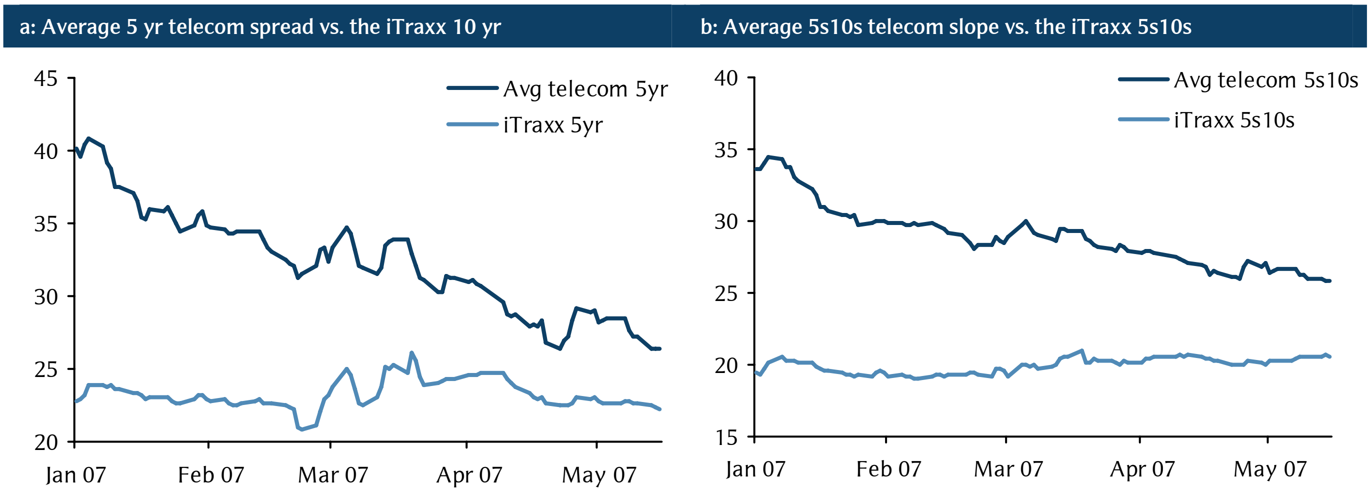
Figure 116: European telecoms sector

	S&P rating	5 yr spread	10 yr spread
BT	BBB+	47.90	84.47
Deutsche Telekom	A-	37.26	68.64
France Telecom	A-	28.18	57.84
KPN	BBB+	64.62	116.25
OTE	BBB+	40.02	72.08
Telekom Austria	BBB+	32.45	62.40
Telecom Italia	BBB+	62.75	108.05
Telefonica	BBB+	35.67	65.24
Telenor	BBB+	19.13	42.32
Teliasonera	A-	50.83	91.64
Vodafone	A-	25.36	49.44

Source: S&P, Markit, Barclays Capital

Not surprisingly, the biggest slide in average ratings over the next four months was in the telecoms sector. Issuers of CDOs preferentially sold protection on these telecoms names, significantly pushing their spreads down relative to the overall market. Figure 117a illustrates how these names tightened relative to the iTraxx over this period.

Figure 117: EUR telecoms 10 yr spreads versus the iTraxx



Source: Markit, Barclays Capital

Curve effects of synthetic activity

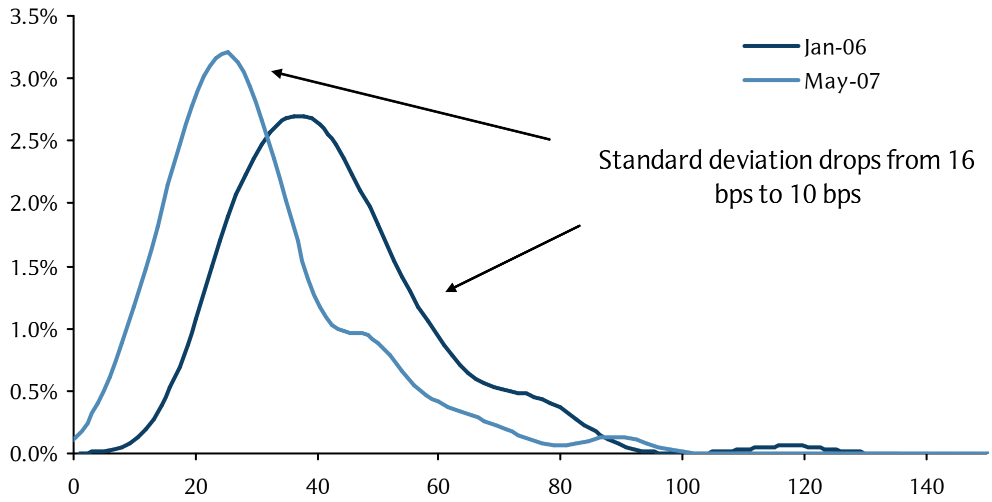
Along with general tightening of spread levels, CDO-efficient names also exhibit curve flattening effects. As efficiency effects are greater in longer maturities (because of higher spreads) they also get hit more often by CDO bid lists. Typically, CDO bids tend to be higher for 10 yr and 7 yr maturities than for 5 yr, which leads to a flattening of the 5s10s (and 5s7s) curves. For the telecoms sector, this is illustrated in Figure 117b; while the average sector slope flattened from 34 bp to 26 bp, the iTraxx actually steepened marginally over the same period.

CDO-driven convergence of spreads within ratings

A further interesting effect of CDO technicals is around the possible convergence of spreads within rating groups. Given the granularity of the ratings awarded by agencies, as well as the relative slow speed at which they are updated to reflect changes, it is to be expected that CDS spreads of names with identical ratings will be heterogeneous. CDO issuers in favourable markets can be expected to take advantage of this pricing differential in risk. Typically, by selling protection on names that have expensive CDS compared with their ratings-implied losses, CDO issuers will bid down the spreads on these names. In periods of low volatility and default rates, we can expect this behaviour to persist, driving a convergence of spreads of names with the same ratings.

Figure 118 compares the spread distributions in January 2006 and May 2007 for credit names (within our universe) that were/are rated BBB+ by S&P. We can see that, along with a general tightening of spreads, spreads also converged, with the standard deviation of the distribution dropping from 16 bp to 10 bp.

Figure 118: 5 yr spread distribution for credit names rated BBB+ by S&P



Source: Markit, S&P, Barclays Capital

Inversions

In this chapter we analyse the concept of CDS curve inversions from a pricing standpoint involving forwards spreads, establishing a theoretical logic for why we should expect curves to invert on distressed credits. We refer the reader to the following topics for a more empirical treatment and plenty of other examples:

- Inflection points and the cross section best-fit line, p.31.
- Why are financials different?, p.33.
- Distressed curves and recovery rates: Case study on US homebuilders, p.81.
- Curve trades as volatility plays: TUI flattener, p.62.

Why do CDS curves invert?

Most high-yield corporate bond investors are familiar with the concept of curve inversions on distressed companies. This is typically understood to be effectively an 'optical' effect driven by the fact that all bonds start trading on recovery value. In order for maturity to be taken into account in the yield computation, yields (and hence spreads) on short-dated bonds need to be much higher than on long-dated.

However, in the government bond and interest rate swap worlds, inverted curves tend to have a different interpretation. They reflect investors' views on future rates and inflation and are sometimes considered to be a leading indicator of a recession.

An intuitive understanding of the inversion of CDS curves actually benefits from analogies from both corporate bond and rates curves:

- An inverted CDS curve reflects the fact that default is being priced to occur in the near term and therefore the PVs of CDS contracts of all maturities begin to converge on recovery values (often CDS will start trading on an upfront price);
- An inverted CDS curve also reflects the market's pricing in of unsustainably high current spread levels, so either the company defaults or it must recover. Essentially, the curve tells us that the forwards are downward-sloping; conditional on the company surviving, spreads should be lower in the future.

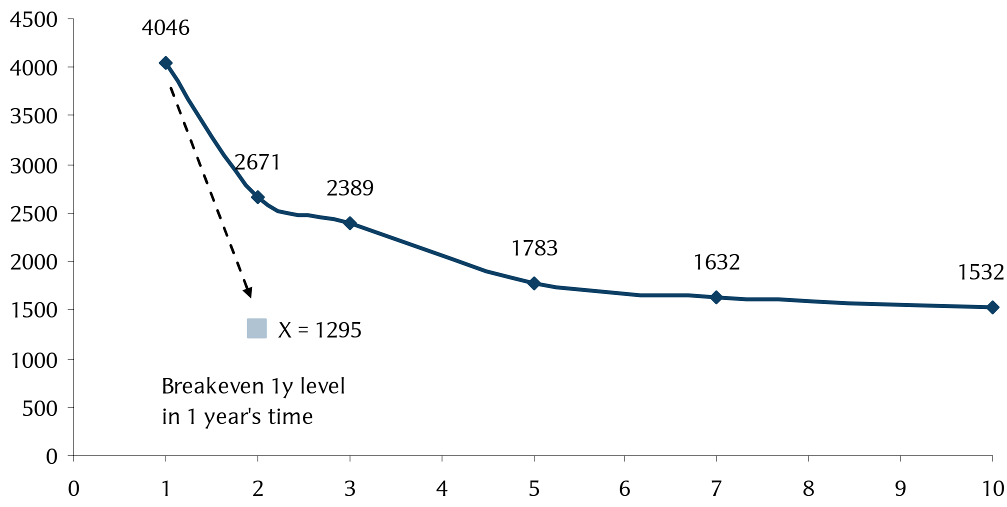
The second point allows perhaps the clearest intuition for inverted curves. The following example looks at the pricing angle.

Curve inversion example

We return to the Delphi example from "Inverted curves", p.15, and consider the options for an investor wishing to buy protection against default. Delphi did in fact default shortly after this snapshot of the curve was taken on 8 October 2005. However, for the purposes of this example, we will consider some hypothetical scenarios relevant to an investor on 30 September 2005.

Note: In distressed situations such as this, most protection would be traded on an upfront basis, not on spreads. However, the intuition developed here based on spreads holds for any inversion scenario.

Figure 119: Inverted curve – Delphi, 30 September 2005



Source: Markit, Barclays Capital

Delphi was trading at 4,046 bp for one year's protection or 2,671 bp, per year, for two years' protection. If there is a default within one year, then both the 1 yr contract and 2 yr contract will have identical payouts of par minus the recovery value, *R*, as usual.

So why pay 4,046 bp for a year's protection when you could pay 2,671 bp and get the same payout if Delphi defaults within year 1? The reason is all based on default timing. If we simplify the situation and say that Delphi can only default at the end of year 1 or at the end of year 2, or not at all, and ignoring discounting, we can compare the P&L of the two strategies for buying protection:

- Strategy A: Buy one year's protection for 4,046 bp. If default has not occurred at the end of year 1, then continue with default protection for the second year; the investor must buy a further year's protection in one year's time at the prevailing 1 yr rate;
- Strategy B: Buy two year's protection at 2,671 bp per year.

Denote the prevailing 1 yr spread in one year's time as X bp, if the company survives.

Figure 120: Comparing P&L depending on default timing

Strategy	Default at end of year 1	Default at end of year 2	No default
A: Buy 1 yr Protection and roll if no default	-4,046 bp + (100%-R)	-4,046 bp - X bp + (100% -R)	-4,046 bp - X bp
B: Buy 2 yr protection	-2,671 bp + (100%-R)	-2,671 bp - 2,671 bp + (100% -R)	-2,671 bp – 2,671 bp
Difference: A - B	-1,375 bp	1,295 – X bp	1,295 – X bp

Source: Markit, Barclays Capital

So, in the first scenario, Strategy B clearly outperforms Strategy A, since the investor has paid less for the same protection.

In the second two scenarios, Strategy B outperforms Strategy A only if X > 1,295 bp. Strategy A outperforms strategy B if X < 1,295 bp.

The value X = 1,295 bp is therefore a breakeven level for where 1 yr protection needs to be trading in one year's time. Although this is a lot lower than the current 1 yr at 4,046 bp, this eventuality is possible. It is likely to occur if the company survives and recovers to some degree in a year's time. Indeed, this is what the market is "pricing" into the curve. In other words, the fact that the curve is inverted in a sense indicates that this is the market's view of where the 1 yr spread will be in one year if the company survives.

This breakeven level is very closely linked to the 1 yr forward 1 yr CDS spread. The conventional market forward spread is calculated similarly, but includes discounting of cash flows by both the risk-free rate and the survival probability (see "Understanding forward spreads", p.113). The actual, fully discounted 1x1 forward spread at this time was in fact even lower, at 507 bp.

Note that this interpretation highlights the subtlety that forward spreads reflect the market's view on future spread levels *conditional* on the company surviving until that point.

An inverted curve, therefore, is pricing in a recovery in the credit quality of the company if a default does not happen in the near term. It can also be interpreted as demonstrating that current short-dated spread levels are unsustainable – in other words the company cannot continue to finance at these levels and hence spreads must drop in the future in order for the company to survive.

Sustainability of financing costs

We encountered the argument of the sustainability of spread levels in the analysis of financial curves under distress (Why are financials different?, p.33). Although distressed curve behaviour is highly complex, driven by many factors, it may be informative for estimating curve behaviour to have a gauge of at what point financing levels do become unsustainable. This will of course be a time-varying and market conditions-dependent number.

Calculating weighting schemes

In this section we analyse the curve weightings question from a more technical standpoint, building up the intuition and ideas from first principles. Throughout, we will refer to all curve trades as 5s10s trades. However, all the ideas and models are fully transferable to other curve points (3s5s, 3s7s, 5s7s etc) as required.

Pure curve trades

Suppose we wish to construct a curve trade that is exposed only to changes in slope and not to changes in spreads. For instance, we may have a view that a curve is too flat relative to where the 5 yr is trading, but have no strong view on whether 5 yr spreads themselves will increase or decrease. We find many such examples in real trading situations.

As discussed in the section on risk-managing curve portfolios (“Risk management of portfolios including curve risk”, p.98), we need to differentiate between changes in cross-section and changes in spread with constant cross-section. By altering the weighting scheme on the curve trade it is possible to hedge against spread changes with constant cross-section, ie, to design a non-directional curve trade. Again, refer to the hedging chapter for a discussion of hedging against changes in cross-section.

Calculating non-directional weights requires an explicit cross-section model, such as those introduced in “Inflection points and the cross section best-fit line”, p.31. Four choices were discussed, in order of typical quality of fit:

1) Linear model: $S_{10y} = A + S_{5y}$

2) Ratio model: $S_{10y} = B \times S_{5y}$

3) Log model: $\log S_{10y} = \alpha + \beta \log S_{5y}$

4) Polynomial model: $S_{10y} = a_1 + a_2 S_{5y} + a_3 S_{5y}^2 + a_4 S_{5y}^3 + \ldots$

In each case, a weighting scheme is implied for a non-directional curve trade. The remainder of this chapter focuses on deriving these weightings. We refer the reader back to “Inflection points and the cross section best-fit line”, p.31 for an analysis of the strengths and weaknesses of the four models.

DV01-neutral weights

The linear model, 1) above, assumes that curves move by parallel shifts. Hedging a curve trade against parallel shifts is straightforward – we use the standard DV01-neutral weights. A derivation of this is given in “Derivation of DV01-neutral weighting”, p.143.

The weighting scheme is:

$\dfrac{DV01_{10}}{DV01_5}$ weight on the 5 yr versus unit weight on the 10 yr

Note that, to be precise, this weighting scheme hedges against small- to medium-size parallel shifts (perhaps up to a move of 100 bp, approximately). This restriction is due to convexity kicking in for larger moves, causing the DV01 ratio to change. We address this in the last part of this chapter.

Beyond DV01-weights

Before looking in more detail at the other curve models, we first argue that DV01 ratio weights should be used as the starting point for all weighting schemes associated with credit curve models.

In fact it is convenient to express all weighting schemes as:

$k \cdot \frac{DV01_{10}}{DV01_5}$ weight on the 5 yr versus unit weight on the 10 yr,

where *k* is a scaling factor derived from a model of spreads.

The explanation for this is to allow the model to deal directly with spreads and not returns. The scaling factor *k* controls how the 10 yr spread is modelled to behave in relation to the 5 yr spread. The DV01 ratio essentially converts from returns space into spread space.

Constant ratio model

In order to implement the percentage-slope neutral curve trade we should in fact use the spread ratio itself as a scaling factor for the DV01 ratio.

$\frac{S_{10}}{S_5} \cdot \frac{DV01_{10}}{DV01_5}$ weight on the 5 yr versus unit weight on the 10 yr.

See "Derivation of constant-ratio curve weighting", p.143 for a formal derivation. There is also a more intuitive explanation, as follows. Consider an example of a name with 5 yr trading at 50 bp and 10 yr at 100 bp. If the 10 yr moves from 100 bp to 150 bp, the 5 yr will also have to move 1.5 times to maintain ratio neutrality. Therefore the 5 yr should move from 50 bp to 75 bp.

Suppose we had a DV01-neutral weighting, so that the DV01 of the 5 yr position is scaled to be equal to the DV01 of the 10 yr position. So a 1 bp move in the 5 yr has the same return as a 1 bp move in the 10 yr.

To maintain the 2x ratio of the10 yr to the 5 yr, the 5 yr must increase by 25 bp. On straight DV01 weighting, this is not enough to compensate for the 50 bp increase in the 10 yr, and the trade will therefore have a non-zero P&L. In fact we need to scale up the protection sold on the 5 yr by exactly the ratio of 10 yr to 5 yr spreads *over and above DV01 weights* so that the move in the 5 yr position is 2 x 25 bp = 50 bp, which, under the DV01 weighting, will have the same return effect as the 50 bp move in the 10 yr.

Log model

How do we take advantage of this better-fitting model in terms of trade weightings? Precisely, we wish to weight the trade in such a way that if 5 yr and 10 yr spreads move according to the model dynamics, there is zero P&L on the trade. We therefore make money specifically when there is a reversion of an anomalous curve to a normal curve, according to the model.

It turns out that the weighting scheme is straightforward and intuitive.

$\beta \cdot \frac{S_{10}}{S_5} \cdot \frac{DV01_{10}}{DV01_5}$ weight on the 5 yr versus unit weight on the 10 yr.

A derivation of this is given in "Derivation of statistical model curve weightings", p.144. The derivation shows that this weighting scheme is essentially a linear approximation of a non-linear model. It is therefore effective for local changes – in other words, small- to medium-sized moves of up to, say, 100 bp.

Polynomial model

The final curve model follows naturally from the first three. However, it is the first non-monotonic model – in other words, it allows for an inflection point after which curves start to flatten. This feature renders the concept of designing direction-free weightings based on this model somewhat inconsistent. This is because, as explained above, any scheme is only a linear approximation – in the case of a polynomial model the linear approximation can prove to be very inaccurate when spreads are near inflection points.

Furthermore, for small- to medium-sized moves in spread, the log model is sufficiently accurate.

Weighting schemes – summary

Figure 121 summarises the curve weighting schemes discussed, and gives some typical values for 5s10s trades on low- to medium-spread names. Note that, as described above, all these weighting schemes are intended for scenarios not involving very large spread moves.

Figure 121: Summary of curve model based on non-directional hedge ratios

Model	Weight on the 5 yr CDS	Typical value for IG name
DV01-neutral	$\frac{DV01_{10}}{DV01_5}$	1.6 to 1.8
percentage-slope or beta-neutral	$\frac{S_{10}}{S_5} \cdot \frac{DV01_{10}}{DV01_5}$	2.3 to 2.9
Statistical model	$\beta \cdot \frac{S_{10}}{S_5} \cdot \frac{DV01_{10}}{DV01_5}$, typically $0.6 < \beta < 0.9$	2.0 to 2.6

Source: Barclays Capital

Further weighting scheme considerations

A final point in this section is that of how to design curve weights when a large move in spreads is anticipated. There are two issues to contemplate – convexity and the corresponding change in DV01 ratio, and the breakdown in the linear approximation of the cross-section model. In the extreme case, a name jumping from investment grade to distressed status will experience an inversion, which is not taken into account in the standard model weights above.

The best solution for designing such trades is purely scenario-based. Using the various likely scenarios and a reasonably sophisticated scenario tool (that at least includes convexity – see the Excel example in “Using Excel”, p.49), it should be possible to test out the P&L effect of different weighting schemes. A weighting scheme that offers the best risk/reward trade-off will be preferable.

Understanding forward spreads

Forward CDS spreads have been discussed in several parts of this guide. In this chapter we take a detailed look at the meaning and calculation of CDS forwards,

What are forward spreads?

A forward CDS spread on a credit entity is the premium agreed today for default protection from a specified start date in the future and continuing until a specified maturity. No cash flows are made under a true forward contract until the start date.

Forward spreads can be interpreted as the market's implied view of where spreads will be in the future. For instance, the 2x5 forward tells us where the market is pricing that spot 5 yr spreads are likely be in two years' time. Forwards, therefore, offer another dimension for taking views on credit risk. Additionally, forwards are used in the pricing of many structured products, from options to exotic derivatives.

Are forwards realised?

As in the interest rate world, there are reasons – theoretical and empirical – for why forwards are generally not realised. The risk premia priced into credit curves essentially lead to forwards being an overestimate of future credit spreads in the same way that default probabilities implied by spreads typically over-estimate realised default rates.

Upward-sloping credit spreads imply that the market is pricing more of the default risk of a credit entity towards the longer term. In other words, the market "expects" credit spreads to widen over time, which translates into higher forward spreads.

Inverted credit curves imply a nearer-term risk of default, but a mid- to longer-term recovery. This tends to lead to forwards being at a level with the spot curve, or even below it. See "Inversions", p.107.

Relating implied default probabilities to forward spreads

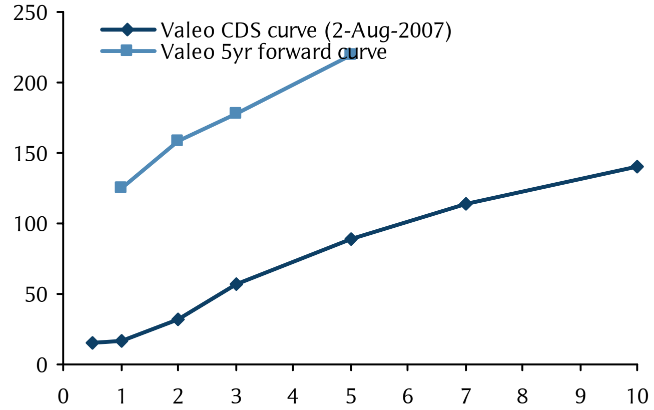
Making assumptions of recovery rates for when an entity actually defaults, it is possible to back out market-implied default probabilities from CDS quotes on a name.

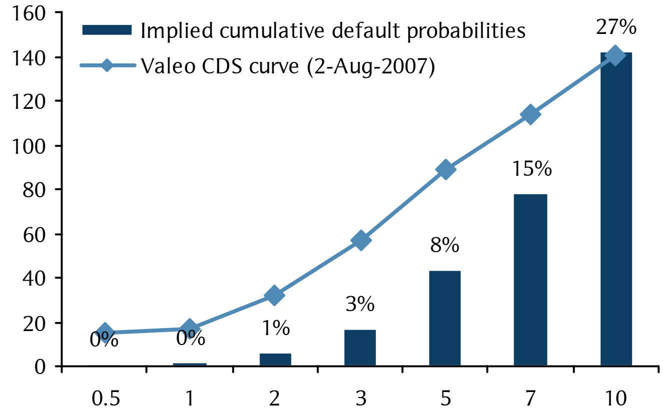
For example, as Figure 122b shows for the CDS curve of Valeo, the implied probability of default generally increases exponentially with time when the credit curve is upward-sloping. In this example, while the cumulative probability of default in the first five years is 8%, the probability of default in the next five years is 27% - 8% = 19%.

Pricing a forward spread off this credit curve explains why forward curves are much steeper for upward-sloping curves. A 5 x 5 forward for Valeo would price in a 19% probability of default from year 5 to year 10 (conditional on Valeo not having defaulted before year 5), or an annual probability of default of 4% (assuming uniform risk of default across any given period). This is higher than the average annual probabilities of default for both the 5 yr and 10 yr spots, which are 2% and 3%, respectively (making the same assumptions of uniform risk of default across any given period).

Figure 122: Valeo CDS spot and forward curves and implied probabilities of default

a: Valeo CDS spot and forward curves	b: Valeo 5 yr and 10 yr expected losses





Source: Markit, Barclays Capital

Pricing forwards through expected losses

Forwards are priced by equating expected losses over two differing time horizons. Typically a 5 yr forward, five years hence, would be priced as follows:

Exp. loss over 5 years, in 5 yrs' time	=	Exp. loss over the next 10 years	-	Exp. loss over the next five years
$F_{5,10} D_{5,10}$	=	$S_{10} D_{10}$	-	$S_5 D_5$

in which expected loss is given by spread x DV01 as indicated. This follows from the pricing of CDS by equating expected loss to the expected premium, given by the product of the premium and the PV of a 1 bp risky coupon stream, or DV01 as it is normally termed.

Rewriting the above expression, we derive the forward spread level to be:

$$F_{5,10} = \frac{S_{10}D_{10} - S_5 D_5}{D_{10} - D_5} = \frac{\textit{Expected loss}}{\textit{Expected duration}}$$

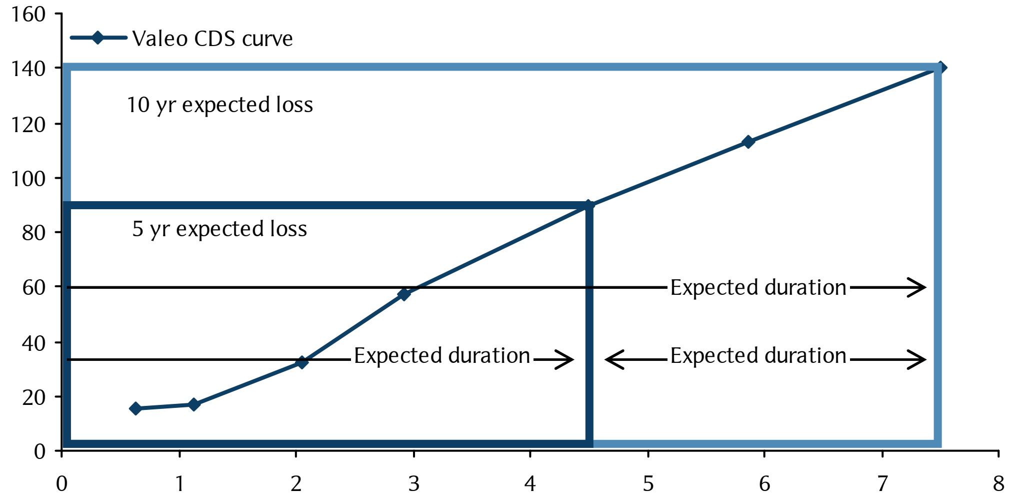
It is evident from this equation that the forward spread depends on two factors:

- The expected loss over the contract period;
- The expected duration of the contract.

The steeper the spot curve, the larger the forward expected losses and the shorter the forward expected durations, both of which drive up the forward spread.

This is schematically illustrated in Figure 123, which plots the spot CDS curve against the *DV01 of each tenor*. The shaded areas represent the expected losses for contracts of different tenors, and the difference between the two represents the expected loss over the forward period. The steeper the spot CDS curve is, the greater the difference between the shaded areas and the shorter the expected duration of the forward, resulting in a higher forward spread.

Figure 123: Valeo CDS spread versus DV01 (tenor 0.5 to 10)



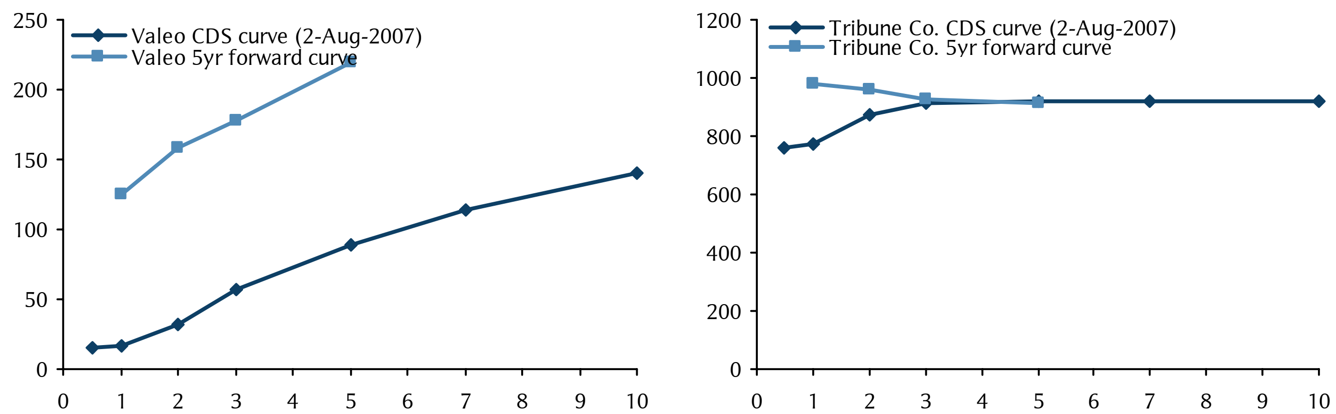
Source: Markit, Barclays Capital

Spot curve inversions

While steep spot curves lead to even steeper forward curves, the scenario changes as spot curves flatten. For inverted spot curves, the forward spread is generally *below* the spot. This is indicated in Figure 124, in which we compare the CDS curves of Valeo with that of Tribune Co. As we can see, the 5 yr forward curve of Tribune is very close to the spot curve, actually dropping below the spot at the 5 yr point.

Figure 124: Valeo and Tribune Co spot and forward spreads

a: Valeo CDS spot and forward curves | **b: Tribune Co CDS spot and forward curves**

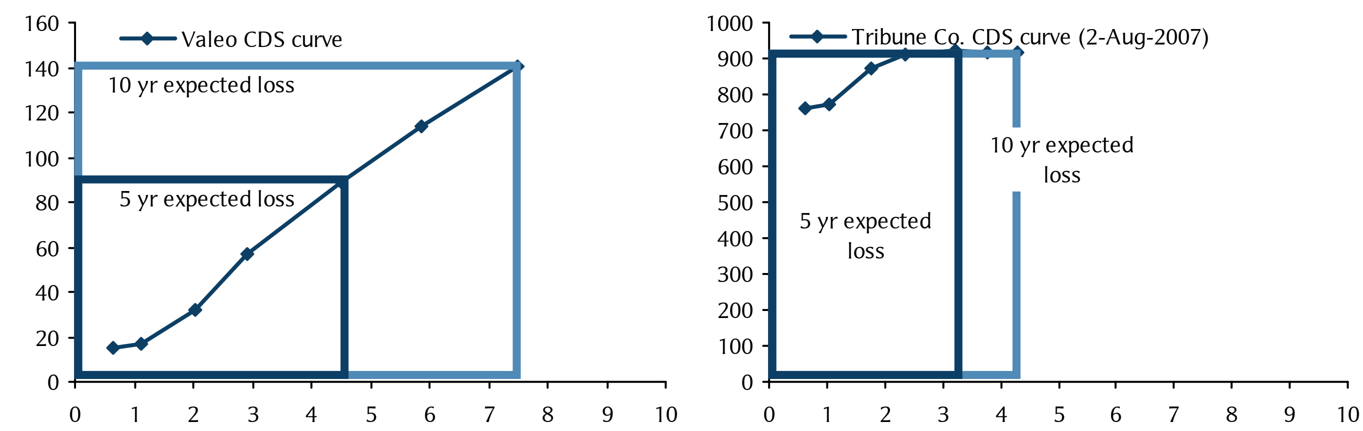


Source: Markit, Barclays Capital

Figure 125a and Figure 125b compare the expected losses in both cases and provide an explanation of this being so. For Tribune, we can see the expected loss in the first five years is much greater than that in the second five years, as priced by the market. Correspondingly, the forward spread is also lower than the spot.

Figure 125: Valeo and Tribune Co expected losses (5 yr and 10 yr)

a: Valeo 5 yr and 10 yr expected losses | b: Tribune Co. 5 yr and 10 yr expected losses



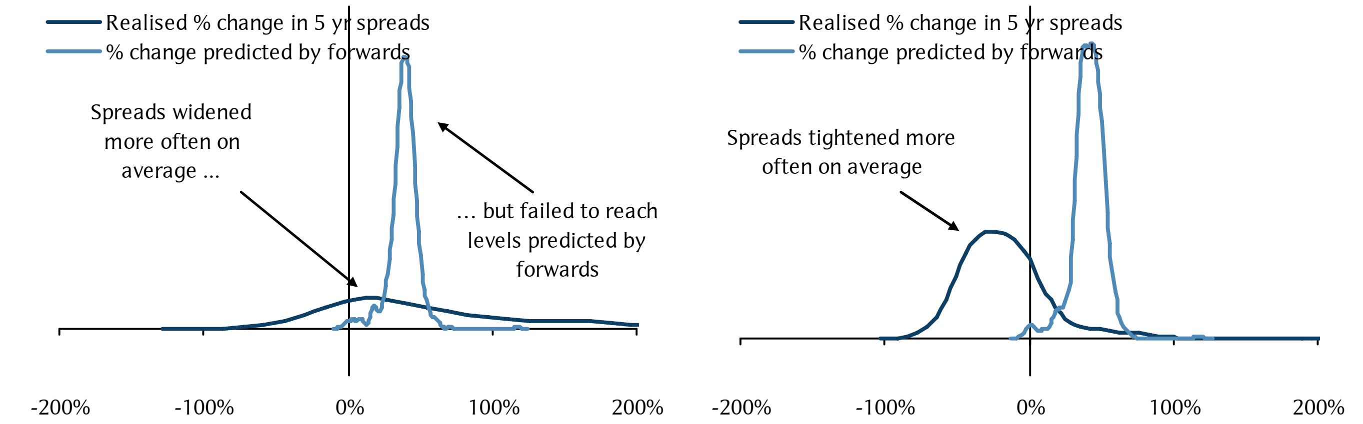
Source: Markit, Barclays Capital

Are forward spreads realised in practise?

We leave a detailed empirical analysis to future research, but present here how European IG spreads have behaved in relation to their forwards over the past year. Figure 126a plots the distribution of percentage change in spreads from August 2006 to August 2007 for all liquid European CDS trading sub 100 bp in August 2006. Not surprisingly, given the past two months of volatility, spreads have widened more often than they have tightened. However, even under these circumstances, spreads were still, on average, below levels predicted by forwards one year back. In Figure 126b, we look at spread changes from May 2006 to May 2007, effectively ignoring the past two months of volatility. In this case, we see spreads have overwhelmingly *tightened*, even though forwards indicated widening.

Figure 126: Spread percentage change distribution (EUR) over 2006/07

a: 1 Aug 06 to 1 Aug 07 | b: 1 May 06 to 1 May 07



Source: Markit, Barclays Capital

How do you trade forwards?

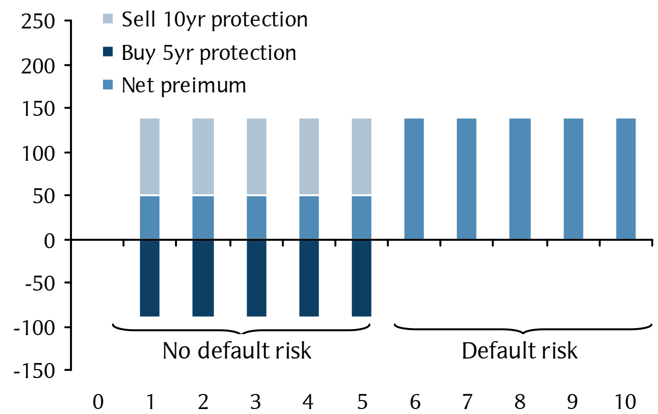
Forwards in the true sense are not normally traded. Instead, investors wishing to express views on forwards typically use a notional-neutral curve position, which mimics the default exposure but changes the cash flow timing.

Notional-neutral curve positions provide the same default protection/exposure as actual forwards in terms of making default payments. However, they differ slightly in terms of timing and size of premium cash flows. The true forward has no cash flows before the default protection period begins. The notional-neutral curve trade will have premium payments equal to the difference in spreads up until the default protection period starts or until the entity defaults, whichever is sooner.

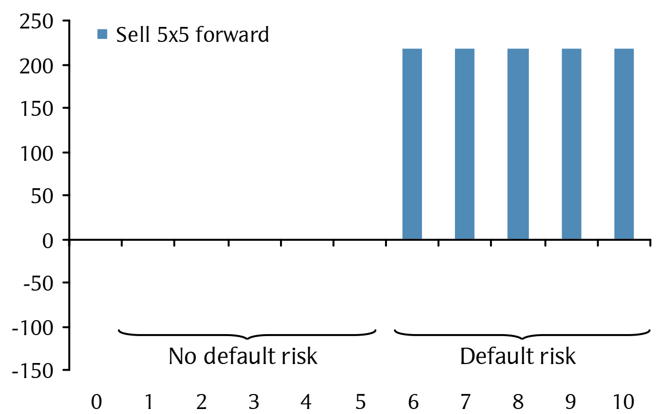
The premium cash flows for both cases for Valeo are illustrated in Figure 127. Note that if default occurs in the first five years, the forward contract will have had no cash flows. Selling a notional neutral flattener (buying 5 yr protection and selling 10 yr protection), on the other hand, will have provided premiums up until default. The forward contract compensates for this with a much higher coupon payment in the second five-year period (if Valeo survives).

Figure 127: Cash flows for Valeo forwards (as of 2 Aug 07)

a: Notional – neutral flattener



b: True 5x5 forward contract



Source: Markit, Barclays Capital

Quantitative techniques

Quantitative screening in the credit market

Quantitative techniques are increasingly being used as a central part of the investment process

Developments over the past few years have led to a significant increase in the use of quantitative methods as a key part of the credit investment process for many asset managers, hedge funds and traders. Increased liquidity and a broadening universe of credit default swaps, combined with improved data quality and longer time-series, aid the development and testing of models and relative value frameworks. Quantitative selection methods are already used actively in equity statistical arbitrage funds and in the liquid markets, but until recently, have not been widely used in credit.

Relative value using quantitative screening

We use a number of quantitative frameworks to screen a wide universe of CDS (covering Euro, US, investment-grade and high-yield) in a fully consistent manner looking for trade signals. Each of the models are extensively written about in Quantitative Credit Strategy research publications, which cover all methodology and testing. Brief descriptions of our slope model and credit direction models are included in the following chapters.

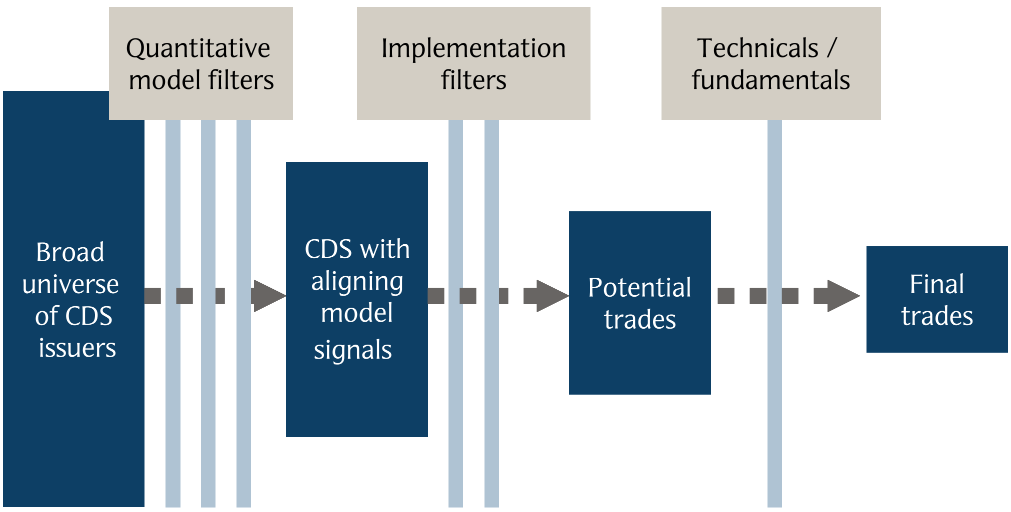
Quantitative techniques are most effective when combined with fundamental information and views

Hedge funds and asset managers which use quantitative techniques most successfully do so by combining model signals with ideas driven by qualitative and fundamental factors. Figure 128 gives a simplified example of such an investment process. The process has three stages:

- **Quantitative model filters:** Overlaying a series of quantitative models with uncorrelated signals to identify consistent trade signals;
- **Implementation filters:** Potential trade profit estimates, liquidity issues, carry, roll-down analysis;
- **Technical and fundamental views:** More qualitative overlays from fundamental analysts and market views.

In "Quantitative trade selection process", p.129, we look at a more detailed trade selection process and give example trade ideas generated under the system.

Figure 128: Simplified investment process using quantitative screening



Source: Barclays Capital

Mechanical strategies and transaction costs

We do not believe that the credit market has yet reached the point where purely quantitative methods can be used widely (with the exception of in the CDS index space). Liquidity and transaction costs (outside the indices), although falling over time, are still too high for most quantitative strategies to generate significant out-performance. For this reason, our philosophy for using quantitative methods is precisely for the screening/signalling applications described above. Models provide consistent frameworks for judging different instruments with different risks and rewards.

Although we do not recommend the mechanical application of the quantitative strategies we introduce here, we do present back-testing results of applying the strategies consistently on a rules-based approach. Back-testing performance, although by no means a conclusive assessment of a strategy, does indicate whether meaningful signals are being generated. Although trading costs can be estimated on top of a strategy, we have reported the numbers pre-transaction costs in order to emphasise the strength of the model signals, rather than to suggest the strategy as a mechanical trading rule.

Slope model framework

A natural application of the curve cross-section analysis (see "The curve cross-section", p.23) is a quantitative framework for analysing all curves at a particular point in time. The framework can select those curves that appear out of shape in some sense and hence potential trading opportunities.

CDS slope model

The model compares metrics of curve steepness in time-series and cross-section

The model we implement uses the log model of the curve cross-section and calculates the error that each curve trades from this best-fit line. That error is then monitored over time, and, at any point where there is a dramatic deviation from normal trading patterns, the curve is flagged as being a potential trading opportunity.

This simple model combines both cross-sectional and time-series dynamics. In its pure form it is a mean-reversion model in two dimensions:

- Cross-sectional reversion: Curves are compared against all CDS curves at one point in time and an error to the cross-section is calculated;
- Time-series mean-reversion: The error is compared with the recent historical patterns. The model flags when it diverges from its mean and how fast it reverts.

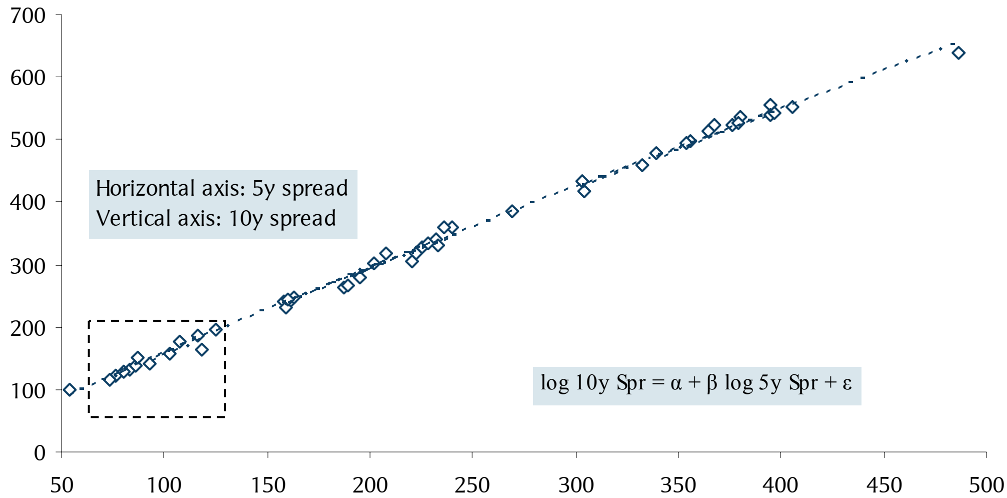
Designing the framework in this way is more sophisticated than a model based on either one of the above dimensions. For instance, a model based purely on time series ignores whether a curve is flat or steep to its peers. A model based purely on cross-section ignores whether there are fundamental reasons for that curve to trade steep or flat to its peers. Combining both dimensions effectively identifies when there is a deviation from standard trading patterns.

Illustrating the framework: Case study on British Airways

We illustrate the framework using British Airways CDS in March 2007 as an example. At the time, British Airways CDS was experiencing idiosyncratic volatility associated with the 'Open-Skies' talks. Figure 129 to Figure 132 show the model in action, step-by-step, and how it identifies potentially anomalous behaviour of the curve during this period.

Starting with Figure 129, a cross-section is fitted to iTraxx XO6 CDS on 20 March 2007. We use the standard log model introduced previously. A dotted line indicates the region we are interested in.

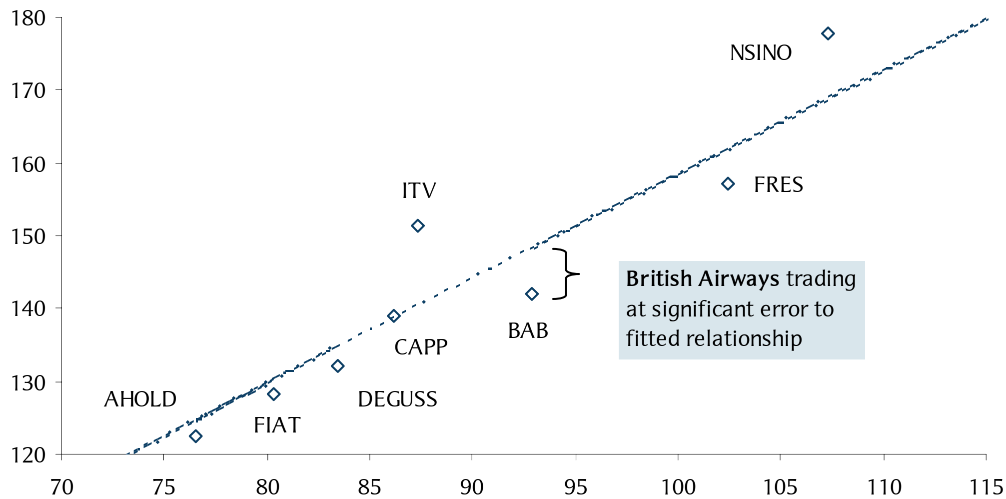
Figure 129: Fitting the cross-section, iTraxx XO6 CDS, 20 March 2007.



Source: Markit, Barclays Capital

Figure 130 zooms into the boxed region. On this larger scale chart we can identify individual CDS. British Airways (BAB) is highlighted trading at a reasonable offset to the best-fit line.

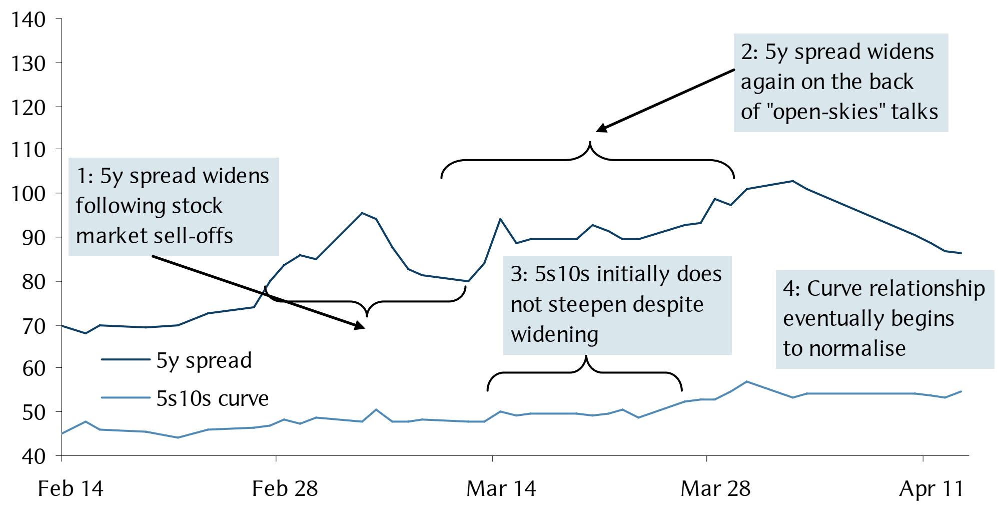
Figure 130: Zooming in on the 5 yr spread range of 70-115 bp



Source: Markit, Barclays Capital

Figure 131 switches to a time-series dimension, plotting both the 5 yr spread series and the 5s10s slope series. The chart is annotated with various events and the impact on the 5 yr and curve. The key point is that the curve fails to react to the 5 yr widening. In fact it more or less parallel shifts over this period.

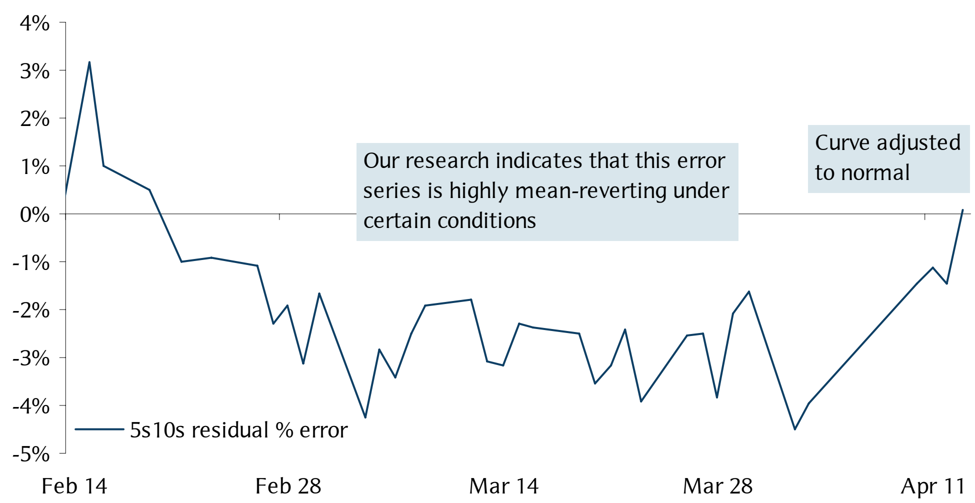
Figure 131: Analysing the British Airways 5 yr and 5s10s time-series



Source: Markit, Barclays Capital

Figure 132 finally introduces the time-series of the cross-section error chart. Here we look at the same time period as in Figure 131. The error time-series clearly highlights how the British Airways 5s10s curve failed to respond to the 5 yr widening, leaving it looking flat to its peers (as indicated by a negative error), when it normally trades in line with its peers (this part is not illustrated in the chart – in fact the model monitors the six-month moving average error for each name).

Figure 132: Tracking the time-series of British Airways cross-section error



Source: Markit, Barclays Capital

This deviation of behaviour was sufficient to trigger a “too flat” signal from the curve model. However, one further complication arises. The model has merely identified that the curve is too flat for current 5 yr levels. It makes no call on whether 5 yr levels themselves should revert, or whether the 5s10s curve should steepen to normalise it for the new 5 yr level. This forms an example motivation for a non-directional model-weighted curve (see “Non-standard weighting schemes”, p.42).

Back-testing the quantitative slope framework

As discussed in Chapter 1 of this section, back-testing of quantitative models is an informative, but not conclusive, assessment of a model's effectiveness. Historical performance is not always a guide to future performance. However, it does help establish that there may be some firm basis to a strategy. Back-testing the slope framework indicates strong performance, as summarised in Figure 133. We test the model across the whole range of available dates from early 2001 to December 2006. The universe used is non-forward looking and spans US and Euro CDS. It varies in size from around 100 CDS issuers in 2001 to more than 1100 in 2006.

The table shows the performance of five portfolios of steepeners constructed using our new statistical model weightings. The five portfolios are formed at the beginning of each month by ranking the model signals. The flattest 20% of the portfolio are the bottom 20% as ranked by the model – therefore the ones we expect to steepen. On average, the steepeners perform in 76% of cases in this portfolio. The steepest 20% of the portfolio are the top 20% as ranked by the model – the ones we expect to flatten. On average, CDS in this portfolio steepen 30% of the time, ie, they flatten 70% of the time.

Performance in terms of returns and Sharpe ratios is also strong in the two extreme portfolios. Note that all performance (including hit ratios) is measured relative to the average performance of the universe. So, if all curves steepen, for example, we measure the relative extra steepening beyond the market.

An especially significant aspect of these results is the symmetry across buckets, on all three performance metrics. This helps build confidence in the robustness of the effects.

Figure 133: Performance[2] of the five-slope quintile portfolios of steepeners, US and Euro CDS, 2001-2006, one-month holding period.

	Flattest 20%	20-40%	40-60%	60-80%	Steepest 20%
Proportion of curves steepening	76%	60%	51%	42%	30%
Average return of steepener (bp)	55	17	0	-13	-50
Sharpe ratio of steepeners	2.8	1.4	0.0	-1.1	-2.7

Source: MarkIt, Barclays Capital

Trade target levels

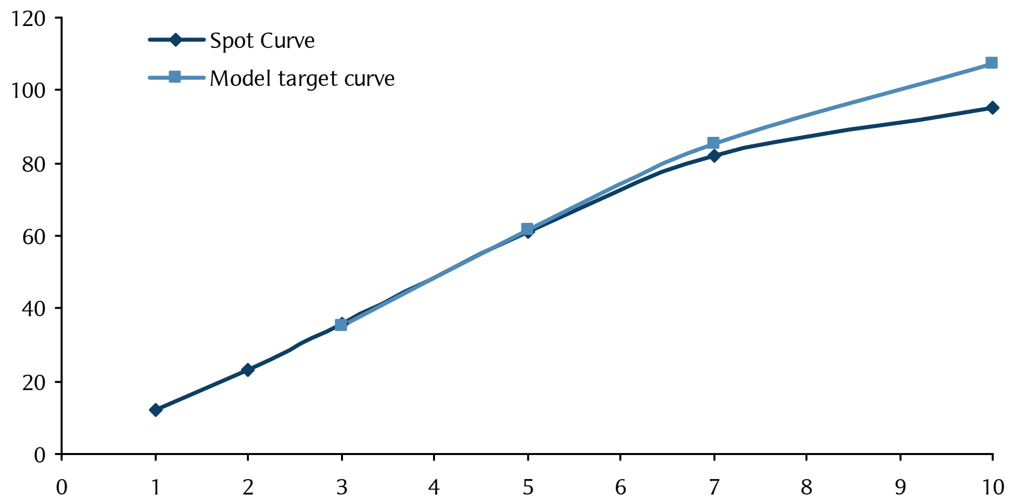
A further benefit of the quantitative slope framework is the estimation of trade target levels. Model-based trade targets are useful for judging potential upside of the trade. In many situations, trades are motivated on several grounds, one of which is the quantitative slope model signal. Therefore, the model-based upside is a conservative upside number.

There are various ways to calculate such a trade target. In many of the trade ideas we analyse, we use the time-series cross-section mean error as a target level for a curve. In other words, a curve that is trading out of line with its usual cross-section position will have a target level calculated by backing out what change needs to occur to bring the curve back in line with normal trading patterns.

[2] *The performance as reported here is not directly comparable with the performance tables presented in Quantitative CDS slope strategies, 23 May 2006. Here, performance is measured over and above a spread group average, to neutralise a spread bias in the results. In the original article, performance was measured on an absolute basis. Compared like-for-like, the enhanced model marginally outperforms the original model on all metrics.*

We saw the Continental 5s10s steepener trade idea in "A bearish steepener: Continental", p.8. Figure 134 shows a simple chart of the spot curve at the time of the trade recommendation, along with the model-based target curve. The model, in this case, was looking for a 10 bp steepening from around 34 bp to 44 bp in the 5s10s.

Figure 134: Continental 5s10s spot and model-target curves, 4 Dec 2006



Source: Markit, Barclays Capital

Directional models

This chapter introduces two directional models (ie, models for selecting long/short CDS candidates) that we find helpful in conjunction with other signals for identifying curve trades:

- The Quantitative Relative Value (QRV[3]) debt-equity-based model for single-name CDS selection;
- The Dynamic Indicator of Equity Momentum (DIEM) model for single-name CDS selection.

The QRV and DIEM models give directional signals for taking long or short CDS protection positions. Both models' output is on a five-point scale from -2 to +2.

Figure 135: QRV and DIEM model output key

Model output	Credit risk signal	CDS protection signal
+2	Strong credit positive	Sell protection
+1	Credit positive	Sell protection
0	Neutral	Neutral
-1	Credit negative	Buy protection
-2	Strong credit negative	Buy protection

Source: Barclays Capital

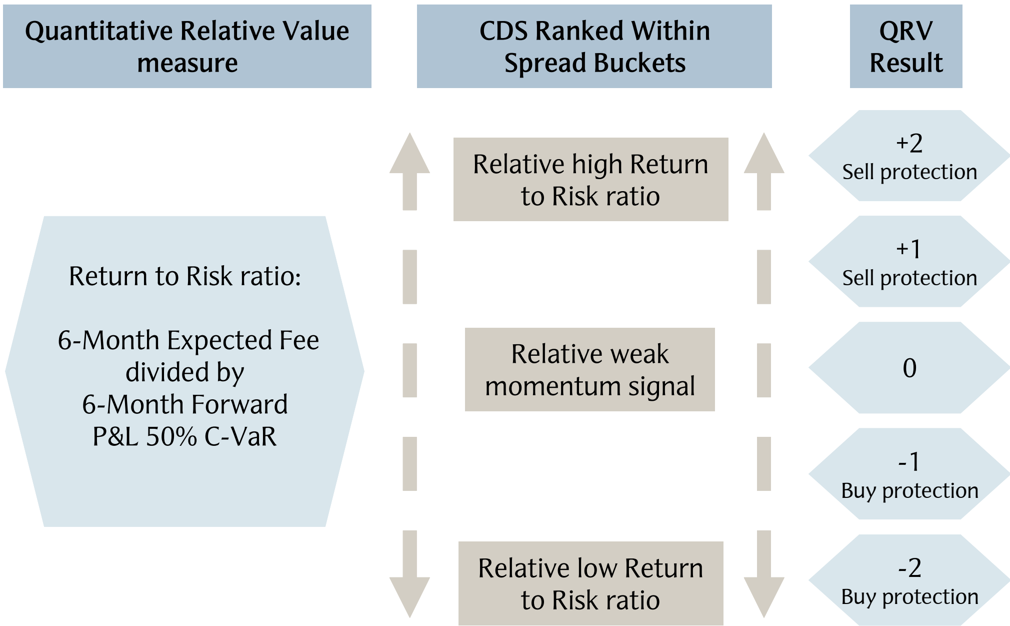
[3] *See* Quantitative relative value indicator, *4 April 2005.*

QRV model overview

QRV: relative value in a Merton-style debt/equity framework

The QRV model uses a variation of the Merton style equity-credit pricing (ECP) model, allowing us to calculate a theoretical CDS spread based on equity prices, equity-implied volatilities, and leverage. In the QRV framework, we use the current stock price and the equity implied volatility number to calculate a forward distribution of stock prices. This distribution is then converted into a theoretical forward distribution of CDS spreads by applying the ECP model to the forward stock price distribution. To obtain the final indicator, we calculate a risk-return measure by dividing the expected return of holding the CDS by the 50% Conditional Value-at-Risk (C-VaR). The 50% C-VaR measure is the aggregate loss potential in the 50% worst scenarios implied by the forward spread distribution.

Figure 136: QRV model summary diagram



Source: Barclays Capital

Back-testing performance

Figure 137 reports the back-testing of long/short strategies based on the QRV model results. Every month, the model is run on our wide universe of USD and EUR CDS. We then sell protection on the +2 ranked CDS and buy protection on the -2 ranked CDS and measure the average performance over the subsequent month. The table also shows the performance of the strategy which goes long +1 ranked CDS versus -1 ranked CDS. Risk-adjusted returns in the form of a Sharpe ratio are given for each strategy. This is calculated as the annualised return of the strategy divided by the annualised volatility of portfolio returns. A Sharpe ratio in excess of 1 usually indicates a strong risk-adjusted performance.

The QRV model performance on the +2/-2 strategy is strong, both on the absolute and risk-adjusted scales. Performance of the +1/-1 strategy is weaker, as expected, but still positive.

Figure 137: Back-testing of QRV model long-short strategies, USD and EUR universe, January 2001 to August 2006, one-month holding period

Long +2/Short -2 Strategy		Long +1/Short -1 Strategy	
Average return on 5 yr CDS portfolio (bp/month)	17.5	Average return on 5 yr CDS portfolio (bp/month)	4.0
Sharpe ratio	2.5	Sharpe ratio	1.0

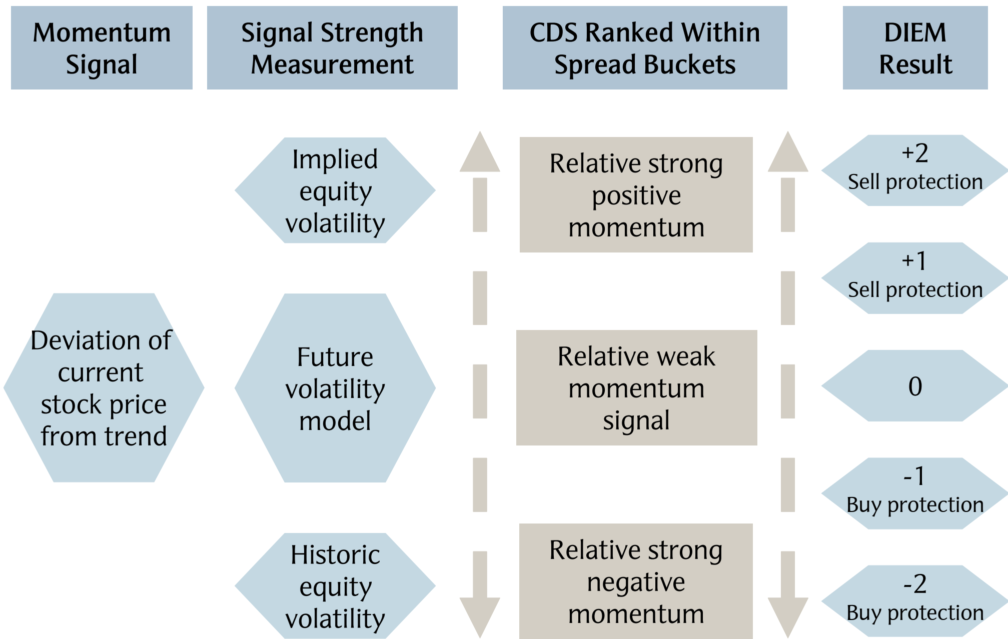
Source: Markit, Barclays Capital

DIEM model overview

DIEM: relative value in an equity momentum framework

Whereas the QRV indicator uses a theoretical approach to how credit should move, the Dynamic Indicator of Equity Momentum (DIEM) is a purely time-series model using a measure of momentum strength to filter strong movers from more neutral names. The indicator is calculated as the percentage value of the current equity price to its two-month average divided by six-month implied volatility. Intuitively, this measures how far the name is away from its trend price in terms of its volatility. Hence, a name which is 10% above its trend price with an implied volatility of 25% will have a stronger indicator than if it had an implied volatility of 35%. The market anticipates it to move less in the first scenario, and hence it is less likely to revert to trend.

Figure 138: DIEM model summary diagram



Source: Barclays Capital

Back-testing performance

Figure 139 reports the back-testing of long/short strategies based on the DIEM model results. Similarly to the QRV model, we sell protection on the +2 ranked CDS and buy protection on the -2 ranked CDS and measure the average performance over the subsequent month. The table again shows performance of the strategy which goes long +1 ranked CDS versus -1 ranked CDS. The average returns and Sharpe ratios look strong for both strategies.

Figure 139: Back-testing of DIEM model long-short strategies, USD and EUR universe, January 2001 to August 2006, one-month holding period

Long +2/Short -2 Strategy		Long +1/Short -1 Strategy	
Average return on 5 yr CDS portfolio (bp/month)	21.0	Average return on 5 yr CDS portfolio (bp/month)	10.0
Sharpe ratio	3.3	Sharpe ratio	2.2

Source: Markit, Barclays Capital

Harnessing the power of cross-section

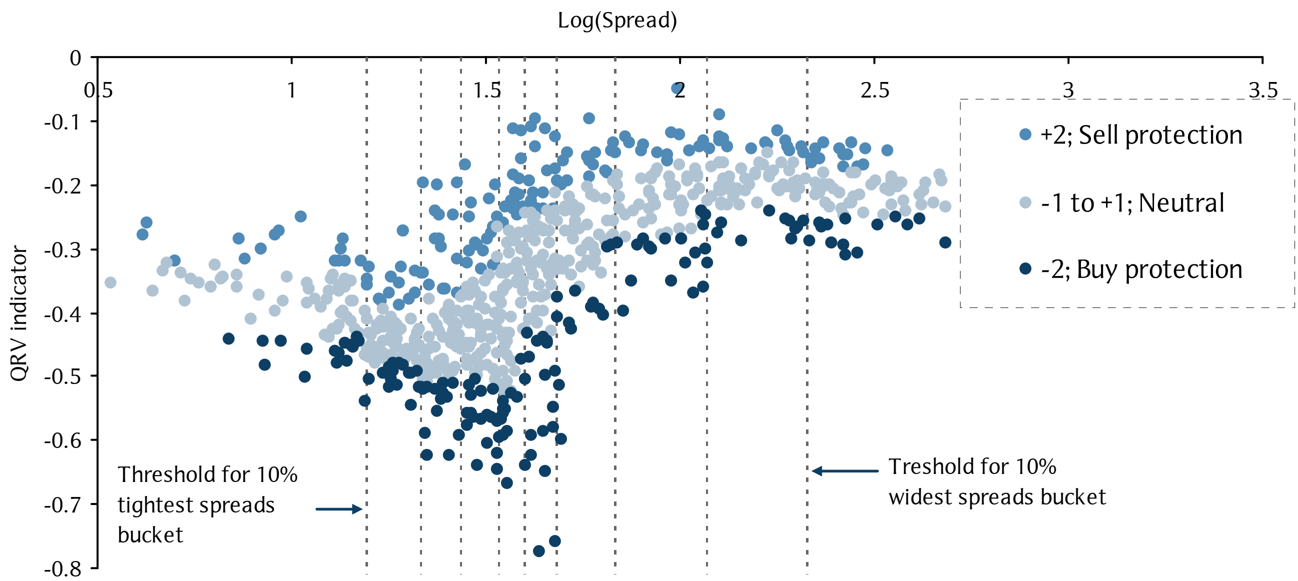
Comparing indicators in cross-section is key to gaining signal strength

Both models gain the majority of their power when the respective indicators are compared across a cross-section of names. We do this in an identical manner for both models. First, we divide our universe of names into 10 spread buckets and second, within these spread buckets, we rank each name in terms of its indicator strength.

Figure 140 demonstrates the cross-section approach using the QRV model. The graph plots individual CDS as points, with the horizontal axis showing the current 5 yr spread (on a log scale), and the vertical axis showing the QRV return-to-risk ratio. The higher this value (ie, the less negative), the better the return-to-risk trade-off of selling protection on the name. Also, vertical dotted lines are shown to divide the universe into 10 deciles of CDS ranked by spread. Within each spread category, the top 20% names are selected as +2 candidates and the bottom 20% names are selected as -2 candidates, as the chart shows.

The chart highlights the non-linearity of the return/risk relationship and therefore the necessity of using spread bucketing to implement cross-sectional comparisons.

Figure 140: Comparing the QRV return-to-risk ratio in cross-section



Source: Markit, Barclays Capital

How does DIEM compare to QRV?

DIEM and QRV share some inputs but are quite distinct and complementary models

Barclays Capital's Quantitative Relative Value indicator and the Dynamic Indicator of Equity Momentum have a number of common input variables, in particular the stock price and implied equity volatility. However, the two models are quite distinct, both in terms of methodology and theory. Although both models perform strongly as CDS screening methodologies throughout the testing period of 2002-2006, we find a low correlation between model signals, suggesting that combining output from both models could lead to improved performance. This is the subject of ongoing Quantitative Credit Strategy research.

Figure 141 lists some of the key features of the two models to make comparison easy.

Figure 141: Comparison of DIEM and QRV methodologies

Dynamic indicator of equity momentum	Quantitative Relative Value
Overview	
Measures the strength and dynamics of a firm's equity momentum and uses this as a credit signal.	Estimates a risk/return measure for future credit spread performance and ranks credits accordingly.
Rationale	
Short-term momentum strategies are profitable in equities. Empirically, we find the equity momentum signal to be informative for credit relative value. This could be due to the higher liquidity of equities, and the availability of liquid implied volatility data.	The key is the superior risk measure used to compare credits – a forward distribution of expected spread changes is derived from equity option data allowing a consistent estimate of down-side risk, including jump-to-default risk.
Method	
An empirical-based framework using *statistical* relationships to measures trends and their strengths.	An analytic framework using *theoretical* relationships between equity and credit variables based on the Merton model.
Drawbacks	
Potential for misleading signals in the case of significant LBO or other re-leveraging speculation. Possibly weaker performance on financials.	Potential for misleading signals in the case of significant LBO or other re-leveraging speculation. Model cannot run on financials.

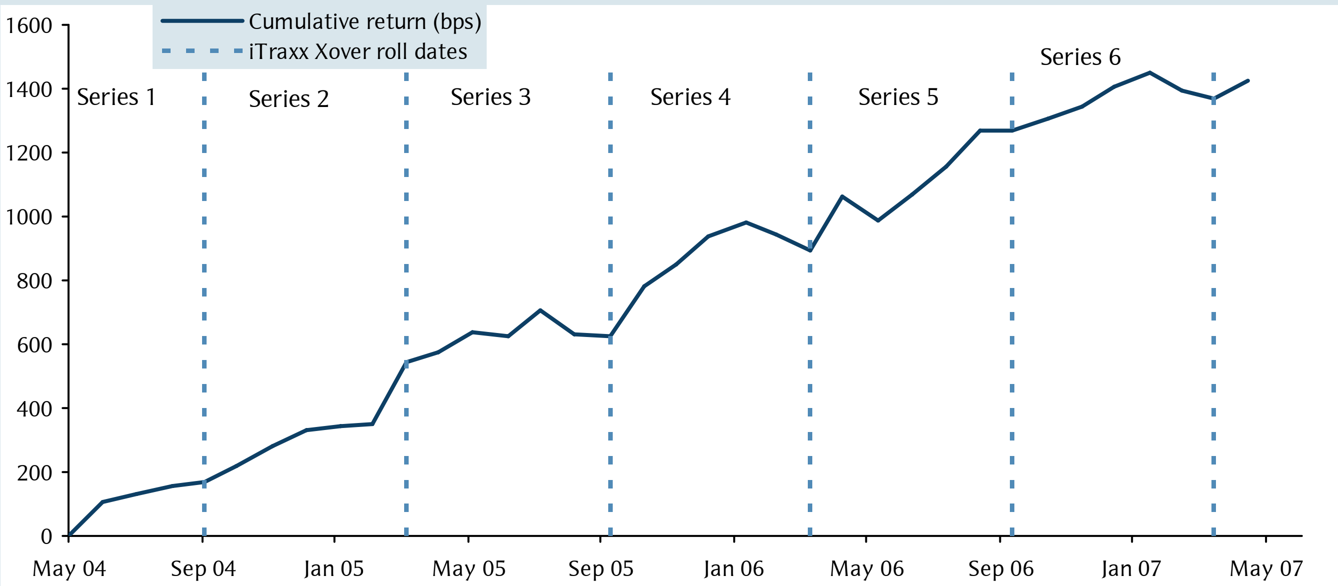
Source: Barclays Capital

iTraxx Crossover equity momentum signals using DIEM

See *Quantitative trade ideas: Crossover equity momentum*, 28 June 2007.

Trade rationale: In general, a certain degree of volatility is required in order for single-name relative value models to overcome transactions costs. In June, 2007, we ascertained that there was enough volatility to implement a basket single-name trade on the basis of our DIEM model, as expressed in Specifically, we generated and back-tested a strategy based on an equal number of short risk versus long risk positions in the on-the-run iTraxx Xover indices. Figure 142 highlights the cumulative, pre-transaction cost performance of this strategy since inception of the Xover index.

Figure 142: Cumulative return performance of the DIEM long-short portfolios



Source: Barclays Capital

The trade: On the basis of past strong performance and DIEM signal, we suggested positioning as in Figure 143, and selling €7.5mn of protection on each of the long names, versus buying €5mn on each of the short names. These weights were designed so as to make the trade carry neutral.

Figure 143: Long and short portfolios as determined by the DIEM percentile indicator

Credit	5 yr Mid spread (27/06/2007)	1 Mth Carry/Roll (€5mn)	Beta to iTraxx XO7 (25 May)	Beta x index spread 25 May	DIEM percentile
Long credit portfolio (sell protection)					
Alcatel Lucent	107	€9,000	0.5	102	75%
Ahold	64	€5,500	0.2	55	75%
Fiat	52	€4,500	0.3	58	80%
Ladbrokes	164	€13,000	0.7	150	88%
Invensys	100	€8,000	0.5	108	96%
Short credit portfolio (buy protection)					
Rank Group	228	€ -18,500	0.9	209	6%
Sol Melia	80	€ -6,500	0.3	69	8%
Gecina	126	€ -10,000	0.5	112	16%
International Power	197	€ -15,500	0.8	181	16%
ITV	74	€ -6,000	0.4	83	18%

Source: Markit, Barclays Capital.

Trade evaluation: the trade was hit by several idiosyncratic events that influence performance quite strongly. On an aggregated basis, however, these worked out positively for the basket, looking at when we suggested taking it off on 16 October, 2007. For example, Invensys was downgraded shortly after the trade inception, making the long risk position underperform strongly and make the total trade go into the red. Later, however, one of the shorts, Rank, issued a profit warning and significantly underperformed in credit making up for the losses incurred on Invensys. Both these events highlighted the need to monitor a basket trade like this carefully. Second, we also note that the trade was actually not put on in the format suggested by the trading strategy (equal notionals on both longs and short irrespective of spreads). As implemented, the trade was actually net long default risk going into the great volatility of the summer. For future reference, this should be traded off versus the fact that the trade was carry neutral.

Quantitative trade selection process

The final chapter in this section introduces a more complete framework for selecting curve trades (and other CDS trades). Such a framework effectively brings together all aspects of curve trading discussed in this guidebook. As mentioned in the first chapter of this section, quantitative methods are generally most effective as screens and scenario systems. This broader framework combines quantitative, fundamental and technical signals.

Figure 144 is an illustration of a combined system. Most boxes reference one or more sections of the guide for a description.

Figure 144: Quantitative trade selection process

Global CDS Universe (Approximately 1200 CDS, 750 US, 450 European)		
Screening stage		
Curve model screening	**Investment theme screening**	**Directional model screening**
Systematically scans full CDS curves for trading opportunities and dislocations	Investment themes, eg, LBO candidates, industry sector stories, market technicals	DIEM equity momentum indicator QRV quantitative risk/reward measure
Potential trade ideas – Analysis stage		
Scenario analysis	**Fundamental credit views**	**Market/macro views**
Risk-reward analysis Model-based trade targets LBO, significant spread change scenarios	Credit view for trade horizon Likely scenarios – news flow Special situations, rating action	Market direction affecting curves Default cycle Balance sheet trends
Liquidity	**Technicals**	**Trade horizon**
Curve liquidity Trade-exit liquidity Transaction costs	Trading flows Synthetic CDO activity Index skew	Timing of news flow Timing of normalisation of curve Time decay costs (carry & roll)
Trade format	**Trade economics**	**Debt structure**
Optimal points on the curve Trade versus an index/single-name Weighting schemes	Carry, roll-down Convexity effects Implications for weighting schemes	Debt maturity profile, issuance Deliverability issues Orphaning potential
Final trade idea		

Source: Barclays Capital

The remainder of this chapter is devoted to example trades that bring together different parts of the selection process.

Aligning signals: Fiat flattener

See *Quantitative trade ideas: Fiat flattener*, 1 October 2007.


BARCLAYS CAPITAL RESEARCH
Quantitative Credit Strategy 01 October 2007
Quantitative trade ideas: Fiat flattener
Trade
Rationale
Trade risks
Figure 1: Trade metrics of selected names

This trade recommendation is a nice example of the trade selection process in action. It receives "ticks" in many of the boxes above, with model-signals and fundamental views aligning. Additionally, we discussed the technical aspects of the trade, risk-reward, and ways of managing market risk. All the details follow.

Trade rationale: Fundamental views and quantitative model signals aligned strongly in the case of a Fiat flattener. We saw the potential for considerable flattening in the Fiat curve, both from a curve-normalisation standpoint and from the positive fundamental outlook and possibility of an upgrade to investment grade. Additionally, Fiat had dropped out of the iTraxx indices (having fallen out of the Xover index between series 8 and 9). We argued that this may remove some pressure on spreads from index arbitrage trades, and that, if bespoke correlation activity picked up, the long end of the Fiat curve might look particularly efficient in synthetic CDO structures.

BMW also had room for substantial curve steepening, according to our model. We also believed this pair of curve trades offered a reasonably market-neutral, relative-value position, having exposure to both steepening and flattening (see the section below on forming a market-neutral RV position).

The argument was that, if market volatility returned in force, given the empirical evidence of behaviour over the summer 2007, we could expect the wider-spread name's (Fiat's) curve to come under more flattening pressure than BMW's. Together with the convexity in this wider-spread flattener position, we expected the trade to break even or even outperform on further volatility.

An alternative format for the trade was against Peugeot instead of BMW. Although the model signals did not support this as well as BMW, it was still identified in our cross section analysis as flat (Figure 146).

Trade format: Implement a DV01-neutral 5s10s flattener on Fiat by buying €17mn 5 yr protection and selling €10mn 10 yr protection, versus a DV01-neutral steepener on BMW by selling €17mn 5 yr protection and buying €10mn 10 yr protection.

Trade evaluation: In the first few weeks, this trade performed strongly, with the Fiat 5s10s curve flattening from around 41 bp (mids) to around 32 bp on 19 October 2007. We would continue to hold such a position as we believe there is further upside and that the other supporting arguments for the trade continue to hold.

We do note, however, that flattener positions are exposed to downside idiosyncratic news. Because of the imbalance in the spread profile of the names selected, this creates a possible asymmetry in the trade's payoff.

Figure 145: Trade metrics of selected names

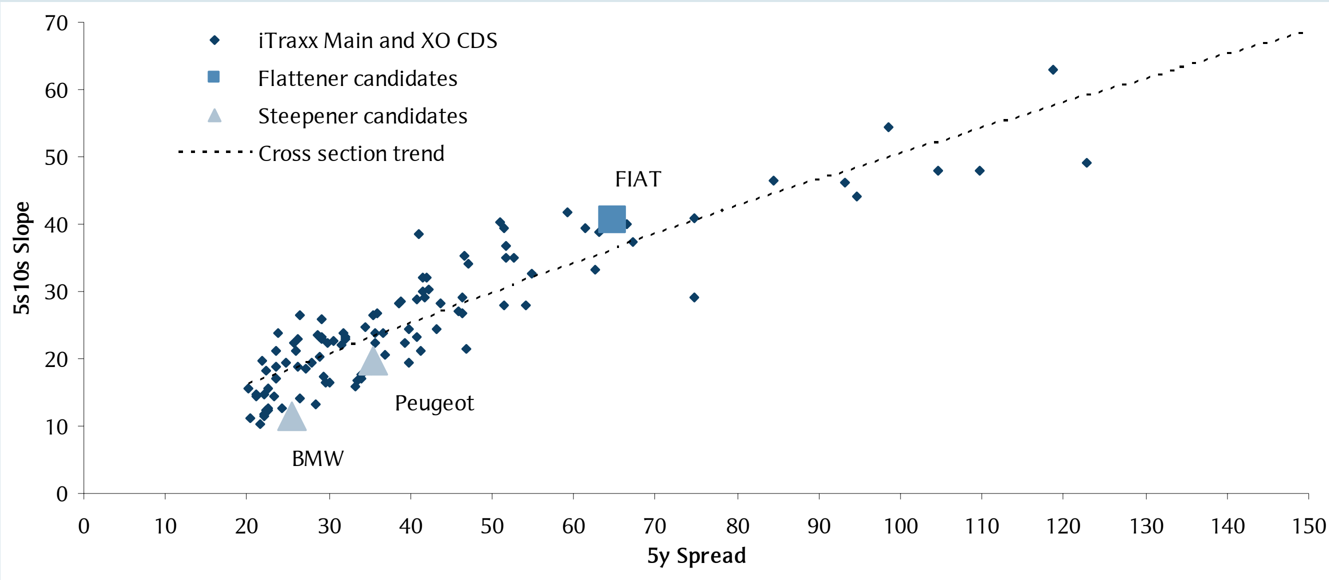
Issuer	Slope model view	5 yr mid	5s10s curve (mid)	3M carry and roll
Fiat	Too steep	63.5	41	-€7,000
BMW	Too flat	26.5	11	€6,500
Peugeot	Neutral/flat	37.5	18	€7,000

Source: Markit, Barclays Capital

Cross section analysis on Fiat

Part of the motivation for the Fiat trade was a cross-section analysis, presented in Figure 146. The chart shows all names in the iTraxx Main and Xover series (series 7). The quantitative slope model uses this kind of analysis with the additional time-series dimension to highlight potential steepener and flattener candidates. We highlight the three names discussed in this trade idea on the chart.

Figure 146: BMW, Peugeot and Fiat – outliers on the cross-section chart of CDS (plotted on axes of 5 yr spread and 5s10s slope)



Source: Markit, Barclays Capital

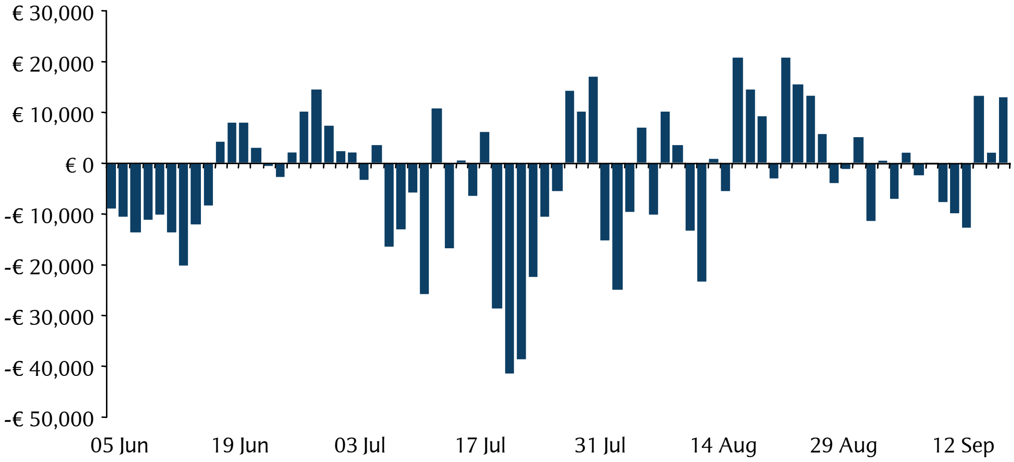
Constructing a market-neutral RV trade

The above trade idea on Fiat is an example of a trade designed to be market neutral. We offset the flattener position with a steepener on BMW. The goal is to remove some of the sensitivity of the P&L on the trade to both market direction and market curve direction.

In this case, it is not a perfectly market hedged trade, as there is a spread discrepancy between the names. However, we argued that in periods of high volatility, the wider spread name should experience more flattening pressure than the tighter spread name. This could potentially lead to a marginal out-performance for the trade in such conditions.

In Figure 147, we illustrate how a trade in an equal notional format (date of the trade is presumed to be 4 June) would have performed. As we can see, this format would have generated a P&L oscillating around zero, despite the market moving quite violently over this period.

Figure 147: P&L graph over BMW steepener, Fiat flattener, €10mn 10 yr notional, struck on 4 June



Source: Markit, Barclays Capital

Expressing a bullish view on Smithfield Foods (SFD)

See *Model-based strategies: Smithfields Foods 5s10s Flattener*, 26 February 2007.

Trade rationale: On 26 February 2007, our quantitative signals were positive on Smithfield Foods – QRV was +1, DIEM was +2, and the 5s10s was too steep. This agreed with our analysts' opinion, which had just been upgraded to Buy from Hold.

Trade format: Carry-neutral 5s10s flattener - Buy \$15.5mn 5 yr protection, Sell \$10mn 10 yr protection.


BARCLAYS CAPITAL

RESEARCH

Quantitative Credit Strategy

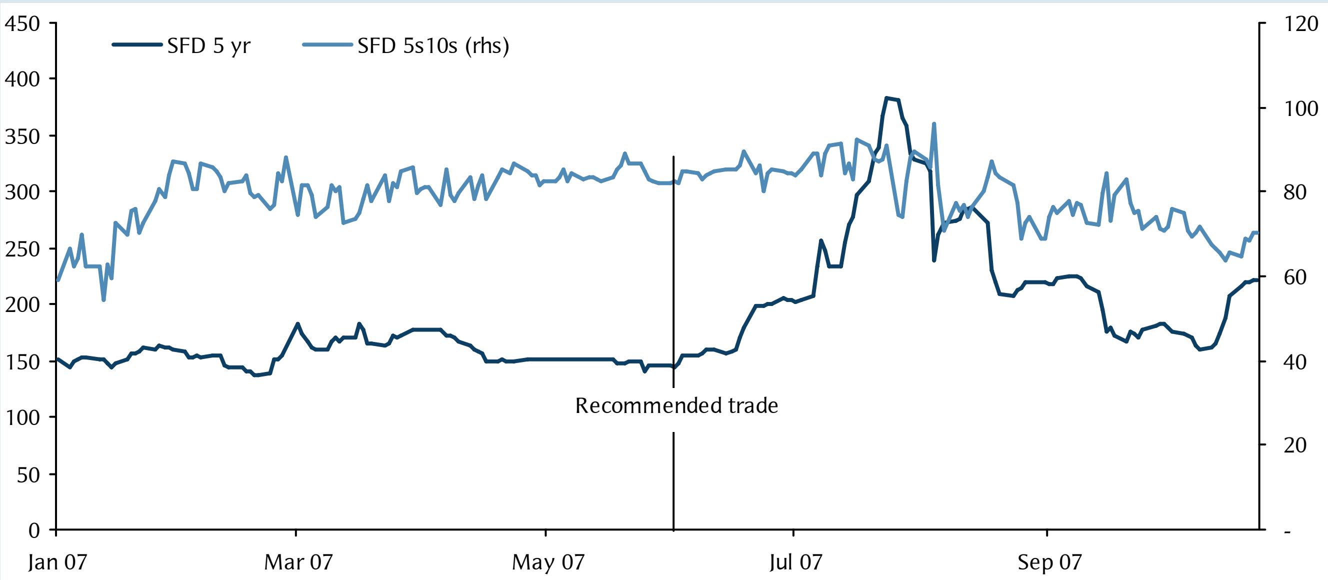
26 February 2007

Model-Based Strategies: Smithfield Foods 5s10s Flattener

Smithfield Fundamentals (Tom O'Neill, Bill Nonneman)

Trade evaluation: This trade has performed, but much more slowly than we expected. The model target for flattening was 15 bp, and the curve has flattened by only 9 bp. However, it is worth noting that the curve has flattened, while the 5 yr spread level is exactly where it was at the trade's inception. In other words, as a way of expressing a positive view on the credit, the flattener has been a better-performing position than an outright long via CDS.

Figure 148: The SFD curve has flattened – but only somewhat (bp)



Source: Barclays Capital

Positioning for event risk: Utilities steepeners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RESEARCH
Quantitative Credit Strategy
11 January 2007
Quantitative trade ideas – EDF, E.ON, Iberdrola, RWE steepeners

See *Quantitative trade ideas – EDF, E.ON, Iberdrola, RWE steepeners*, 11 January, 2007.

This trade recommendation blended curve model and directional model signals with fundamental and technical factors along with a specific industry-sector view.

Trade rationale: These steepener positions were viewed as low- or zero-cost, low-beta shorts, as they were anticipated to perform in a general credit market widening, a utility sector-specific widening, idiosyncratic widening on the names, or specific name-driven events. As such, the trades had a somewhat option-like pay-off, with substantial upside and capped downside. We also argued that rating downgrades might have made these names less CDO-efficient, as well as any LBO activity leading to a general steepening across the sector. Also, we forecasted long-end issuance in the upcoming year, supporting steeper curves.

Model signals for each of the selected names are summarised in Figure 149 (see *iTraxx and CDX reports – Primer*, 21 September 2006 for a full description of the fields).

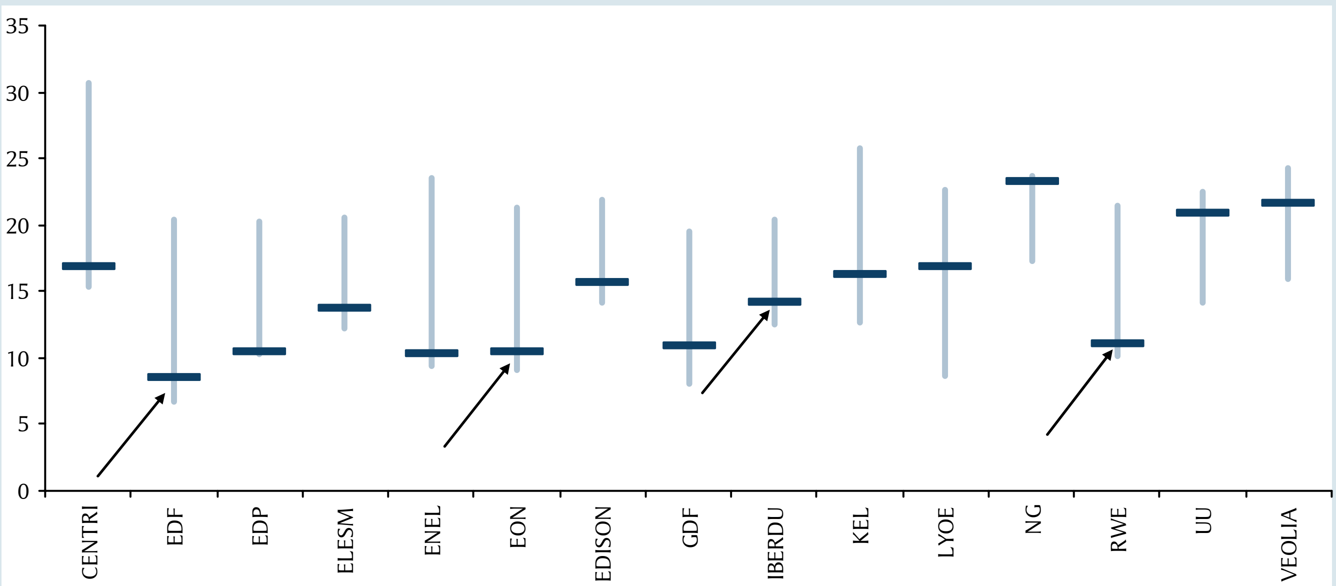
Figure 149: Select Utility sector names – Market data and model signals

		Ref bond rating Mdy/S&P	5 yr Mid	5s-10s (Mids)	6M ATM Eq Vol	1 M Stock Return	Slope Model 5s-10s signal	QRV Indicator	DIEM Momentum Indicator
EDF FP	EDF	Aa1/AA-	13	10	28%	-4%	Flat	-2	-1
EOA GR	E.ON	Aa3/AA-	17	12	23%	-1%	Flat	-2	-1
IBE SM	Iberdrola	A2/A	22	14	22%	-3%	Flat	-1	-2
RWE GR	RWE	A1/A+	14.5	11	24%	-9%	Flat	-2	-2

Source: Bloomberg, Factset, MarkIt, Barclays Capital

Trade evaluation: The trades had a mixed performance. With the widening in July, 2007, two main motivations of the trade – M&A risk and CDO bid – rapidly weakened. Curves steepened marginally, but not as much as expected (due to the cross-section flattening, see "Steepeners in credit market sell-offs", p.22). Also, convexity worked against the trades, although the effect was marginal.

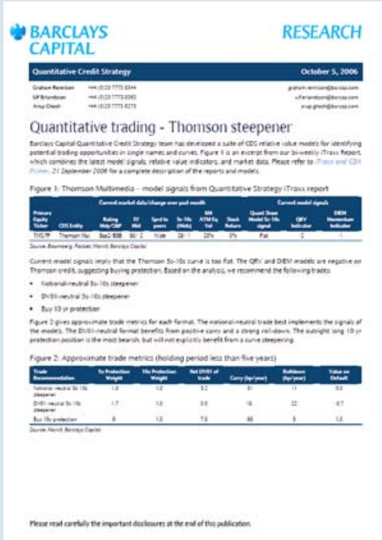
Figure 150: Utilities sector, 5-10s slopes and 1 yr trading ranges (bp) – selected curves identified



Source: MarkIt, Barclays Capital

Bearish steepener: Thomson 5s10s

See *Quantitative trading: Thomson steepener*, 5 October 2006.



Trade rationale: Figure 151 and Figure 152 summarise various model signals on Thomson (see *iTraxx and CDX reports – Primer*, 21 September 2006 for a full description of Figure 151). The slope model indicated that the 5s10s curve, at around 29 bp, was much too flat compared with its peers and its own history. Additionally, the QRV and DIEM directional signals were consistent and credit-negative.

These combined signals meshed well with a negative fundamental view from Barclays Capital's credit research team, which considered that further LBO speculation or an actual bid could result in spread widening.

Trade economics were attractive on a steepener struck at these levels, with reasonable positive carry and roll-down.

One particular risk of the trade, however, was that there was little outstanding long-dated debt for Thomson at the time, potentially leaving a steepener position exposed to a no-deliverables, orphaned CDS scenario.

Trade format: Sell €17mn 5 yr and buy €10mn 10 yr Thomson protection.

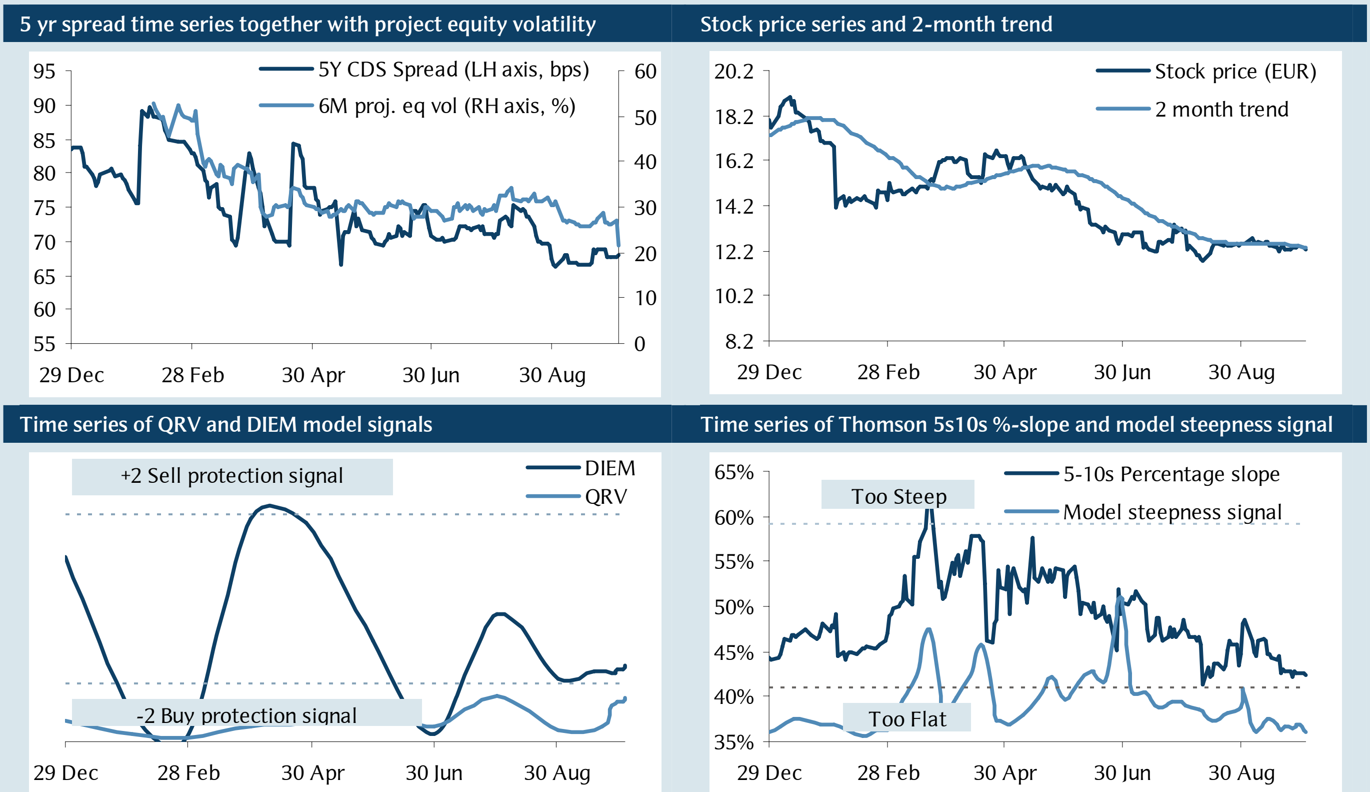
Trade evaluation: The Thomson curve rapidly steepened over the subsequent few weeks. The name remained volatile for some time after this, but the curve continued to trade well above 29 bp.

Figure 151: Thomson Multimedia – Model signals from quantitative strategy iTraxx report

	Current market data/change over past month						Current model signals		
Equity Ticker	CDS Entity	Rating Mdy/S&P	5 yr Mid	5s-10s (Mids)	6M ATM Eq Vol	Stock Return	Slope Signal	QRV Indicator	DIEM Indicator
TMS FP	Thomson	Baa2/BBB	68/-2	29/-1	28%	0%	Flat	-2	-1

Source: Bloomberg, Factset, MarkIt, Barclays Capital

Figure 152: Model-signals and analysis – Thomson 5s10s steepener



Source: Bloomberg, Factset, Markit, Barclays Capital

Further avenues of quantitative research

This guide largely represents our collective experience of analysing, recommending and monitoring curve trade ideas over the past 12 months. Although we believe this guide offers a comprehensive overview of the subject, there are always further avenues of research that we hope to cover in future publications. Some specific areas include:

- Inversion points: Designing a robust approach to estimating cross-section inflection points across different market environments.
- Distressed curve trading: Although some of the techniques introduced here are extendable to distressed situations, a further treatment is required, especially around upfront vs. running and basis issues.
- Basis curve trading: Basis opportunities between cash and CDS includes a large curve angle which we have not addressed in this piece.
- Butterfly trades: We have frequently used butterfly trades to express unusual credit views. Further research may focus on transferring techniques from interest rate swap world, such as principal components analysis of curve variation.
- Portfolio management issues: A major further area of research is in the application of methods introduced here to management of portfolios including curve risk.

Appendices

Appendix A: Defining the efficiency metric

The investment collateral in a synthetic CDO is replicated by selling protection on a portfolio of single-name CDS. While the ratings of these underlying assets in part determine the ratings of the CDO tranches, the protection premium received determines the returns of the tranches. Thus, an easy way to improve the risk/return profile of these tranches is by selling protection on names that trade at the widest spread levels relative to their ratings peers. These would then be the so-called "CDO-efficient" names.

Credit risk incorporates both implied default rates, and expected recovery rates. Thus one way of comparing the differing price set to it by ratings agencies and the CDS market is by comparing *expected losses*. Based on this, we can define a CDO-efficiency measure as follows:

$$Loss\ ratio = \frac{Rating\ \ agency\ \ Expected\ Loss}{CDS\ \ Expected\ Loss}$$

$$= \frac{(1 - RR^{S\&P})\, x P_d^{S\ \&\ P}}{S\ x\ DV01} = \frac{\Phi\,(rating, seniority, term, geography)}{\Psi\,(CDS\ curve, term)}$$

The most CDO-efficient names are the entities with the lowest loss ratios

where:

$RR^{S\&P}$	S&P implied recovery rate for rating and country
$P_d^{S\ \&\ P}$	S&P implied default probabilities for rating and term
S	CDS spread for term
$DV01$	Credit duration of term

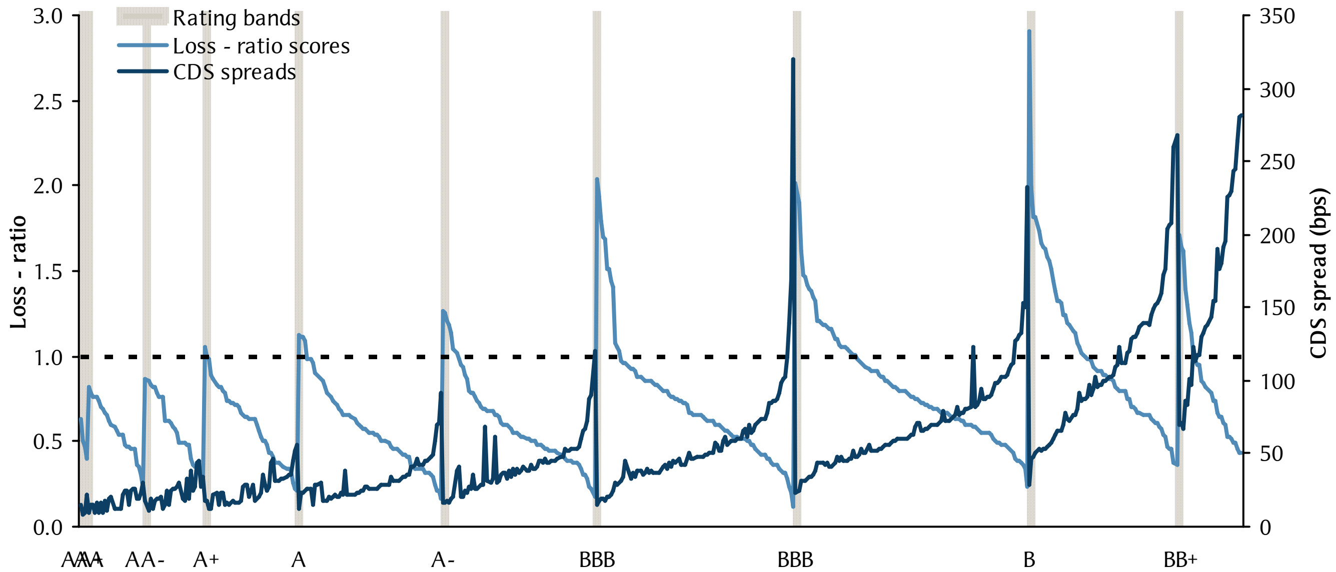
In the expression, the denominator is market-determined, while the numerator takes into account the view of the ratings agency.

A low loss-ratio score would imply that the CDS market is pricing in a much higher default risk than the ratings agencies. For CDOs, this would imply that the underlying credit entity is an attractive underlying asset to sell protection on.

Our analysis of CDO-efficiency, using the "loss ratio" measure is thus a first step in choosing names for a CDO portfolio.

Figure 153 plots the CDO loss-ratio scores for about 675 USD and EUR names, along with their spreads, for 10 yr maturities. The companies are arranged, within rating groups, in descending order of efficiency.

Figure 153: CDS spreads versus CDO efficiency (10 yr maturities, USD & EUR)



Source: Markit, S&P, Barclays Capital

As is evident from the plot, within a ratings group, spreads and loss-ratio scores have an inverse relationship, viz the higher the spread, the lower the loss ratio, and thus the more attractive the name for CDO bids. The most CDO efficient names are entities with the lowest loss ratios, and these typically are the highest spread names within their ratings group.

This makes intuitive sense, as within the same ratings group the risk implied by the rating is almost the same, while increasing spreads imply a higher risk as perceived by the CDS market.

A loss – ratio of 1 indicates an identical pricing of risk by ratings agencies and the market

The dashed line marking "1" on the loss-ratio axis, indicates the threshold level, where ratings agencies and the CDS market price the same risk on a credit entity.

Names below 1 can be argued to be CDO-efficient and vice versa. We can see, however, that there is a marked ratings bias in the loss ratios, viz higher ratings names overwhelmingly have ratios lower than 1 and lower ratings names have ratios higher than 1. This does not imply, though, that AAA names can never be incorporated in CDO portfolios. From the perspective of ratings diversity as well as improving the overall ratings of CDO tranches, such names might well be included in CDO bids.

To provide a more balanced measure of CDO efficiency we rank companies within their ratings group on their loss ratios.

It is important to note the following technical details regarding the computation of the loss ratio for different companies:

- All ratings and spread figures are for senior-unsecured debt, with the exception of financial companies;
- Ratings for all companies are converted to "notched" ratings; viz ratings for names with a positive/negative watch are moved one notch above/below the actual ratings;
- For financial companies (banks, insurance, diversified financials), the CDS spreads are for subordinated debt, and so, correspondingly, are the recovery rate assumptions.

Limitations of this metric

It is important to note the limitations of this metric of efficiency. As previously discussed, this metric measures portfolio-independent efficiency and does not take into account factors around diversification of portfolios. Actual names selected for CDO collateral will be chosen partly on the back of considerations such as this metric but will also often have input from a credit fundamental point of view, in terms of avoiding event risk names or those credits with weaker long-term views.

However, we have found this to be a useful indicator to consider as part of the trade selection process.

Appendix B: Barclays Capital QCX indices

Barclays Capital proxy CDS indices (QCX) extend the time-series of iTraxx and CDX spreads and returns back to 2001. This advance enables macro-level studies of benchmark CDS index behaviour over a full credit cycle.

The QCX indices are constructed using a detailed rules-based approach to avoid survivor-bias. Names were selected based on their likelihood of having formed the constituents of the CDX and iTraxx family between 2001 and 2004. The rules used to choose names, when applied on today's universe, match well with the constituents of the real indices.

Constructing the indices

The following table lays out the steps taken in constructing each series of the virtual QCX indices. It also summarises the basic rules and assumptions which have been used to construct the indices.

Figure 154: Steps in the selection criteria

Rules
1: Roll dates specified at six monthly intervals from March 2001 (on the 20th of every March and September)
2: Index composition kept as close as possible to 20% financials, 10% utilities, 70% industrials Individual names are included in the index based on liquidity and spread levels (used as ratings proxy)
3: Index level calculated for each date in the series by calculating the intrinsic spread viz the DV01-weighted average spread, modified for flat curve assumptions
4: Coupon for the virtual series calculated on each roll-date by rounding *average spreads* of constituents to nearest multiple of five
5: Companies that have spreads quoting above 1,500 bp are assumed to have defaulted and are removed from that particular series from that day onwards

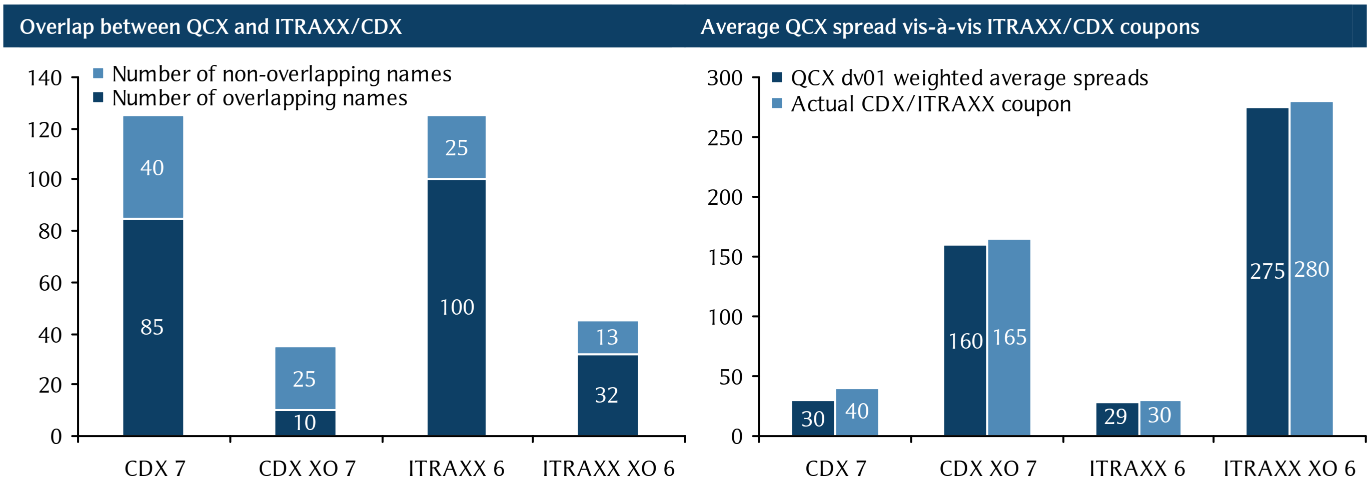
Source: Barclays Capital

Note that we do not use historical ratings as part of the selection criteria, owing to the difficulties of obtaining accurate data on the complete universe. Moreover, our definition of the Crossover indices is not based on rating transition from investment grade to high yield.

"Goodness-of-fit": QCX names vis-à-vis iTraxx6/CDX7

As the above rules are meant to mimic today's index selection criterion, a good test for their suitability is to apply them to the current universe. The overlap between the names chosen by these rules on a specific roll date, and the indices that were then on-the-run would be indicative of the "goodness-of-fit". Figure 155 provides a comparison of the both the number of names that overlap and the average spreads of those names compared with CDX7 and ITRAXX6 (IG & Xover).

Figure 155: Name selection by QCX vis-à-vis ITRAXX6/CDX7



Source: Markit, Barclays Capital

The index selection rules fit today's indices well on both a name-by-name and spread basis

The panel on the left shows the number of names that overlap between QCX and the on-the-run ITRAXX/CDX. The set of overlapping names is more than 70% for the ITRAXX, both on the IG and Xover. While the CDX overlap is a bit lower in the XO, it is a respectable 68% in the IG. Even more significantly, in almost all the cases, the DV01-weighted average spreads (panel on the right) is within 5 bp of the coupon of the actual series (CDX IG being the only exception).

Comparing the spreads with the coupons, we can see that the selection of QCX names is slightly more conservative than the selection of names for the ITRAXX/CDX, but for all practical purposes, the fit between the two sets is very close.

Appendix C: Derivations of weighting schemes

Derivation of DV01-neutral weighting

Consider a curve trade in which we sell α units of 5 yr protection and buy 1 unit of 10 yr protection. Let:

S_5 = 5 yr spread at beginning;

S_{10} = 10 yr spread at beginning;

S_5^T = 5 yr spread at end;

S_{10}^T = 10 yr spread at end;

D_5 = DV01 of 5 yr at time T;

D_{10} = DV01 of 10 yr at time T.

Then the P&L at time T (excluding carry) is

$$P\,\&\,L = -\alpha D_5\left(S_5^T - S_5\right) + D_{10}\left(S_{10}^T - S_{10}\right) \qquad (1)$$

Suppose the curve has parallel-shifted, so that:

$$S_5^T = C + S_5, S_{10}^T = C + S_{10} \qquad (2)$$

Then we can rewrite (1) as

$$P\,\&\,L = -\alpha D_5(C) + D_{10}(C) = C\left(-\alpha D_5 - D_{10}\right) \qquad (3)$$

For the P&L to equal zero in (3), we therefore need

$$\alpha = \frac{D_{10}}{D_5},$$

giving us the required DV01-neutral weight on the 5 yr position.

Derivation of constant-ratio curve weighting

Following the same set-up as above, now suppose the curve has shifted in such a way that the ratio of spreads remains unchanged, i.e.:

$$\frac{S_{10}^T}{S_5^T} = \frac{S_{10}}{S_5} \qquad (4)$$

Then we can rewrite (1) as

$$P\,\&\,L = -\alpha D_5\left(S_5^T - S_5\right) + D_{10} S_5^T \frac{S_{10}^T}{S_5^T} - D_{10} S_5 \frac{S_{10}}{S_5}$$

then substitute (4) and gather terms with $\left(S_5^T - S_5\right)$

$$
\begin{aligned}
P\,\&\,L &= -\alpha D_5\left(S_5^T - S_5\right) + D_{10} S_5^T \frac{S_{10}}{S_5} - D_{10} S_5 \frac{S_{10}}{S_5} \\
&= \left(S_5^T - S_5\right)\left[-\alpha D_5 + D_{10}\frac{S_{10}}{S_5}\right]
\end{aligned}
\qquad (5)
$$

Setting (5) = 0 we either have that $S_5^T = S_5$ in which case (4) implies $S_{10}^T = S_{10}$ in which case the curve hasn't moved, or that

$$
\alpha = \frac{S_{10}}{S_5}\frac{D_{10}}{D_5}
$$

This is the final "ratio-neutral" weight to use.

Derivation of statistical model curve weightings

Consider forming a curve trade again, as in Appendix A. Suppose now that the 5 yr and 10 yr spreads move according to the fitted statistical curve model:

$$
\log S_{10} = \alpha + \beta \log S_5 + \varepsilon \qquad (6)
$$

What is the change in the 10 yr spread for a 1 bp change in the 5 yr spread under (6)? To answer this we differentiate (6) to give:

$$
\frac{dS_{10}}{S_{10}} = \beta \frac{dS_5}{S_5} \Rightarrow \frac{dS_{10}}{dS_5} = \beta \frac{S_{10}}{S_5} \qquad (7)
$$

This is then the required hedge ratio to be used as a multiplier on top of the DV01-weights.

Appendix D: Replicating a CDS index

CDS indices can be replicated exactly using the underlying single names. For a replication to be exact, all cash flows must match under all possible scenarios between the replicating portfolio and the CDS index. As a by-product of the derivation, we can deduce the theoretical market spread of the index implied by the single names, or the "intrinsic spread" as it is termed. The replication strategy is relatively simple in theory. In practice, a full index-arb is a complex trade to execute, both technically and administratively.

Replication recipe

To replicate a short protection position on an index with N constituent CDS, with weight $1/N$ on each name, maturity date T, fixed coupon C, market spread at time t, S_t^{Index}, we can use the following portfolio of single-names:

- Sell protection on each underlying single name, with notional $1/N$ and current market spread S^i;
- The CDS maturity should exactly match the index maturity (note that this will involve using off-the-run maturities in the periods 20 March to 20 June and 20 September to 20 December of each year);
- The CDS should be "struck" at a coupon of C. This means the seller of protection receives a total annual premium of C rather than the market premium of S^i. This is necessary for the premium leg of the replicating strategy to match the premium leg of the index;
- In order to adjust for this 'off-market' strike, an upfront payment is made (or received). The value of this payment is simply the difference between the market spread and the coupon multiplied by the (risky) present value of a 1 bp coupon stream, or the DV01, ie, Upfront Payment on CDS i is $\frac{1}{N}\left(S^i - C\right)DV01^i$.
- The total payment made to enter the replicating portfolio is then $\frac{1}{N}\sum_{i=1}^{N}\left(S^i - C\right)DV01^i$.

Note that a true replicating portfolio is obtained only if all these conditions are met. Later we discuss relaxations of these conditions and the implications for the trade.

Furthermore, a replicating strategy on the CDX indices has an additional complication in that the index trades with no-restructuring documentation, in contrast to single names, which trade with modified restructuring.

Matching cash flows

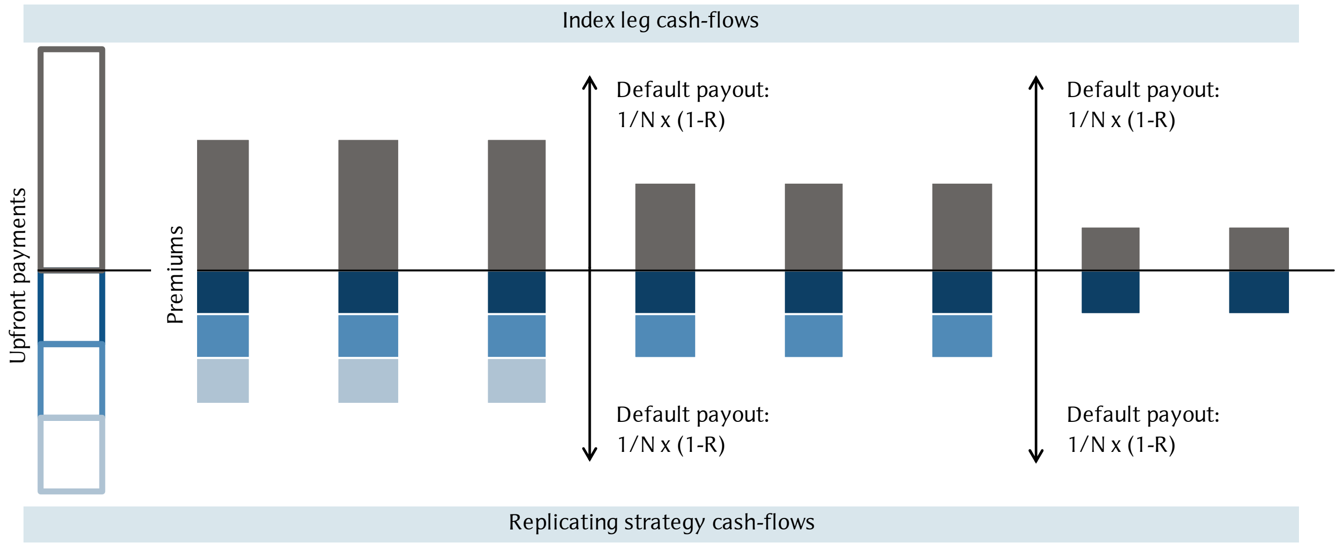
To demonstrate that this strategy truly replicates the pay-off of the index, we need to consider the premium leg and default legs separately. Figure 156 and Figure 157 illustrate the equivalence.

Figure 156: Comparing the cash flows of the index with the replicating strategy

Leg	Index cash flow	Replicating portfolio cash flow
Premium	Pays an annual coupon of C on the remaining notional of the index. For example, if one name has defaulted then the annual coupon reduces to $\frac{N-1}{N}C$	Pays an annual coupon of C/N on each CDS that has not knocked out due to default. For example, if one name has defaulted then the total annual coupon is $\sum_{i=1}^{N-1} C/N = \frac{N-1}{N}C$
Default	According to the rules of the index, in the event of default on one name, the seller of protection pays $\frac{(1-R^i)}{N}$ to the protection buyer, where R^i is the recovery rate.	In the event of default on one CDS contract, the seller of protection pays $\frac{(1-R^i)}{N}$ to the protection buyer, where R^i is the recovery rate.

Source: Barclays Capital

Figure 157: Hypothetical index and replicating strategy with three names and two defaults



Source: Barclays Capital

Calculating the intrinsic index spread

Since the cash flows of the replicating strategy match those of the index, then so should the upfront payments, or else there is an arbitrage. The upfront payment on the index is simply $(S^{Index} - C)DV01^{Index}$ (note that by market convention we use a flat spread curve to calculate the index DV01). Therefore the intrinsic spread, $S^{Intrinsic}$, must satisfy:

Upfront payment on Index = Upfront payment on replicating portfolio

$$(S^{Intrinsic} - C)DV01^{Index} = \frac{1}{N}\sum_{i=1}^{N}(S^i - C)DV01^i$$

Value of the arbitrage

If the market spread is not equal to the intrinsic spread then there is a non-zero index skew $S^{Market} - S^{Intrinsic}$. The value today of this arbitrage opportunity is simply derived from above as:

Arbitrage value today $= (S^{Market} - C)DV01^{Index} - \frac{1}{N}\sum_{i=1}^{N}(S^i - C)DV01^i$

Practical difficulties of the index-arb

The replication recipe given above is difficult to implement in practice. Some of the issues include:

- The large number of single names involved causes administrative difficulties and timing risk (not all names will be executed simultaneously). For this reason, HiVol and Xover are the preferred indices for the trade;
- Bid-offers tend to be at their widest when index volatility (and hence the skew) is high. This significantly limits the proportion of any skew that can be captured;
- In practice, some market participants choose to sacrifice the accuracy of the replicating portfolio by trading the on-the-run par CDS swaps, sometimes leading to better execution. However, this results in convexity mismatches as well as possibly maturity mismatches, which then need to be managed. In particular, large moves in a single name may result in an unmatched mark to market between the index and replicating portfolio.

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