Morgan Stanley

MORGAN STANLEY FIXED INCOME RESEARCH

Morgan Stanley & Co.
International Limited

Giles Gale
Primary Analyst
Giles.Gale@morganstanley.com
+44 (0)20 7677 7121

European Interest Rate Strategy Group
+44 (0)20 7677 7528

May 11, 2006

Europe

Primer

Interest Rate Products

Using and Trading Asset Swaps

Interest Rate Strategy

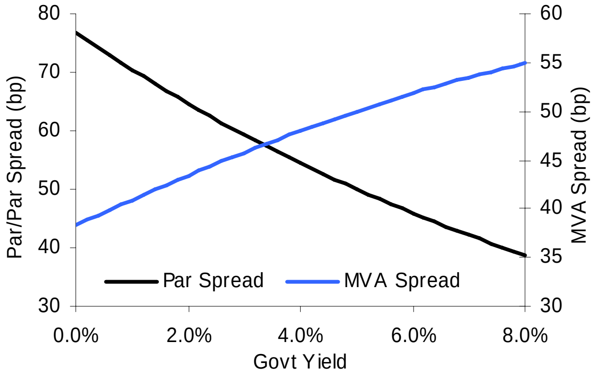
The spread between swaps and bonds can be traded in many different ways. In this publication, we describe the asset swapping methodologies in detail with particular emphasis on the calculation of spreads, risks, and tracking of trades.

The spread of bond yields to swaps is also commonly used to evaluate richness and cheapness of bonds of differing maturities. The margin for error in using an inappropriate spread in valuation is much greater than the value that is likely to be found. We discuss the risks associated with valuation using tradable and theoretical swap spreads in detail to help users choose the most appropriate available.

This publication is intended as a manual and reference for investors who trade asset swaps and those who use asset swap levels as a tool for identifying rich and cheap bonds on the yield curve.

What's Inside

Par/Par and MVA are Directional and Not Duration Hedged



Source: Morgan Stanley

The Primary Analyst(s) identified above certify that the views expressed in this report accurately reflect his/her/their personal views about the subject securities/instruments/issuers, and no part of his/her/their compensation was, is or will be directly or indirectly related to the specific views or recommendations contained herein.

This report has been prepared in accordance with our conflict management policy. The policy describes our organizational and administrative arrangements for the avoidance, management and disclosure of conflicts of interest. The policy is available at www.morganstanley.com/institutional/research.

Please see additional important disclosures at the end of this report.

Introduction

An asset swap is an agreement to swap the form of the stream of future cash flows or benefits generated by an asset, typically from fixed to a market based floating rate such as Libor. Asset swapping is common by investors, as is liability swapping by issuers. The buyer of a bond may prefer floating cash flows as a match for expected future liabilities, for example. They may also wish to swap a fixed coupon asset in order to reduce the interest rate risk associated with it or to ensure that it better matches liabilities expected to be linked to market interest rates. Similarly, a borrower may issue a fixed coupon bond for demand reasons but prefer floating liabilities. This is common, for example, among financial institutions.

This publication is intended as a manual and reference for investors who trade asset swaps, and for those who use asset swap levels as a tool for identifying rich and cheap bonds on the curve.

New Edition

This is a new edition of the first section of the *Asset Swaps and Swap Spreads* publication from July 2005. It includes a more detailed treatment of the asset swap methodologies most commonly used in the index-linked markets and a discussion of Credit Default Swaps (CDS) and the CDS/asset swap basis.

Organisation of This Publication

This publication has two main sections.

In the first part, we detail the mechanics of different asset swapping techniques seen in the market.

In the second part, we assess the value of the information that different methodologies provide on the richness and cheapness of bonds.

Asset Swapping Methodologies

There are four main ways to set up an asset swap trade. They may be listed in order of simplicity, and most likely familiarity to the reader; thus: Yield/Yield, Par/Par, MVA, and Yield Accrete. We will deal with each, in turn, in this section before dealing with the purely theoretical spreads, the YCS or Zero Spread. We finally discuss Credit Default Swaps, their behaviour, and how their premium may relate to the swap spreads arising from other swap spread transactions.

Exhibit 1 breaks down the characteristics of the different spreads.

Exhibit 1

Overview: Asset Swap Types and Characteristics

Spread	What Is It?	Curve Exposure	Directionality	Simplicity	Use for Relative Value
Yield/Yield	**Spread:** Difference in yield between bond and swap to same maturity **Trade:** Bonds against swap to same maturity, duration weighted	Spread tends to widen as curve steepens for bonds trading above par.	Trade is duration neutral, but not convexity hedged. Re-hedging will be needed on large yield curve moves.	The most simple ASW transaction	Good when the yield curve is flat. Very poor when comparing bonds with very different coupons and the yield curve is steep.
Par/Par	**Spread:** Spread applied to floating leg such that Swap PV = 100 – Bond DP **Trade:** Bond bought for par, plus a swap. Swap fixed schedule matches bond coupons. Floating schedule is [Libor + Spread]. Notional is Par.	For given bond price, par/par swap spread falls as the swaps curve steepens.	Par/Par spread falls as yields rise. Trade is not duration neutral – hence, trade loses money in a sell-off.	Complexity compensated by familiarity with this spread in the market. P&L can be easily approximated as changes in spread.	The spread is highly dependent on the dirty price of the bond. We, therefore, dislike this spread for RV. It is nevertheless widely used.
MVA	**Spread:** Spread applied to floating leg such that Swap FV = 100 – Bond DP MVA = [Par/Par]*100 / [bond DP] **Trade:** Bond bought for dirty price, plus a swap. Swap fixed schedule matches bond coupons. Fee of [Settlement DP] -100 paid to ASW buyer at expiry. Floating schedule is [Libor + spread]. Notional is bond dirty price at settlement.	For given bond price, the MVA swap spread falls as the swaps curve steepens.	MVA spread rises as yields rise. Trade is not duration neutral.	P&L is not easily approximated. Quoted MVA spread involves a swap of notional equal to bond dirty price. Quoted spread, therefore, does not indicate unwind terms. MVA is not frequently traded.	The spread is dependent on the dirty price of the bond, although this dependency is much less than for Par/Par, especially for very high coupon bonds. It is not widely used, but we prefer it to Par/Par for RV.
Yield Accrete	**Spread:** Spread applied to floating leg such that Swap PV = 0. Spread should lie between Par/Par and MVA. **Trade:** Bond bought for dirty price. Swap fixed schedule matches bond coupons. Floating schedule is [Libor + Spread] based on a notional that accretes from [bond DP] to Par according to some schedule. ASW buyer receives accretion in swap notional, in addition to [Libor + Spread] on that notional.	YA spread will display some yield curve exposure according to the accretion schedule. This should be muted compared to that shown by Par/Par and MVA as the spread lies between the two.	YA spread will display some directionality according to the accretion schedule. This should be muted compared to that shown by Par/Par and MVA as the spread lies between the two.	Spread is hard to calculate, and systems are often not set up to handle it. Notional accretion may be linear, compound, or some other schedule, and spread will differ from one to another. There is no consensus on the 'standard' form.	In theory, the YA spread should be better for relative value decisions than either Par/Par or MVA or Yield/Yield except when the yield curve is very flat. The spread is hard to calculate, so z-spread may be preferred.
YCS (Z-Spread)	**Spread:** Spread applied to the swaps zero curve (or par curve) such that PV of bond cash flows discounted on the shifted curve = bond DP	YCS will show some exposure to changes in the relative steepness of the government and swaps curves.	YCS is not directional.	Spread is straightforward to calculate using most risk systems.	This is the generally preferred spread for RV.
CDS	**Spread:** Annual premium payable for option to put a par amount of bonds with CDS writer. **Trade:** Premium typically payable quarterly. Option typically triggered by default, certain debt restructuring, or issuer downgrade. Protection buyer may normally put any of an issuer's bonds (denominated in specified currency) with seller.	No 'mechanical' curve exposure.	No 'mechanical' directionality. CDS have a spread duration – their PV varied with changes in spread according to a 'DV01'.	CDS are quoted, hence no calculation is required. The theoretical models of CDS involving recovery rates and default probabilities are complicated.	CDS are not bond-specific and do not provide information for RV between bond issues. CDS are widely used for RV between issuers and maturities for one issuer.

Source: Morgan Stanley

Terminology

Swap spreads generally refer to spreads that must be applied to swaps to make them in some way 'equivalent' to a bond. The spread is bond-specific. Because the Par/Par spread involves the application of a spread to the floating leg of the swap, swap spreads are often referred to as *Libor Spreads*.

Government bonds and bonds of very good credit issuers, such as agencies and supras – especially shorter issues, trade at negative spreads to swaps. A 'widening' of spreads, therefore, refers to a richening of the bond (a decline in bond yield compared to swaps). For credits with a positive Libor spread, the opposite is true. As our discussion in this publication concentrates on government swap spreads, 'widening' will usually mean 'richening'.

In the US, Treasury spreads are normally quoted as positive numbers as swaps used to be quoted as spreads over Treasuries. In Europe, governments are normally quoted as negative numbers, consistent with the spreads arising from Par/Par transactions, although government spreads are frequently referred to as positive for convenience.

Yield/Yield Asset Swaps

A long asset swap position or a long swap spread position refers to owning a bond against a hedge in swaps.

The simplest way for an investor to achieve such a position is by buying a bond and paying fixed on a swap to the same maturity. The trade must be duration weighted so that, to the first order of approximation, the yield/yield asset swapper is exposed only to the spread between the swap rate and the bond yield and not to market direction.

This transaction gives rise to a trade on the yield/yield spread, which is defined as the yield of the bond less the swap rate of a matched maturity swap. The investor makes money as the spread widens since the bond yield falls relative to the swap rate.

The advantage of the yield/yield methodology is its simplicity. Yield/yield asset swaps are easy to execute and monitor. Most short term (less than three to six months) views on governments versus the swaps curve are expressed in this way because of this.

There are problems with this technique, however. Carry estimations are complicated because cash flows are not matched and the position is not convexity hedged. Finally there is curve risk, which is greater the higher the duration mismatch between the swap and the bond.

Tracking the Performance of a Yield/Yield Asset Swap

As noted above, monitoring yield/yield asset swaps is relatively simple. But it is important to take account of the following when tracking the performance of a yield/yield trade:

- Cash flows are not matched, so carry needs to be calculated on both legs.
- The trade is duration hedged, but not convexity hedged.

The first step is to determine how many basis points the yield spread has moved in your favour or against you and to multiply this by the risk of the trade. Illustrating this with an example, consider a long spread position in the on-the-run 10-year Treasury, the 4% Feb 2015's. The investor has bought $100 mm of the bond, with a total risk of $79,540 per basis point. To match duration, they must pay fixed on $101 mm notional of the swap (the duration of the swap is 7.87). The yield on the bond is 4.219%, the swap rate is 4.656%, so the yield/yield spread is -43.78 bp. If in 7 days, the yield/yield spread widens to, say, -45 bp, the gain on the spread would be approximately $97,040 (=$79,540*1.22 bp).

Carry arises because the spread between the funding rates is not equal to the yield spread and the swap position is not on the same notional amount as the investment in the bond. In our example, the initial rate setting of the floating leg of the swap is 3.12% and the fixed leg is 4.656%, while the bond yields 4.219% and has funded at 2.75% for one week. The day count conventions are 30/360 and Actual/360 on the fixed and floating legs of the swap, Act/Act on the bond and 30/360 on repo. The carry over the 7-day period on the fixed leg of the swap is:

7/360 * $101 mm * (3.12%-4.656%) = -$30,165

The carry on the bond is:

(7/365 * 4.219% - 7/360 * 2.75%) * $100 mm = $27,440

Hence the net carry is -$2,725.

This compares with the rule of thumb that carry is

(Swap Spread – Funding Spread) * Notional * Day Count

= (-43.78 bp + 37 bp) * $100mm * 7/365

= -$1,300

Carry can be more important for a steeper swap spread term structure where the difference between the funding costs and the yield spread is greater. The duration hedge ratio, which will be largely a function of the coupon of the bond, may also accentuate this.

How Big Is the Convexity Risk?

Consider an instantaneous upward parallel curve shift of 50 bp.

Continuing the above example, if the position is not rehedged, a 50 bp shift upward in yield leaves us with an investment worth $96.055 mm in the bond, i.e., a loss of $3.945 mm. Our gain on the swap is $3.889 mm, so we lose $56,000 due to the convexity mismatch. This is very approximately equivalent to a 0.7 bp move in the yield/yield spread. The risk per bp of the bond position has fallen to $75,825, while the risk per bp on the swap falls to $77,710. So the risk associated with further parallel yield curve movements is $1,885/bp.

Curve Risk

In an upward sloping yield-curve environment, a high coupon bond normally has a lower modified duration than a low coupon bond. Taking an extreme example to illustrate the problem, consider the 4% and 11¼% Feb '15 US Treasuries. The low coupon bond has a modified duration of 7.955, while the high coupon bond has a modified duration of 6.7. If the yield curve steepens, we would expect the yield to rise further on the low coupon bond than on the high coupon bond. Hence selling this bond and buying the high coupon bond in duration-neutral amounts will leave us with a steepening exposure in much the same way as if we were to buy an 8-year bond and sell a 10-year bond.

The same problem can arise when trading swap spreads on a yield/yield basis because the duration of the swap may be different to that of the bond. A swap maturing on Feb 15, 2015, was seen above to have a duration of 7.87, significantly exceeding the modified duration of the 11¼% Feb '15 Treasury. A steepening or flattening in both curves may therefore lead to a mechanical widening or tightening of the yield spread

In this example, a steeper curve should imply a wider yield/yield swap spread for a high coupon bond.

Par/Par Asset Swaps

For an investor, a par/par asset-swapped bond is like a floating rate bond, whose only net cash flows are the floating receipts, which are based on a constant spread to Libor. This spread reflects factors affecting the price of the bond outside of duration.

The par/par methodology therefore allows an investor to be exposed only to the idiosyncrasies of the bond issuer rather than taking interest rate risk.[1] For this reason, the par/par asset-swap is particularly popular in credit, for investors who want to take a view on a credit, but not interest rate risk. Investors will also swap a bond in such a way if they wish to match assets and liabilities expected to be floating, especially when this results in smoothing of accounting earnings and/or tax liabilities.

Again, the rate received on a swapped government bond will usually be at a negative spread to the corresponding Libor floating rate. Any technical or fundamental factors causing the bond to richen compared to Libor will cause this spread to become more negative ('widen' for most governments), and vice versa.

The transaction consists of two legs. The investor (asset-swap buyer) buys a bond from an asset swap seller for par rather than the full price. The investor then pays fixed on a swap to the maturity of the bond at a rate equal to the coupon of the bond, and receives the Libor rate less (in the case of most governments) a spread. All fixed cash flows are timed to coincide and net off.

The spread is calculated such that the present value of the swap equals the difference between par and the price of the bond in the market. The dealer is thus compensated for selling the bond at a discount or premium to its market value.

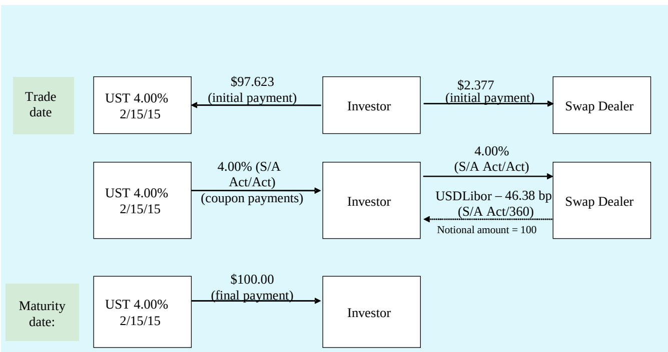
Example of a Par/Par Asset Swap

The basic scheme of a par/par ASW is shown in Exhibit 2 for the 4% Feb '15 Treasury.

1 There is a small residual interest rate risk due to the difference between the discount factors based on the government curve and those based on the swaps curve. See p12 for more on this.

Exhibit 2

Trading a Par/Par Asset Swap



Source: Morgan Stanley

The net effect is that the buyer becomes the holder of an asset paying a stream of floating cash flows equal to Libor less the swap spread of 46.38 bp and the final redemption payment of par at maturity.

Exhibit 3 shows the full set of cash flows arising on the par/par asset swap of this bond from the point of view of the investor for a hypothetical trade. Note that the PV of the swap matches the dirty price of the bond less par.

Exhibit 3

Indicative Cash Flows Arising From the Par/Par Asset Swap of the 4% Feb '15 US Treasury

Bond	T4% Feb '15
Frequency	Semi-Annual
Basis	Act/Act
Price	96-30
Accrued	$ 685,083
Full Price	$ 97,622,583
Price - Par	$ -2,377,417
Settlement	18-Apr-05

Swap	
Notional	$ 100,000,000
Floating Basis	Act/360
Margin	-46.38
Fixed	4.000%, Act/Act
PV Fixed	($ 32,044,238)
PV Floating	$ 34,421,661
Net PV	$ 2,377,423
Swap Fee	($ 2,377,423)

Date	Bond	Swap Fixed	Forward 6m Libor	Swap Floating
18-Apr-05	($ 100,000,000)			
15-Aug-05	$ 2,000,000	($ 2,000,000)	3.252%	$ 921,495
15-Feb-06	$ 2,000,000	($ 2,000,000)	3.883%	$ 1,747,842
15-Aug-06	$ 2,000,000	($ 2,000,000)	4.226%	$ 1,891,510
15-Feb-07	$ 2,000,000	($ 2,000,000)	4.426%	$ 2,025,192
15-Aug-07	$ 2,000,000	($ 2,000,000)	4.543%	$ 2,050,940
15-Feb-08	$ 2,000,000	($ 2,000,000)	4.635%	$ 2,132,203
15-Aug-08	$ 2,000,000	($ 2,000,000)	4.704%	$ 2,143,590
17-Feb-09	$ 2,000,000	($ 2,000,000)	4.756%	$ 2,217,850
17-Aug-09	$ 2,000,000	($ 2,000,000)	4.837%	$ 2,198,832
16-Feb-10	$ 2,000,000	($ 2,000,000)	5.066%	$ 2,339,611
16-Aug-10	$ 2,000,000	($ 2,000,000)	5.070%	$ 2,315,781
15-Feb-11	$ 2,000,000	($ 2,000,000)	4.998%	$ 2,304,779
15-Aug-11	$ 2,000,000	($ 2,000,000)	5.041%	$ 2,301,079
15-Feb-12	$ 2,000,000	($ 2,000,000)	5.131%	$ 2,385,690
15-Aug-12	$ 2,000,000	($ 2,000,000)	5.200%	$ 2,394,333
15-Feb-13	$ 2,000,000	($ 2,000,000)	5.257%	$ 2,449,670
15-Aug-13	$ 2,000,000	($ 2,000,000)	5.306%	$ 2,434,557
18-Feb-14	$ 2,000,000	($ 2,000,000)	5.353%	$ 2,539,734
15-Aug-14	$ 2,000,000	($ 2,000,000)	5.387%	$ 2,434,153
17-Feb-15	$ 102,000,000	($ 2,000,000)	5.419%	$ 2,560,013
	Present Value	($ 32,044,238)		$ 34,421,661

Source: Morgan Stanley

Calculating the Par/Par Swap Spread

To arrive at a mathematical expression for the par/par swap spread, we think of the asset swap as constructed in the following way:

- The bond is sold for par. The swap dealer (often the seller) 'lends' the buyer by P-100, where P is the full market price of the bond.
- The coupons received by the buyer are netted off against matching fixed payments to the seller on a swap for the life of the bond.
- The buyer's receipts on the floating leg of the swap are adjusted by a fixed spread such that the present value of the swap equals the upfront implicit loan of P-100.

The formula, then, that must be solved for the par/par asset swap spread is:

$$P-100=C\cdot\sum_{i=1}^{n_{fix}}df(t_i)-\sum_{i=1}^{n_{float}}a_i(L_i+S)\cdot df(t_i)$$

The formula simply says that the amount paid or received to bring the bond to par (left hand side) equals the present value of the swap (right hand side). P is the full price of the bond, C is the fixed coupon paid by the bond, *df(t)* is the discount factor applicable to a cash flow at time t, L_i is the i^{th} Libor fixing, and S is the par/par asset swap spread (negative for most governments).

More technically, a_i is the accrual factor (the proportion of the full interest period that interest is to be paid for). This will likely be equal to 1 in all cases except for i=1. In most par/par transactions, the buyer passes the whole first coupon to the seller, receiving only the floating interest earned from the settlement of the contract.

Tracking a Par/Par Asset Swap trade

One attractive feature of the par/par trade is that its performance is simple to track. The spread is always calculated on a swap of par notional, so if we par/par swap a bond at a spread of -40 bp (we receive floating less 40 bp) and this spread moves to -35 bp, we can unwind the position by paying on a swap of the same notional and pay floating less 35 bp to lock in a loss of 5 bp running.

One problem with the methodology is that the trade is not duration hedged. This means that the P&L will vary with outright market level, i.e., the par/par spread is directional. The exposure is bullish. Another problem is that the spread depends on the dirty price of the bond, as can be seen simply from the formula above. These questions are discussed more fully on page 12.

Default

If the bond defaults, the buyer's claim is on the recovery value of the bond. But the buyer must continue to pay on the swap, although he/she may choose to close it out at market value.

Funding and Collateral

The execution of a par/par trade also involves some complications. The most important of these, in our view, is that the large upfront payment leads to the question of the correct funding charge to apply.

Because the swap and the sale of the bond are not independent transactions, to model the spread fairly, we need to understand the financing cost of the upfront payment. This will depend on the collateral agreements in place with each counterparty. The distortion due to an inappropriate assumption on the funding can be very substantial where a bond trades far from par.

The interest rate implicit on the loan of P-100 is Libor since it is repaid via a swap (for which the discount curve is Libor). But this is only appropriate if Libor is the right rate to apply given the collateral provided. In some cases, the correct rate for the loan will be general collateral repo on the collateral type offered. In the extreme case of highly rated issuers that enjoy one-way collateral agreements with the dealer, it will be necessary to apply the dealer's cost of funding, which is likely to exceed Libor. Funding charges will need to be taken into account and modelled into the swap spread on a case-by-case basis by the trader

Corollary: Trading Swap Spreads

Because of the complicated nature of a par asset swap, particularly because of the need to collateralise a potentially large off market swap and because the trade is directional (not duration neutral), we believe it is unlikely that an investor would swap a bond using this methodology in order to speculate on short term swap-spread movements. Our discussion of the yield/yield methodology showed that the drawbacks of convexity and curve risk were unlikely to outweigh the advantage of simplicity for most trades.

Market Value Accrued (MVA) Asset Swaps

To help address the problems created by collateralisation for a par/par swap, the market value accrued or MVA technique can be used.

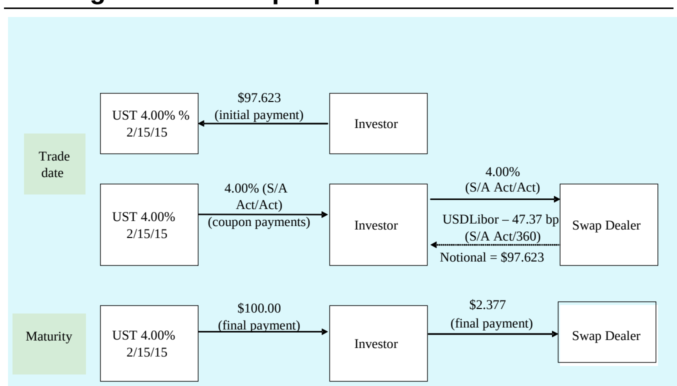
The MVA method is very similar to the par/par method, but the difference between par and the dirty price of the bond is exchanged at maturity rather than at settlement and the floating notional is equal to the dirty price of the bond. The result is that the counterparty exposure is switched from one party to the other and the exposure starts low and builds over time rather than starting high and reducing. A par/par swap creates a collateral problem immediately as the swap starts off-market and the present value declines over the life of the agreement. In an MVA swap, however, counterparty exposure is expected to accrue over the life of the swap until it is discharged with the payment of the fee at termination of the contract.

MVA delays counterparty risk and this can reduce bid-offer spreads. The present value of the payment made to bring the bond to par is also smaller because it occurs in the future. This means that the swap does not need to be as far off par as in the par/par methodology and the problems caused by collateralisation of a large loan are reduced. The MVA methodology is, however, much less common than the par/par asset swap for government bonds.

A summary of the cash flows involved in an MVA asset swap using the same bond as in the par/par example is shown in Exhibits 4 and 5. Notice that the spread applied on an MVA asset swap is not the same as for par/par.

Exhibit 4

Trading an MVA Swap Spread



Source: Morgan Stanley

Exhibit 5

Indicative Cash Flows Arising From the MVA Asset Swap of the 4% Feb '15 US Treasury

Bond	T4% Feb '15
Frequency	Semi-Annual
Basis	Act/Act
Price	96-30
Accrued	$ 685,083
Full Price	$ 97,622,583
Price - Par	$ -2,377,417
Settlement	18-Apr-05

Swap	
Fixed Notional	$ 100,000,000
Floating Notional	$ 97,622,583
Floating Basis	Act/360
Margin	-47.3714
Fixed	4.000%, Act/Act
PV Fixed	($ 33,526,168)
PV Floating	$ 33,526,164
Net PV	($ 3)
Swap Fee (at maturity)	$ 2,377,417

Date	Bond	Swap Fixed	Forward 6m Libor	Swap Floating
18-Apr-05	($ 97,622,583)			
15-Aug-05	$ 2,000,000	($ 2,000,000)	3.252%	$ 896,383
15-Feb-06	$ 2,000,000	($ 2,000,000)	3.883%	$ 1,701,334
15-Aug-06	$ 2,000,000	($ 2,000,000)	4.226%	$ 1,841,667
15-Feb-07	$ 2,000,000	($ 2,000,000)	4.426%	$ 1,972,091
15-Aug-07	$ 2,000,000	($ 2,000,000)	4.543%	$ 1,997,307
15-Feb-08	$ 2,000,000	($ 2,000,000)	4.635%	$ 2,076,558
15-Aug-08	$ 2,000,000	($ 2,000,000)	4.704%	$ 2,087,728
17-Feb-09	$ 2,000,000	($ 2,000,000)	4.756%	$ 2,160,114
17-Aug-09	$ 2,000,000	($ 2,000,000)	4.837%	$ 2,141,683
16-Feb-10	$ 2,000,000	($ 2,000,000)	5.066%	$ 2,279,062
16-Aug-10	$ 2,000,000	($ 2,000,000)	5.070%	$ 2,255,852
15-Feb-11	$ 2,000,000	($ 2,000,000)	4.998%	$ 2,245,058
15-Aug-11	$ 2,000,000	($ 2,000,000)	5.041%	$ 2,241,499
15-Feb-12	$ 2,000,000	($ 2,000,000)	5.131%	$ 2,324,018
15-Aug-12	$ 2,000,000	($ 2,000,000)	5.200%	$ 2,332,510
15-Feb-13	$ 2,000,000	($ 2,000,000)	5.257%	$ 2,386,477
15-Aug-13	$ 2,000,000	($ 2,000,000)	5.306%	$ 2,371,804
18-Feb-14	$ 2,000,000	($ 2,000,000)	5.353%	$ 2,474,319
15-Aug-14	$ 2,000,000	($ 2,000,000)	5.387%	$ 2,371,491
17-Feb-15	$ 102,000,000	($ 4,377,417)	5.419%	$ 2,494,143
	Present Value	($ 33,526,168)		$ 33,526,164
				($ 3)

Source: Morgan Stanley

Calculation of the MVA Asset Swap Spread

We can think of the MVA asset swap as constructed in the following way:

- The bond is sold at the market value, P.
- The coupons received by the buyer are cancelled by matching fixed payments to the seller on a swap for the life of the bond.
- The buyer's receipts on the floating leg of the swap, which is based on a notional amount equal to the dirty price of the bond, are adjusted by a fixed spread such that the *future value* of the swap equals the excess paid over par, P-100.
- The investor receives P-100 from the dealer at the maturity of the swap.

The formula which must be solved for the MVA asset swap spread is:

$$(P-100)\cdot df(T) = C\cdot\sum_{i=1}^{n_{fix}} df(t_i) - \frac{P}{100}\cdot\sum_{i=1}^{n_{float}} a_i\cdot(L_i+S)\cdot df(t_i)$$

Where P is the price of the bond paid, *df(t)* is the discount factor to time, t, T is the maturity of the bond, L is the Libor setting, and S is the MVA swap spread.

The left hand side is the present value of the final payment. The right hand side contains the present value of the fixed payments received (equal to the coupon rate) and the present value of the floating payments of Libor less the spread based on a notional of P.

Notice the similarity with the equation for the par asset swap. It can be shown that:

$$S_{MVA} = S_{par/par}\cdot\frac{100}{P}$$

Where S_{MVA} is the MVA swap spread, $S_{par/par}$ is the par/par swap spread and P is the dirty price of the bond. A simple demonstration of this is shown in the appendix.

Collateralisation

The MVA swap does reduce the problems with collateralisation in one important respect. The off-market swap must be worth the same as the *present value* of the difference between the bond's price and par paid at the maturity of the bond. As a consequence, the 'loan' will be for a smaller amount and the swap spread will be smaller (if the bond trades above par). This is the intuition for the above relationship between par/par spreads and MVA spreads.

Monitoring an MVA Swap

The performance of an MVA transaction is difficult to monitor because the notional of the swap on which the transaction is based changes daily as the dirty price of the bond changes. This means that unlike the par/par transaction, the MVA spread on one day is not an indication of the spread at which an investor can unwind a previous MVA transaction.

As a consequence we recommend tracking the carry on the bond and the swap separately. The MVA method, however, does make it easier to approximate the net carry. Unlike the par/par asset swap, the repo and floating notional of the swap are both on the same amount, so it is possible to simply compare the rates paid/received on each.

Yield Accrete or Constant Bond Yield

The yield accrete methodology arises from an attempt to overcome the problems of advance and delayed payments in par/par and MVA transactions. It is in some sense a hybrid of the two techniques.

Imagine a high coupon bond whose yield does not change. The money we make in each period is equal to the coupon received minus the capital loss on the decline in the price of the bond over the period, usually referred to as pull-to-par. This amount, as a percentage of the price actually paid, is the yield of the bond over the period.

In a yield accrete asset swap, we seek to exchange this amount for a floating yield based on Libor (Libor+S). Just as a 4% yield on a bond worth $150 at settlement should 'pay' $6 net in the first year, the floating amount will be calculated on the price of the bond each year. We don't know what the pull-to-par will be in a changing yield environment, of course, but we can approximate it over the life of the bond. One sensible way of doing this is by assuming the yield to maturity is constant, in our view. Other schedules, such as a linear accretion or amortization, are possible.

Yield is the combination of an expected capital loss (or gain) as the bond pulls to par, and the coupon cash. Intuitively, then, on one side we would like to pay the coupon to the dealer and receive the pull-to-par of the bond as approximated by the accretion/amortization schedule, since these reflect the expected mark-to-market gain/loss on the bond as it pulls to par.

On the other side we wish to receive Libor+S on the expected value of the bond as modelled in the accretion/amortisation schedule. This leads to a payment schedule like the one stylistically represented in Exhibit 6 for the T11.25% Feb '15. The swap spread is calculated as the spread equating the present values of the two legs.

In this construction, we are really swapping cash flows including the expected mark-to-market loss/gain due to the pull-to-par on the bond (often loosely called 'the yield') for income tied to Libor.

Exhibit 6

Indicative Cash Flows for a Yield Accrete Asset Swap of the 11¼% 15 Feb 2015 Treasury

T 11.25% 15 Feb 2015	
Price	155-28
Accrued	$ 2,392,956
Settlement	03-May-05
PV Fixed	($ 91,327,698)
PV Floating	$ 91,327,650
Spread	-37.407

Date	Fixed Notional	Fixed C.F.	Floating Notional	Amortisation	Fwd Libor	Libor - S	Total Floating
03-May-05			$ 158,267,956				
15-Aug-05	$ 100,000,000	($ 5,625,000)	$ 154,552,692	$ 3,715,263	3.294%	$ 1,335,174	$ 5,050,437
15-Feb-06	$ 100,000,000	($ 5,625,000)	$ 152,187,715	$ 2,364,977	3.728%	$ 2,649,012	$ 5,013,989
15-Aug-06	$ 100,000,000	($ 5,625,000)	$ 149,773,295	$ 2,414,420	4.053%	$ 2,815,076	$ 5,229,496
15-Feb-07	$ 100,000,000	($ 5,625,000)	$ 147,307,489	$ 2,465,806	4.252%	$ 2,968,231	$ 5,434,037
15-Aug-07	$ 100,000,000	($ 5,625,000)	$ 144,790,132	$ 2,517,357	4.357%	$ 2,950,071	$ 5,467,428
15-Feb-08	$ 100,000,000	($ 5,625,000)	$ 142,175,515	$ 2,614,617	4.433%	$ 3,003,977	$ 5,618,594
15-Aug-08	$ 100,000,000	($ 5,625,000)	$ 139,565,059	$ 2,610,457	4.509%	$ 2,971,869	$ 5,582,326
17-Feb-09	$ 100,000,000	($ 5,625,000)	$ 136,883,409	$ 2,681,650	4.593%	$ 3,041,980	$ 5,723,630
17-Aug-09	$ 100,000,000	($ 5,625,000)	$ 134,146,701	$ 2,736,708	4.627%	$ 2,926,793	$ 5,663,501
16-Feb-10	$ 100,000,000	($ 5,625,000)	$ 131,366,640	$ 2,780,061	4.561%	$ 2,855,435	$ 5,635,496
16-Aug-10	$ 100,000,000	($ 5,625,000)	$ 128,513,318	$ 2,853,322	4.646%	$ 2,821,345	$ 5,674,667
15-Feb-11	$ 100,000,000	($ 5,625,000)	$ 125,615,321	$ 2,897,997	4.796%	$ 2,889,017	$ 5,787,014
15-Aug-11	$ 100,000,000	($ 5,625,000)	$ 122,640,416	$ 2,974,905	4.863%	$ 2,835,075	$ 5,809,980
15-Feb-12	$ 100,000,000	($ 5,625,000)	$ 119,602,294	$ 3,038,122	4.893%	$ 2,832,738	$ 5,870,860
15-Aug-12	$ 100,000,000	($ 5,625,000)	$ 116,500,461	$ 3,101,833	4.945%	$ 2,764,072	$ 5,865,905
15-Feb-13	$ 100,000,000	($ 5,625,000)	$ 113,278,711	$ 3,221,751	5.011%	$ 2,761,117	$ 5,982,868
15-Aug-13	$ 100,000,000	($ 5,625,000)	$ 110,098,734	$ 3,179,977	5.071%	$ 2,675,126	$ 5,855,103
18-Feb-14	$ 100,000,000	($ 5,625,000)	$ 106,739,666	$ 3,359,067	5.129%	$ 2,719,468	$ 6,078,535
15-Aug-14	$ 100,000,000	($ 5,625,000)	$ 103,386,049	$ 3,353,617	5.175%	$ 2,533,690	$ 5,887,307
17-Feb-15	$ 100,000,000	($ 5,625,000)	$ 100,000,000	$ 3,386,049	5.219%	$ 2,587,734	$ 5,973,783
			($ 91,327,698)				$ 91,327,650

Source: Morgan Stanley

Because the swap is *at market*, collateralisation does not complicate the transaction. The yield accrete spread, *S*, solves the following equation:

$$C \cdot \sum_{i=1}^{n_{fix}} df(t_i) = \sum_{i=1}^{n_{float}} \left[a_i \cdot (L_i + S) \cdot N_i + (N_i - N_{i+1}) \right] \cdot df(t_i)$$

Where the symbols are as for the par/par methodology and N_i is the notional amount of the floating leg of the swap, calculated according to a compounded or other amortisation/accretion schedule as described above.

Yield Accrete for Low Coupon Bonds

The trade is constructed in the same way as above. The buyer must pay the pull-to-par, rather than receive it, however. This brings up the problem that the asset does not actually generate the cash flows that are swapped. Nevertheless, this should not be a problem if the bond is repoed, because as the bond pulls to par, the buyer will expect to be able to borrow more on repo against it to meet the payments on the swap.

Asset Swapping Index-Linked Bonds

Conceptually, it is simple to asset swap an index-linked bond. As for any asset swap, we need to use the swap market to hedge the bond's various risk components (in this case inflation and interest-rate) and synthetically transform the bond into a Libor floater.

Given the nature of inflation-linked bonds, we cannot resort to our simple yield/yield methodology for expressing bond/swap positions. Rather, the swap spread is best derived either as a YCS or z-spread, or as a transactional spread akin to the par/par or MVA. The transactional spreads are the most commonly quoted and so we will focus first on these.

In all cases, we have to consider the asset swap as being comprised of two stages:

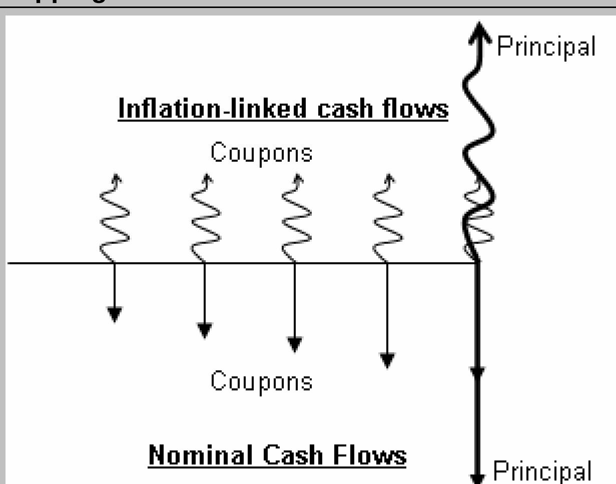
1. Inflation-linked to nominal fixed
2. (Nominal) fixed to floating

1. Swapping an Index-Linked Bond to Floating

In the first step of any asset swap of an index-linked bond, the schedule of nominal cash flows needs to be set by finding the nominal amount that each cash flow arising from the bond swaps to (i.e., nominal cash flows in Exhibit 7).

Exhibit 7

Swapping an Index-Linked Bond to Nominal



Source: Morgan Stanley

In practise this calculation is complicated and requires modelling of monthly inflation uplift factors using the inflation swaps curve and seasonality.

With a schedule of nominal cash flows in hand, we are able to swap the bond to Libor. It is here that we have a choice of transactions: the MVA (proceeds) and Par/Par.

2. Swapping the Nominal Schedule to Floating

a. Proceeds Asset Swap (MVA)

The 'proceeds' asset swap is the most commonly quoted in the UK and US. To understand this technique, it is best to draw parallels with the MVA technique (page 7). The proceeds asset swap breaks down as follows:

- The bond is paid for at its market price.
- The bond (fixed) leg of the swap exactly mirrors the bond's nominalised cash flow schedule derived from step 1 (coupons and principal).
- The floating notional is equal to the settlement price of the bond. Floating payments are made on an independent schedule (typically semi-annual in Europe and the UK, quarterly in the US).
- The swap is at market, i.e., its present value is zero.

A strict adherence to the MVA structure would include a final payment (a fee) of the settlement price less uplifted par such that the total net income at maturity perceived by the investor would be the coupon plus and the settlement price paid for the bond. This is not typically done in the proceeds asset swap of a linker: the investor's final net receipt is equal to the value of the swapped inflation-linked principal, not the settlement price of the bond.

The investor's set of net cash flows include floating Libor-based payments and the swapped principal at maturity. In return for these, he buys the bond at its market price and passes all the payments arising from it (both coupons and uplifted principal) to the dealer.

Exhibit 8 shows an indicative cash flow schedule arising from the proceeds asset swap of the July 15 OAT€I. Note that the cash flows are presented from the point of view of the investor.

Exhibit 8

Illustrative Cash Flow Schedule for a Proceeds Asset Swap of the OAT€I 15s

Inflation Swap (Stage 1)					
Trade		10-Apr-06	**Price**		98.807
Settlement		13-Apr-06	**Real Accrued**		1.14849
			Settlement Price		106.177

Bond		Inflation Swap			
	Index-		Index-	Implied	Nominal
CF Date	Linked CFs	CF Date	Linked CFs	Indexation	CFs
Settlement	(106.18)				
25-Jul-06	1.60	25-Jul-06	(1.60)	102.06076	1.722
25-Jul-07	1.60	25-Jul-07	(1.60)	104.33084	1.760
25-Jul-08	1.60	25-Jul-08	(1.60)	106.58757	1.798
25-Jul-09	1.60	25-Jul-09	(1.60)	108.82694	1.836
25-Jul-10	1.60	25-Jul-10	(1.60)	111.13048	1.875
25-Jul-11	1.60	25-Jul-11	(1.60)	113.51127	1.915
25-Jul-12	1.60	25-Jul-12	(1.60)	115.96423	1.957
25-Jul-13	1.60	25-Jul-13	(1.60)	118.48128	1.999
25-Jul-14	1.60	25-Jul-14	(1.60)	121.07373	2.043
25-Jul-15	1.60	25-Jul-15	(1.60)	123.75135	2.088
25-Jul-15	**1.60**	**25-Jul-15**	**(100.00)**	**123.75135**	**132.581**

Interest Rate Swap (Stage 2)					
Swap Notional		106.1769	Fixed PV		32.464
Spread		-8 bp	Floating PV		32.459
			Swap PV		-0.0052

Fixed Leg		Floating Leg			
	Nominal		Fwd Libor -	Accrual	Floating
CF Date	CFs	CF Date	Spread	Period	CFs
25-Jul-06	(1.722)	25-Jul-06	2.834%	0.286	0.861
		25-Jan-07	3.121%	0.511	1.694
25-Jul-07	(1.760)	25-Jul-07	3.463%	0.503	1.849
		25-Jan-08	3.598%	0.511	1.953
25-Jul-08	(1.798)	25-Jul-08	3.683%	0.506	1.977
		26-Jan-09	3.776%	0.514	2.061
25-Jul-09	(1.836)	27-Jul-09	3.838%	0.506	2.060
		25-Jan-10	3.902%	0.506	2.094
25-Jul-10	(1.875)	26-Jul-10	3.954%	0.506	2.122
		25-Jan-11	4.011%	0.508	2.165
25-Jul-11	(1.915)	25-Jul-11	4.040%	0.503	2.157
		25-Jan-12	4.074%	0.511	2.211
25-Jul-12	(1.957)	25-Jul-12	4.137%	0.506	2.221
		25-Jan-13	4.198%	0.511	2.278
25-Jul-13	(1.999)	25-Jul-13	4.238%	0.503	2.262
		27-Jan-14	4.284%	0.517	2.350
25-Jul-14	(2.043)	25-Jul-14	4.332%	0.497	2.287
		26-Jan-15	4.381%	0.514	2.390
25-Jul-15	(2.088)	27-Jul-15	4.414%	0.506	2.369

Source: Morgan Stanley

b. Par/Par Asset Swap

Asset swaps for European linkers are typically quoted par/par. The first stage (inflation-swap component) of the par/par transaction is as described above and does not differ from the first stage of the proceeds (MVA) transaction. The difference arises in the second (interest rate swap) step. The details are:

- The bond is bought for 100 (cash) and an off market swap.
- The PV of the swap is equal to the cash settlement price less 100.
- The floating leg notional is 100, and includes a payment of 100 at maturity.
- The bond (fixed) leg of the transaction includes the uplifted redemption.
- The investor's net receipts are Libor plus (minus) a spread on a notional of 100, and 100 at redemption.

Notice that this structure is designed to make the transaction look (to the investor) like a par/par swap of a conventional bond. Thus, the transaction requires payment of a 'par' value of 100, and receipt of the same amount at maturity. A truer adherence to the conventional par/par methodology would imply a structure in which the bond is bought for the value of the redemption swapped to nominal, with the investor receiving this amount at redemption and Libor plus the spread on a swap of the same notional. Such a structure is presumably unpopular because it would involve paying significantly more than the market price for the linker in most cases.

c. Z-Spreads and YCS

YCS and z-spreads are done in the same way as for nominal bonds (see page 15). The nominal schedule of cash flows for the index-linked bond is first set as described above. The shift that must be applied to the swaps curve (zero coupon curve in the case of a z-spread) is then found such that the present value of these nominal cash flows based on the resulting discount factors equals the cash market price of the bond. We believe that these methodologies represent the best measures of relative value between index-linked bonds and swaps.

Linker Swap Spreads are Triangular

It should be remembered that swap spreads of linkers reflect the relative value between interest rate swaps, inflation swaps and bonds. Hence a tight swap spread may reflect that a bond is cheap either to interest rate swaps or to inflation swaps or both.

Credit Default Swaps

A credit default swap (CDS) is an option to sell (put) bonds at face value with the writer of the option. The option to put bonds can be triggered by a number of credit events. These are described in the ISDA agreements, and each trade confirmation will specify which events serve as triggers. If the CDS is triggered, the CDS holder can put a face value of bonds written by the name specified[2] and receive the par value of these bonds in return[3]. The CDS premium is typically paid quarterly.

Swaps on government credits are very liquid and trade at benchmark maturities such as 5 and 10 years, and the market is growing very quickly. CDS tend not to trade on governments in their own currency – CDS on US government debt denominated in USD, for example. But in Europe, euro-denominated CDS are popular for the issuers whose paper is most actively traded on a spread basis from a credit point of view: Italy, and Greece.

Trigger Events

Broadly speaking, the most relevant credit events for sovereigns include:

- Outright default, failure to pay, or repudiation of obligations.
  Repudiation is described in lengthy clauses in the document. In general, any challenge to the validity of obligations by someone with authority will lead to a credit event.
- Restructuring.
  Restructuring includes changes to interest or principal payable and redenomination of debt to a non-permitted currency. A permitted currency is either G7 or the currency of any AAA rated government.
  In particular, a Greek redenomination of debt to Drachma is a credit event, but Italian redenomination of debt to Lira would not trigger standard CDS.

Trading CDS

You don't need the CDS to trigger to make money by owning credit protection. Trading CDS spreads is very similar to trading swap spreads. If the spread widens, say from 10 bp to 15 bp, you can close out the trade by selling protection of maturity equal to the time remaining on your contract and lock in the present value of 5 bp[4].

CDS can be seen as having a 'spread duration'. If a 10-year CDS widens by 1 bp, we will make more money by owning it (around 7.5¢ per 100 notional) than we would on a widening of 5-year CDS by 1 bp (around 4¢). The annuity earned on closing a profitable CDS trade is valued on the Libor curve – the spread duration is the present value of a 1 bp annuity to the maturity of the CDS discounted on this curve.

The CDS – Swap Spread Basis

Both CDS and swap spreads may be traded when taking a view on a credit – both will widen ('tighten' if swap spread is negative) if the creditworthiness of the issuer is seen to deteriorate. Although very different structures, clearly both trades should behave in a similar manner. How does the CDS spread compare with the swap spreads then?

If a 10-year bond trades at a spread of +10 bp to a 'risk-free' benchmark, e.g. Treasuries or Bunds, it might be thought that the 'premium' receivable for owning the bond and taking extra credit risk is 10 bp a year (0.01% of the cash invested). If we can alternatively buy insurance against credit events for 10 years in the CDS market, we might expect the CDS spread to be close to 10 bp of notional also. We do, indeed, observe that bund spreads and CDS premia are usually of a similar order, but they can be very different. The reason is that the above makes a number of significant simplifications.

Trading the Basis

CDS can be traded against any swap spread trades to take advantage of opportunities we identify between the two markets. If we think that CDS are rich, we sell CDS, and we sell the bond against swaps. If the swap spread rises (the bond cheapens) or the CDS spread falls, we will make money.

Against Yield/Yield
We can trade CDS against a Yield/Yield asset swap by weighting the trade in terms of PV01 exposure to spread changes, for example. To do this, we would buy (sell) a bond, and buy (sell) protection for a notional amount equal to the notional of the swap on which we pay (receive).

[2] As the name must be the exact legal entity issuing the bonds, care must be taken on this point.
[3] Some CDS may be cash settled, with the difference between the market price at exercise and the par value being paid to the CDS holder by the writer.

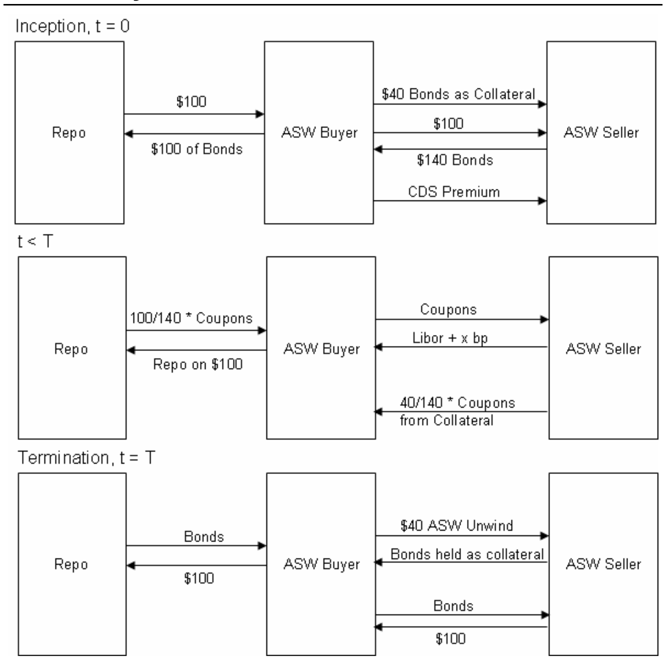
[4] For a much fuller discussion of CDS analytics and trading, see Morgan Stanley's Credit Derivatives Insights

Against Par/Par and Link to Over/Under-Hedging
We can trade CDS against a bond on a Par/Par basis by buying CDS against a bond we have asset swapped. The question of the hedge ratio is a tricky one, however. Consider the trade illustrated in Exhibit 9 involving a high coupon bond worth $140:

We buy the bond for $100 and a swap with a PV of -$40. We repo $100 of the bonds, and we use the rest as collateral for the swap. If we assume immediate default[5], skipping the intermediate (t<T) step, how does it all unwind if we assume that the bond is trading in the distressed market at $30?

Exhibit 9

Sale, Carry and Unwind of Bonds on ASW and CDS



Source: Morgan Stanley

We need to pay $100 to repo and $40 to unwind the swap. In return, we get our bonds back ($100 face) and put these to the writer of the protection we have bought. If we have only bought protection on $100 face value, we will only recover $100, though we make a loss of $40 on the trade. Clearly, this is not a good hedge ratio.

Imagine instead that we buy protection on $140 face value. If we follow the steps above, nothing is different until we come to put the bonds with the CDS seller. The problem is that we only own $100 face value of bonds, so we need to go to the market to buy $40 face value of extra bonds. We then put the bonds and make $140 – enough to unwind the whole of the original trade at zero P&L. However, the $40 of distressed bonds we had to buy are not free, as some recovery will be assumed. If they were trading at $30, we still lose $12. We, therefore, have exposure to the recovery rate.

Although this exposure to the recovery rates cannot be easily disposed of, it should be relatively clear that to trade a larger notional of CDS when buying a bond whose price is far above par is better than just buying protection on the par amount. If we are comfortable with 30% recovery, perhaps $157 of protection is the right amount to trade: we buy $57 of bonds for $57*0.3= $17. Putting the $157 (face) worth of bonds to the CDS writer, we make $140 net.

This now links to the basis between the Par/Par spread and CDS. If the fair hedge ratio is $157 of protection per bond, the basis is, in reality, spread(CDS)*1.57 - Spread(Par/Par).

In practice, this source of basis between the raw spreads seems small. That is, it does not appear that adjusting the CDS spread for such hedge ratios brings the spread systematically closer to the Par/Par spread.

Main Sources of CDS/Swap Spread Basis

The CDS/swap spread basis has the following components:

- Funding (Repo/Libor) spread
- Delivery option
- Maturity mismatch
- Bond price (over/under hedging)

Funding (Repo/Libor) Spread
We highlight the funding spread as the most important source of basis between swap spreads and CDS premia for governments. This is because the CDS spread should be more like the bond’s yield spread to a risk-free bond than the swap spread.

To see how the funding spread between repo and libor enters the equation, think of buying CDS protection against a long swap spread position (i.e. long bond against swaps) structured in a way that minimises expected P&L on default, and consider how the trade carries. To keep things simple, the bond is trading at par.

On the swap spread position, we receive Libor + x, where x is the swap spread, while we pay repo. On the CDS, we pay y, where y is the CDS spread. Net, our carry position is Libor

[5] We need to consider carry if we don’t make this assumption. We discuss carry below as a separate, important, source of basis.

+ x – repo – y = Libor – repo + (y – x). This should have zero present value if the expected P&L for the rest of the transaction is zero. But the present value of the repo/Libor spread is the risk-free (i.e. Treasury) swap spread! Hence, the CDS for a truly risk-free bond should be zero, as intuition suggests.

A matched-maturity package of bonds and CDS that carries positively when swapped to Libor is a much sought after trade.

Delivery Option

The delivery option is akin to the delivery option embedded in bond futures. As an owner of 10-year protection, we are not limited to delivering 10-year bonds in a credit event. We may submit bonds of any maturity when exercising a CDS and will naturally choose the cheapest bond available.

How do bonds trade when an issuer is in trouble? Often, until actual default, when bonds of all maturities of a certain level of seniority are treated equally, long bonds suffer more than short ones, but there are no rules.

EMU Exit Risk and European the Delivery Option in Europe

Perhaps the risk that buyers of Greek CDS most desire protection from more than any other is that of exit from EMU (see above).

It is unlikely that Greek debt would be immediately assumed at risk of outright default if it left EMU. But the reason to leave EMU would presumably be to devaluate the currency, which would raise inflation significantly, most likely steepening the yield curve. Current 30-year Greek government paper is trading at 4.7% in yield. If inflation were to rise to 10%, for a time, 30-year yields could easily reach 14%, in our view, bringing the 30-year paper down to around €33. A 2-year bond would only fall in price to €90 for a similar rise in yield.

For us, therefore, it seems clear that the risk in selling 10-year protection on Greece would be that we may be delivered 30-year paper rather than 2-year paper on EMU exit. Greek (and other peripheral European countries such as Spain, Austria, the Netherlands, etc.) CDS should be priced accordingly.

Maturity Matching and Bond Price

If a bond is not trading at par, then we are over or under hedged in the event of a default. The basis between a bond spread and CDS will incorporate this. We do not view this as a significant contributor to the basis for most government bonds, however.

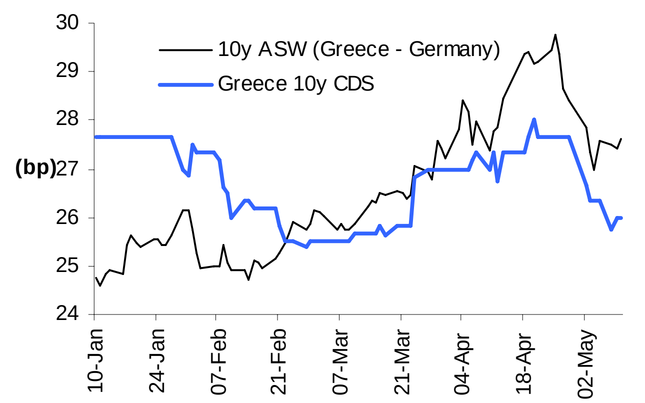
Bonds don't always have convenient maturities, but derivatives often do. If we trade 10-year CDS against 10.2-year bonds, the maturity mismatch will be a source of basis. We do not believe this is an important source in most circumstances, however.

The Greek CDS/Swap Spread Basis

Exhibit 10 shows how the10-year Greek CDS and the 10-year Greek benchmark spread to Bunds have changed since the beginning of 2006. The similar level of the two spreads fits with our discussion of the contribution of the funding spread to CDS above.

Exhibit 10

Greek 10-year CDS and Bund Spread



Source: Morgan Stanley

Greek CDS have cheapened significantly compared to the cash over the period. This is at odds with the shortening of the bond maturity compared to the benchmark CDS, as this should have reduced the bond's Bund spread. As rates have risen and the cash bond has cheapened, the hedge ratio has fallen. This also should have pushed the CDS higher relative to the cash. Further, it is confusing that the CDS spread fell relative to cash in February when Greece brought a 30-year supply to the market as this would have put emphasis on the delivery option embedded in the CDS. Indeed, we argue that the delivery option should ensure the CDS trades wider than the cash Greece-Bunds spread.

Swap Spreads for Rich-Cheap Analysis

Using the Swaps Curve as the Reference for the Term-Structure

Bonds differ in many ways that make comparison by yield alone misleading. Maturity is the most important of these, of course. It is almost trivial to say that a 5-year yield is not the same as a 10-year yield, so it is important to have a term structure (curve) to control for it. For this, we may fit a smooth curve to the bonds and compare yields to this smooth curve.

However, bonds are also afflicted by differing coupon size, liquidity, futures deliverability, inclusion in benchmark indices, and other idiosyncrasies. All these complicate curve fitting and the evaluation of a bond compared to surrounding issues.

Swap spreads are popular for comparisons between bonds because the swaps curve is observable and objective, rather than subjectively fitted.

The swaps curve is also free from such problems, but this does not help you compare bonds that are not. As a comparator for the government curve, the swaps curve is not perfect. Most importantly, the curve is often flatter or steeper than the government curve which leads to a need to make assumptions on the shape of the swap-spread curve, which can be lumpy as certain sectors trade differently to others. Even for bonds that are close in maturity, this can be important, especially where a bond may roll into a futures basket or into view of a new class of investors, for example.

In the Methodologies chapter, we discussed different ways of undertaking asset-swaps, each of which produces a different measure of the difference in yield between the two instruments. The question we now turn to is how useful these measures are for comparing bonds.

Yield/Yield

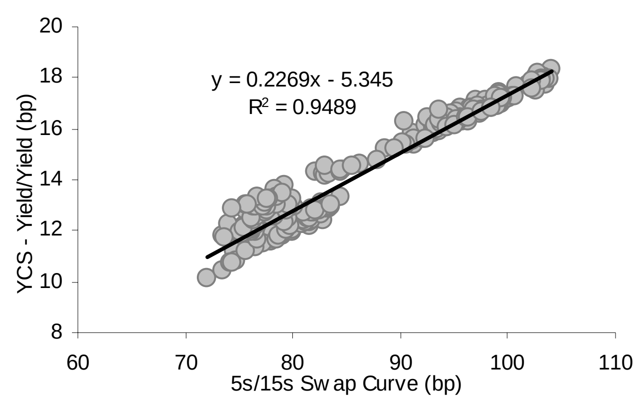
The yield/yield spread is a popular choice because of its ease of calculation. But of the swap spread methodologies, the informational value of the yield/yield spread is the poorest in most situations, in our view.

The core problem is that the yield/yield spread will be significantly biased by the size of the coupon on the bond. See the section on trading yield/yield swap spreads in the previous section for more discussion of the curve exposure.

Exhibit 11 illustrates this bias by showing the sensitivity to the slope of the curve of the difference between the yield/yield spread and our preferred Yield Curve Shift (YCS) spread described later in this section for the period of one year from November 2003 to November 2004. We believe that the upward sloping yield curve helps to explain why the 11¼% Feb 15 trades near Libor – 43.6 bp on a yield/yield basis, but about 5 bp cheaper to our theoretically preferred YCS methodology.

Exhibit 11

Yield Curve Shift Spread Less Yield/Yield Spread for the 11¼% Feb '15 Treasury vs. Curve Slope



Source: Morgan Stanley

The corollary is that the bond with the wider yield/yield spread will not necessarily be the 'richer' security, so we need methodologies that control for the effect of different coupons.

Par/Par and MVA Swap Spreads

The main problem we encounter with the yield/yield methodology is the duration mismatch between the bond and the swap we compare it with.

Many use the par/par swap spread in order to adjust for the lower risk of high coupon bonds (or higher risk of low coupon bonds). The reasoning is that this methodology essentially compares the bond with a swap that trades away from par by approximately the same amount that the bond trades away from par in the market. Equivalently, the par/par spread aims to tell us how much less than the expected floating rates we should be willing to receive if the bond's price is par.

The MVA swap treats valuation in a similar way.

As the bond trades further from par, however, the question of the Libor based loan inherent in these transactions becomes progressively more important. That is, we are trying to control for the coupon effects on duration by using a method that is sensitive to the distance a bond trades from par. The result is that in some cases the cure is worse than the disease.

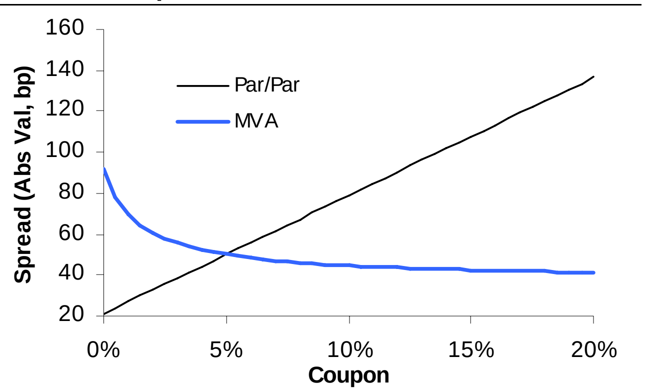
MVA and Par/Par Compared – Upfront vs. Delayed Restoration to Par

Exhibit 12 shows the relationship between the swap spread (par/par and MVA) and the coupon of a 30-year government bond where the government yield curve is flat at 5% and the swaps curve is flat at 5.5%.

The true swap spread is intuitively 50 bp and this is the result for a 5% coupon bond trading at par. But even for a realistic range of coupons, say 4% to 10%, the range of spreads is considerable: the par/par varies by 34.6 bp, while the MVA range is 7.7 bp.

Exhibit 12

Distortion in Par/Par and MVA Swap Spreads for Different Coupons



Source: Morgan Stanley

On this basis then, we should be inclined to prefer the MVA spread over the par/par spread.

To show why this deviation from the true swap spread happens, it is useful to look at the details of the transaction for such a simplified yield environment.

Exhibit 13 shows the cash flows that would arise from a par/par swap of a 10-year government bond paying a 10% coupon under the same yield assumptions as above. The resulting swap spread is -62.22 bp. The main point to notice is that the asset swapper effectively converts their 5% yield into a 4.878% yield! The reason this happens is that the client is loaned money that he pays for at Libor flat. But in reality the investor does not invest this cash at Libor – they just give it back to the dealer for collateral purposes.

Exhibit 13

Cash Flows of a Hypothetical Par/Par Asset Swap

Govt curve horizontal at:	5.00%
Libor curve horizontal at:	5.50%
Swap Notional	100
Spread (bp)	-62.22

	Bond			Swap		
Year	Govt Disc. Factor	Cash Flow	PV Cash Flow	Swap DF	Fixed C.F.	Fwd Libor + Spread
1	0.9524	10	9.524	0.948	-10	4.878
2	0.9070	10	9.070	0.898	-10	4.878
3	0.8638	10	8.638	0.852	-10	4.878
4	0.8227	10	8.227	0.807	-10	4.878
5	0.7835	10	7.835	0.765	-10	4.878
6	0.7462	10	7.462	0.725	-10	4.878
7	0.7107	10	7.107	0.687	-10	4.878
8	0.6768	10	6.768	0.652	-10	4.878
9	0.6446	10	6.446	0.618	-10	4.878
10	0.6139	110	67.530	0.585	-10	4.878
	PV (Dirty Price)		**138.6087**	PV	**-75.37626**	**36.767**
	Price - Par		-38.60867	Net Swap PV		-38.609

Source: Morgan Stanley

The yield give-up on the transaction is the difference between the 'true' spread and the par/par spread of 12.22 bp. To see where this comes from, notice that the buyer effectively makes repayments on the loan of 10-4.878 = 5.122. Discounted at Libor, we are not surprised to find this has a present value of 38.609, the off-par amount of the bond. But discounted at the 5% government yield,[6] the present value of the loan is 39.552. The difference, 0.943, has a Libor annuity value of 12.22 bp.

Exhibit 14 sets out the cash flows for the MVA swap under the same assumptions. The explanation for the 5.11 bp deviation from the 'true' spread of 50 bp is similar to the above. Notice, though, that in this case, the payments made for the right to receive 38.609 in 10 years' time are rolled up at Libor, hence the structure is to the benefit of the buyer. The yield achieved is now 5.0511%.

[6] The fair discount rate if we may assume that interest on a collateralised loan is approximately equal to the government yield.

Exhibit 14

Cash Flows of a Hypothetical MVA Asset Swap

Govt curve horizontal at:	5.00%
Libor curve horizontal at:	5.50%
Swap Notional	138.6087
Spread (bp)	-44.889

	Bond			Swap		
Year	Govt Disc. Factor	Cash Flow	PV Cash Flow	Swap DF	Fixed C.F.	Fwd Libor + Spread
1	0.9524	10	9.524	0.948	-10	7.001
2	0.9070	10	9.070	0.898	-10	7.001
3	0.8638	10	8.638	0.852	-10	7.001
4	0.8227	10	8.227	0.807	-10	7.001
5	0.7835	10	7.835	0.765	-10	7.001
6	0.7462	10	7.462	0.725	-10	7.001
7	0.7107	10	7.107	0.687	-10	7.001
8	0.6768	10	6.768	0.652	-10	7.001
9	0.6446	10	6.446	0.618	-10	7.001
10	0.6139	110	67.530	0.585	-10	7.001
	PV (Dirty Price)		**138.609**	PV	**-75.37626**	**52.773**
	Price - Par		-38.609	Net Swap PV		-22.603
	PV(End Payment)		-22.603			

Source: Morgan Stanley

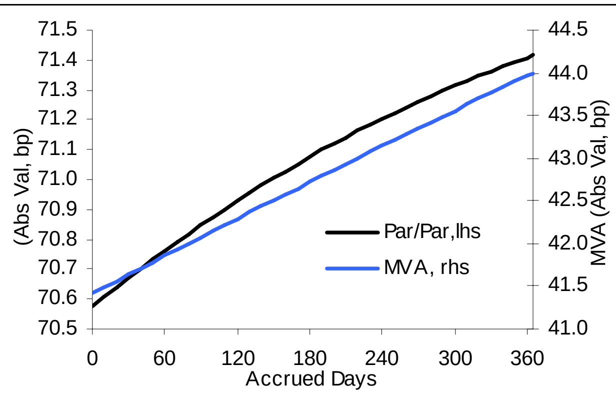
MVA and Par/Par Compared – Accrued Interest

The path of the dirty price (present value) of a bond is not smooth. Bonds richen as the next coupon date nears. Par/par and MVA swap spreads are dependent on the off-par amount of the bond that must be borrowed, so this is relevant to the resulting spread. Exhibit 15 illustrates just how relevant, using the same yield assumptions as above examples, and a 20-year bond.

The interesting point is that the MVA spread varies by 2.5 bp, while the par/par spread moves by just 0.8 bp. This difference is more pronounced for lower coupons. In our view, this makes the use of the MVA spread questionable for judging richness/cheapness of a bond over time.

Exhibit 15

Par/Par and MVA Swap Spread Variation with Accrued Interest



Source: Morgan Stanley

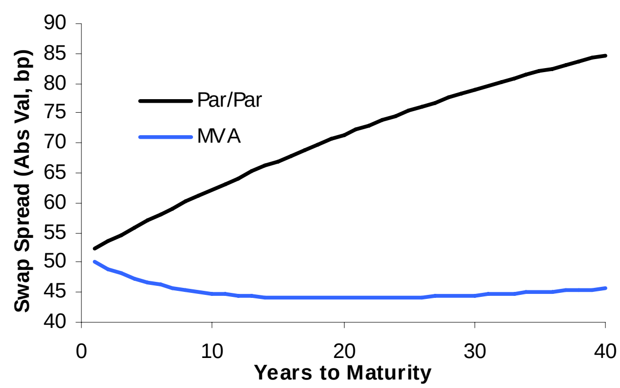
This also implies that the MVA spread will provide poorer comparison of bonds that pay coupons on different dates.

MVA and Par/Par Compared – Time to Maturity

Finally, we turn to the maturity of the bond. As expected, because the off-par amount increases as the bond lengthens, the par/par swap spread also diverges from the 'true' spread. The MVA starts by diverging, but there is a tug-of-war between the speed at which the off-par amount of the bond paid at maturity increases and the rate at which it is discounted to spot. The MVA spread actually re-converges after 23 years in this example. (See Exhibit 16.)

Exhibit 16

Par/Par and MVA Swap Spread Variation with Years to Maturity



Source: Morgan Stanley

This also suggests that the MVA spread should be preferred to the par/par spread. The magnitude of the variation in the par/par spread due to differing maturity is large compared to the variation in the MVA spread under different accrual periods.

Yield Curve Shifts – Interest Rate Exposure

We are also now in a position to explain what happens to the par/par and MVA spreads as the market moves.

One of the first things we learn in mathematics is that we cannot simultaneously solve too many problems given the variables under our control. The purpose of a par/par or an MVA swap is not to wind up with a duration hedged position, and the rigidity of the structures means that we cannot do this in general.

As stated in the previous section, it is possible to trace the performance of a par/par transaction by the change in the spread and this spread increases under parallel rally in the swap and government curves. A par/par transaction therefore has a bullish exposure.

Example – Stylised Low Coupon Bond

Consider a 40-year 1% coupon bond without accrued interest. For a flat yield curve at 5% and a 50 bp spread to Libor, this bond is worth $31.36 and has a par/par spread of 22.25 bp. The buyer holds the bond and the swap, whose present value is $68.64. If the yield and Libor curves rally by 100 bp to 4% and 4.5% respectively, the bond is now worth $40.62 and the swap agreement (pay 1%, receive Libor - 22¼ bp) declines in value to $60.31. There are two ways this position may be unwound:

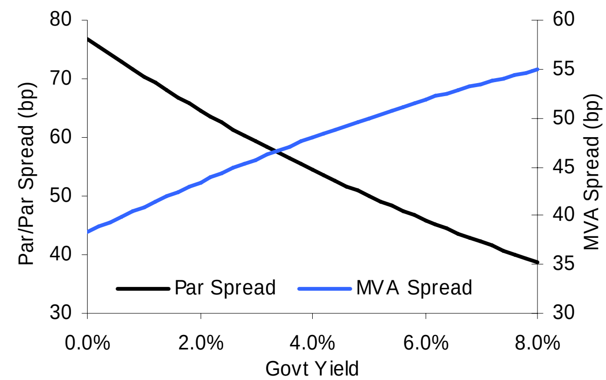
- Sell the bond at the market price and unwind the swap at fair value.
- Sell the bond on par/par asset swap. The bond is sold at par, just as it was bought and the investor is left with two swaps based on a notional of $100. The fixed legs and the Libor components of the floating legs cancel out, and the investor is left with an annuity which may be unwound at a market value.

The two methods are equivalent, of course. In our example, the first method would yield proceeds from sale and unwind of $40.62 + $60.31 = $100.93. This translates to a profit of 93 cents. The second method yields a profit equivalent to the value of an annuity of 5.05 bp on $100 notional. This is worth 93 cents discounted at 4%.

The bond rallies more than the swap because convexity ensures its duration is always higher. Exhibit 17 shows the directionality of the par/par and MVA spreads for a 10-year 5% coupon bond under parallel Libor-Government curve assumptions.

Exhibit 17

Par/Par and MVA are Directional and Not Duration Hedged (Libor = Govt + 50 bp)



Source: Morgan Stanley

How Important Are these Discrepancies in Practice?

It is clear that these are potentially important sources of error in some markets. Because the errors are a result of the difference between government (as a proxy for a collateralised borrowing yield curve) and the Libor discount factors, they will be especially pronounced when swap spreads are wide as in the US and UK. This is illustrated in the case of the US in Exhibit 19 in the summary section below, which compares swap spreads derived from different methodologies for the 11.25% and 4% Feb '15 Treasuries.

In Europe, the problem is less pronounced. The MVA and par/par spreads for the 6.25% Jan 2030 differed by 1.33 bp on April 1. This contrasts with the 6% 2028 gilt for which the difference between the par/par and MVA spreads was 5.44 bp.

Exhibit 12 (page 16) suggests a possible rough-and-ready solution to this problem though. Given that when the MVA is an underestimate of the fair spread, the par/par spread is an overestimate, and vice versa, we should be able to improve our estimate of the swap spread by averaging the two in many non-extreme cases. This leads us into discussion of the advantages of the yield accrete method.

Yield Accrete

As a 'middle way' between the MVA and the par/par methodologies, the yield accrete spread should generally be closer to the 'true' spread than either.

This is supported by similar analysis on flat yield and swap curves as in the above examples. Exhibit 18 provides the details of the cash flows arising from the theoretical transaction. The PV of the swap is zero as the cash flows on the fixed and floating legs are projected to be exactly 10 in each period. Because the notional of the swap's floating leg amortises to par just as a bond yielding 5%, the floating cash flows must be 5% of this amount.

Exhibit 18

Cash Flows of a Hypothetical MVA Asset Swap

Govt. Curve Horizontal at	5.00%
Govt. Coupon	10%
Libor Curve Horizontal at	5.50%
Spread	50.00 bp

Bond		Swap					
Cash Flow	Govt. C.F. (Rec)	Fixed Notional	Fixed C.F (Pay)	Floating Notional	Compound Accretion	Swap Flt	Total (Rec)
0	0	100		138.609			
1	10	100	10	135.539	3.070	6.930	10.000
2	10	100	10	132.316	3.223	6.777	10.000
3	10	100	10	128.932	3.384	6.616	10.000
4	10	100	10	125.378	3.553	6.447	10.000
5	10	100	10	121.647	3.731	6.269	10.000
6	10	100	10	117.730	3.918	6.082	10.000
7	10	100	10	113.616	4.114	5.886	10.000
8	10	100	10	109.297	4.319	5.681	10.000
9	10	100	10	104.762	4.535	5.465	10.000
10	110	100	10	100.000	4.762	5.238	10.000

Source: Morgan Stanley

When available, therefore, we generally prefer the yield accrete spread to the MVA or par/par spreads as a measure of value.

Yield Curve Shift (YCS) and Zero Spreads (z-Spreads)

YCS and z-spread are purely theoretical spreads designed to allow a bond yield to be compared to a swap rate as fairly as possible.

Calculation of the Spread

We discount the cash flows of a bond using the swap curve and arrive at a price. The swap curve is then shifted in parallel and the price of the security is re-calculated in the same way. We do this iteratively until the price, as calculated off the shifted par swap curve, equals the dirty price of the bond. The YCS is the basis point amount of this parallel shift. The z-spread refers to the size of the equivalent shift to the zero-coupon swaps curve.

This method, however, is computationally intensive. For many applications, instead of the above, we value the bond by summing its cash flows discounted at the spot zero rates, but then simply calculate the yield implied by this price and compare it to the corresponding swap rate. The difference between this approximation and the accurately calculated YCS spread is very small and the gains in efficiency outweigh the disadvantage of the small error for many applications.

YCS or zero spreads are our preferred methods for looking at richness or cheapness of bonds because they compare bonds directly and consistently with the swap curve.

How does the YCS stand up to the kinds of stress tests our other methodologies are put through above? In the cases studied to illustrate the shortcomings of MVA and Par/Par swap spreads (a government yield of 5% and swaps curve of 5.5%), the YCS is constantly 50 bp.

To see this is simple: how much will we need to shift the swaps curve to ensure that the bond cash flows discount to the bond's market price? Well, we know that we need to discount at the government yield, which is 5%. So the yield curve shift to be applied is 50 bp. (In this particular case, the z-spread and the YCS spread are identical also, since the zero curve is the same as the coupon swaps curve.)

Synthetic Par Bonds

YCS is not a spread arising from any transaction that might be observed in the marketplace and is not directly tradable. It is, however, possible to construct a synthetic par bond whose yield/yield spread to swaps comes close.

In this methodology, the investor purchases a bond that is not trading at par and either takes a long or short position in the principal strip with the same maturity to synthetically create a par bond. It should be stressed, as will be clear from the examples below, that this is not an asset swapping technique.

When doing this kind of trade in practice, we must consider the financing of both instruments, and a liquid strips market is essential. We also need a matched maturity strip.

Example – High Coupon Bond

In the example of the UST 11.25% 2/15, an investor can create a par bond by buying $40.22 mm UST 11.25% 2/15 and buying $59.78 mm of the UST 2/15 principal strip. The yield of the resulting par bond will be 4.539% or (0.385 * 11.25%). We then compare this yield to 4.914%, the swap rate with the same maturity, to generate a yield/yield swap spread of Libor – 37.5 bp on the synthetic par bond, which comes closer to the YCS spread than the yield/yield, par/par, or MVA, see Exhibit 19 below.

To calculate the yield of the synthetic par bond, we solve the following system of equations: $W_cP_c + W_sP_s = 100$ and $W_c + W_s = 1$ where W_c = weight on coupon bond, W_s = weight on principle strip, P_p = clean price of whole bond, and P_s = price of principle strip. The synthetic coupon of the par bond = W_cC_c where C_c = coupon of the coupon bond. This yield is then compared to the swap rate to the same maturity as the underlying bond.

Example – On-The-Run Treasury 4% February 2015

If the T4% Feb 15 has a clean price of $96-14, the principal strip costs $63-30, we have weights of 1.1096 and -0.1096 for the bond and the strip respectively. This yields a synthetic coupon (=yield for a par bond) of 4.434%, which translates to a yield spread of -48 bp if the swap rate is 4.914%. Notice that in contrast to the high coupon example, because the bond pays a lower coupon than its yield (trades below par), it was necessary to short an amount of the principal strip.

Conclusion

Each of the tradable spreads above has drawbacks. Exhibit 19 summarises the spreads for the 4% and 11.25% Feb 2015 Treasuries.

Exhibit 19

Swap Spreads for the 4% and 11.25% Feb 2015 US Treasuries

	YCS	Yield/Yield	Par/Par	MVA	Yield Accrete
UST 4% Feb 2015	-46.7	-45.7	-44.1	-45.2	-45
UST 11.25% Feb 2015	-38.5	-43.6	-49.3	-31.6	-42.7

Figures are correct as of April 1, 2005
Source: Morgan Stanley

On April 1, 2005, the 4% Feb '15 yielded 4.45%, but we can see that the distortions between methods are small. But for the much more expensive 11.25% Feb '15, the discrepancy between the par/par and MVA spreads was 17.7 bp. Notice that the MVA spread is closer to the YCS spread than the par/par, as expected given the discussions above.

The benchmark premium on the 4% coupon bond over the 11.25% coupon bond is about 8.2 bp according to the YCS spread. The yield/yield spread shows a much smaller benchmark premium due to the lower duration of the high coupon bond. The par/par spread, on the other hand gives the very misleading result that the 11.25% coupon bond trades at a premium to the benchmark. The MVA spread, conversely, grossly exaggerates the discount to the benchmark.

How about the suggestion to average the par/par and MVA spreads? The mean spreads are 44.6 bp and 40.45 bp for the 4% and 11.25% coupon bonds respectively. This yields a benchmark premium of 4.2 bp, around half of the premium according to YCS, but better than any one of the individual methods.

In general, then, we prefer the YCS spread, when available, and otherwise the yield accrete or the MVA spread, while mostly choosing to steer clear of the par/par method for comparing bonds. In very flat yield curve environments, there is likely some merit in the yield/yield spread.

We recommend taking care in interpreting the spreads provided by the various measures, however. A bond is often labelled rich or cheap by investors looking for the optimal issue to buy or sell in a strategy on the basis of swap spread changes and discrepancies of not much more than a basis point. This section shows how small such a margin for error is.

Appendix – The Relationship Between MVA and Par/Par Swap Spreads

Starting with the equations provided in the text for the Par/Par and MVA spreads:

[1] $$P - 100 = C \cdot \sum_{i=1}^{n_{fix}} df(t_i) - \sum_{i=1}^{n_{float}} a_i (L_i + S) \cdot df(t_i)$$

[2] $$(P - 100) \cdot df(T) = C \cdot \sum_{i=1}^{n_{fix}} df(t_i) - \frac{P}{100} \cdot \sum_{i=1}^{n_{float}} a_i \cdot (L_i + S) \cdot df(t_i)$$

Subtracting, we get:

[3] $$(P - 100) \cdot (1 - df(T)) = \sum_{i=1}^{n_{float}} \left[a_i \cdot \frac{P}{100} \cdot (L_i + S^{MVA}) - a_i (L_i + S^{Par}) \right] \cdot df(t_i)$$

now, substituting the following (from the well known result that a Libor floating-rate bond is worth par),

[4] $$100 \cdot (1 - df(T)) = \sum_{i=1}^{n_{float}} a_i \cdot L_i \cdot df(t_i)$$

We arrive at the following after some rearrangement:

[5] $$P \cdot (1 - df(T)) = \frac{P}{100} \cdot \sum_{i=1}^{n_{float}} a_i \cdot L_i \cdot df(t_i) + \sum_{i=1}^{n_{float}} a_i \cdot \left(\frac{P}{100} \cdot S^{MVA} - S^{Par}\right) \cdot df(t_i)$$

Applying [4] again, we see that

[6] $$\sum_{i=1}^{n_{float}} a_i \cdot \left(\frac{P}{100} \cdot S^{MVA} - S^{Par}\right) \cdot df(t_i) = 0$$

Since the discount factors are non-zero, this can only hold if

[7] $$\frac{P}{100} \cdot S^{MVA} = S^{Par}$$

Important Disclosures on Subject Companies

The information and opinions in this report were prepared by Morgan Stanley & Co. Incorporated and/or one or more of its affiliates (collectively, “Morgan Stanley”) and the research analyst(s) named on page one of this report.

Morgan Stanley policy prohibits research analysts from investing in securities/instruments in their MSCI sub industry. Analysts may nevertheless own such securities/instruments to the extent acquired under a prior policy or in a merger, fund distribution or other involuntary acquisition.

Morgan Stanley is involved in many businesses that may relate to companies or instruments mentioned in this report. These businesses include market making, providing liquidity and specialized trading, risk arbitrage and other proprietary trading, fund management, investment services and investment banking. Morgan Stanley trades as principal in the securities/instruments (or related derivatives) that are the subject of this report. Morgan Stanley may have a position in the debt of the Company or instruments discussed in this report.

Other Important Disclosures

The securities/instruments discussed in this report may not be suitable for all investors. This report has been prepared and issued by Morgan Stanley primarily for distribution to market professionals and institutional investor clients. Recipients who are not market professionals or institutional investor clients of Morgan Stanley should seek independent financial advice prior to making any investment decision based on this report or for any necessary explanation of its contents. This report does not provide individually tailored investment advice. It has been prepared without regard to the individual financial circumstances and objectives of persons who receive it. Morgan Stanley recommends that investors independently evaluate particular investments and strategies, and encourages investors to seek the advice of a financial advisor. The appropriateness of a particular investment or strategy will depend on an investor’s individual circumstances and objectives. You should consider this report as only a single factor in making an investment decision.

Morgan Stanley fixed income research analysts, including those principally responsible for the preparation of this research report, receive compensation based upon various factors, including quality, accuracy and value of research, firm profitability or revenues (which include fixed income trading and capital markets profitability or revenues), client feedback and competitive factors. Analysts’ compensation is not linked to investment banking or capital markets transactions performed by Morgan Stanley or the profitability or revenues of particular trading desks.

This report is not an offer to buy or sell any security/instrument or to participate in any trading strategy. In addition to any holdings disclosed in the section entitled “Important Disclosures on Subject Companies,” Morgan Stanley and/or its employees not involved in the preparation of this report may have investments in securities/instruments or derivatives of securities/instruments of companies mentioned in this report, and may trade them in ways different from those discussed in this report. Derivatives may be issued by Morgan Stanley or associated persons.

Morgan Stanley makes every effort to use reliable, comprehensive information, but we make no representation that it is accurate or complete. We have no obligation to tell you when opinions or information in this report change.

With the exception of information regarding Morgan Stanley, reports prepared by Morgan Stanley research personnel are based on public information. Facts and views presented in this report have not been reviewed by, and may not reflect information known to, professionals in other Morgan Stanley business areas, including investment banking personnel.

The value of and income from investments may vary because of changes in interest rates, foreign exchange rates, default rates, prepayment rates, securities/instruments prices, market indexes, operational or financial conditions of companies or other factors. There may be time limitations on the exercise of options or other rights in securities/instruments transactions. Past performance is not necessarily a guide to future performance. Estimates of future performance are based on assumptions that may not be realized.

This report may include research based on technical analysis. Technical analysis is generally based on the study of trading volumes and price movements in an attempt to identify and project price trends. Technical analysis does not consider the fundamentals of the underlying issuer or instrument and may offer an investment opinion that conflicts with other research generated by Morgan Stanley. Investors may consider technical research as one input in formulating an investment opinion. Additional inputs should include, but are not limited to, a review of the fundamentals of the underlying issuer/security/instrument.

To our readers in Taiwan: Information on securities/instruments that trade in Taiwan is distributed by Morgan Stanley & Co. International Limited, Taipei Branch (the “Branch”). Such information is for your reference only. The reader should independently evaluate the investment risks and is solely responsible for their investment decisions. This publication may not be distributed to the public media or quoted or used by the public media without the express written consent of Morgan Stanley. Information on securities/instruments that do not trade in Taiwan is for informational purposes only and is not to be construed as a recommendation or a solicitation to trade in such securities/instruments. The Branch may not execute transactions for clients in these securities/instruments.

To our readers in Hong Kong: Information is distributed in Hong Kong by and on behalf of, and is attributable to, Morgan Stanley Dean Witter Asia Limited as part of its regulated activities in Hong Kong. If you have queries concerning this publication, please contact our Hong Kong sales representatives.

Certain information in this report was sourced by employees of the Shanghai Representative Office of Morgan Stanley Dean Witter Asia Limited for the use of Morgan Stanley Dean Witter Asia Limited.

THIS PUBLICATION IS DISSEMINATED IN JAPAN BY MORGAN STANLEY JAPAN SECURITIES CO., LTD.; IN HONG KONG BY MORGAN STANLEY DEAN WITTER ASIA LIMITED; IN SINGAPORE BY MORGAN STANLEY DEAN WITTER ASIA (SINGAPORE) PTE., REGULATED BY THE MONETARY AUTHORITY OF SINGAPORE, WHICH ACCEPTS RESPONSIBILITY FOR ITS CONTENTS; IN AUSTRALIA BY MORGAN STANLEY DEAN WITTER AUSTRALIA LIMITED A.B.N. 67 003 734 576, A LICENSED DEALER, WHICH ACCEPTS RESPONSIBILITY FOR ITS CONTENTS; IN CANADA BY MORGAN STANLEY CANADA LIMITED, WHICH HAS APPROVED OF, AND HAS AGREED TO TAKE RESPONSIBILITY FOR, THE CONTENTS OF THIS PUBLICATION IN CANADA; IN GERMANY BY MORGAN STANLEY BANK AG, FRANKFURT AM MAIN, REGULATED BY BUNDESANSTALT FUER FINANZDIENSTLEISTUNGSAUFSICHT (BAFIN); IN SPAIN BY MORGAN STANLEY, S.V., S.A., A MORGAN STANLEY GROUP COMPANY, WHICH IS SUPERVISED BY THE SPANISH SECURITIES MARKETS COMMISSION (CNMV) AND STATES THAT THIS DOCUMENT HAS BEEN WRITTEN AND DISTRIBUTED IN ACCORDANCE WITH THE RULES OF CONDUCT APPLICABLE TO FINANCIAL RESEARCH AS ESTABLISHED UNDER SPANISH REGULATIONS; IN THE UNITED KINGDOM BY MORGAN STANLEY & CO. INTERNATIONAL LIMITED, AUTHORISED AND REGULATED BY THE FINANCIAL SERVICES AUTHORITY; AND IN THE UNITED STATES BY MORGAN STANLEY & CO. INCORPORATED AND MORGAN STANLEY DW INC., WHICH ACCEPT RESPONSIBILITY FOR ITS CONTENTS. IN AUSTRALIA, THIS REPORT, AND ANY ACCESS TO IT, IS INTENDED ONLY FOR “WHOLESALE CLIENTS” WITHIN THE MEANING OF THE AUSTRALIAN CORPORATIONS ACT. NOT FOR DISTRIBUTION TO PRIVATE CUSTOMERS AS DEFINED BY THE UK FINANCIAL SERVICES AUTHORITY.

The trademarks and service marks contained herein are the property of their respective owners. Third-party data providers make no warranties or representations of any kind relating to the accuracy, completeness, or timeliness of the data they provide and shall not have liability for any damages of any kind relating to such data.

This report may not be sold or redistributed without the written consent of Morgan Stanley.

Morgan Stanley research is disseminated and available primarily electronically, and, in some cases, in printed form.

Additional information is available upon request.

4-19-06 po

The Americas
1585 Broadway
New York, NY 10036-8293
United States
Tel: +1 (1)212 761 4000

Europe
25 Cabot Square, Canary Wharf
London E14 4QA
United Kingdom
Tel: +44 (0)20 7425 8000

Japan
20-3, Ebisu 4-chome
Shibuya-ku,
Tokyo 150-6008, Japan
Tel: +81 (0)3 5424 5000

Asia/Pacific
Three Exchange Square
Central
Hong Kong
Tel: +852 2848 5200