

Relative value analysis: calculating bond spreads Moorad Choudhry January 2006

Relative value analysis: bond spreads Moorad Choudhry

Investors measure the perceived market value, or relative value, of a corporate bond by measuring its yield spread relative to a designated benchmark. This is the spread over the benchmark that gives the yield of the corporate bond. A key measure of relative value of a corporate bond is its swap spread. This is the basis point spread over the interest-rate swap curve, and is a measure of the credit risk of the bond. In its simplest form, the swap spread can be measured as the difference between the yield-to-maturity of the bond and the interest rate given by a straight-line interpolation of the swap curve. In practice traders use the asset-swap spread and the Z-spread as the main measures of relative value. The government bond spread is also used. In addition, now that the market in synthetic corporate credit is well established, using credit derivatives and credit default swaps (CDS), investors consider the Cash-CDS spread as well, which is known as the *basis*.

Credit derivatives are introduced in the author's book on structured credit products (Choudhry 2004b) as well as his paper on the CDS basis (Choudhry 2004a).

The spread that is selected is an indication of the relative value of the bond, and a measure of its credit risk. The greater the perceived risk, the greater the spread should be. This is best illustrated by the credit structure of interest rates, which will (generally) show AAA- and AA-rated bonds trading at the lowest spreads and BBB-, BB- and lower-bonds trading at the highest spreads. Bond spreads are the most commonly-used indication of the risk-return profile of a bond.

In this section we consider the Treasury spread, asset swap spread, Z-spread and basis.

Swap spread and Treasury spread

A bond's swap spread is a measure of the credit risk of that bond, relative to the interestrate swaps market. Because the swaps market is traded by banks, this risk is effectively the interbank market, so the credit risk of the bond over-and-above bank risk is given by its spread over swaps. This is a simple calculation to make, and is simply the yield of the bond minus the swap rate for the appropriate maturity swap. Figure 1 shows Bloomberg page IRSB for Pounds sterling as at 10 August 2005. This shows the GBP swap curve on the left-hand side. The right-hand side of the screen shows the swap rates' spread over UK gilts. It is the spread over these swap rates that would provide the simplest relative value measure for corporate bonds denominated in GBP. If the bond has an odd maturity, say 5.5 years, we would interpolate between the five-year and six-year swap rates.

GRAB														ե	ovt	T	RSI
							Bri	tish	Pound								
Ticker	TIME	Bid	Ask	Change	Open	High	Low	Prev Cls	Ticker	TIME	Bid	Ask	Change	Open	High	Low	Prev Cl
GBP Swa	p Rates								GBP Swa) Sprea	3						
2) 1 YR	11:22	4.4940	4.5020		4,4980	4.5005	4.4870	4.4980	19) 1 YR	11:22	33.80	39,80	+2.10	31.40	33.80	29.90	31,700
3) 18 MO	11:22	4.3925	4.4225	0087	4.4150	4.4175	4.3950	4.4163	20) 2 YR	11:21	29.50	33,50	+1.00	29.00	32.25	28.50	30,500
4) 2 YR	11:18	4.4070	4.4150	0055	4.4150	4.4225	4.3975	4.4175	21) 3 YR	11:21	31.00	35.00	+.75	30.75	33.25	30.00	32.250
5) 3 YR	11:23	4.4110	4.4350	0008	4.4225	4.4275	4.4000	4.4238	22) 4 YR	11:23	30.50	35.50	+.50	30.50	33.25	30.00	32,500
6) 4 YR	11:23	4.4150	4.4150	0118	4.4250	4.4515	4.4085	4.4263	23) 5 YR	11:14	26.50	36.00	-4.50	30.50		28.50	33.000
7) 5 YR	11:23	4.4230	4.4240	0127	4.4350	4.4370	4.4125	4.4363	24) 6 YR	11:23	32.75	37.75	+.50	32.50		32.50	34.750
8) 6 YR	11:23	4.4340	4.4625	0030	4.4500	4.4550	4.4233	4.4513	25) 7 YR	11:23	32.00	37.00	+.50	32.00	34.75	32.00	34.000
9) 7 YR	11:23	4.4440	4.4520	0157	4.4600	4,4690	4,4355	4.4638	26) 8 YR	11:21	31.00	36.00	+.50	30.75	33.75	30.75	33.000
10) 8 YR	11:23	4.4520	4.4590	0158	4.4675	4.4750	4.4422	4.4713	27) 9 YR	11:21	29.75	34.75	+.50	29.75	32.50	29.75	31.750
11) 9 YR	11:23	4.4580	4.4630	0157	4.4725	4.4800	4,4478	4.4763	28) 10 YR	8:05	29.75	34.75	+.25	32.25	32.50	32.25	32.000
12) 10 YR	11:23	4.4610	4.4640	0138	4.4750	4.4840	4,4550	4.4763	29) 15 YR 30) 20 YR	11:21	22.75 19.00	32.00	+.25	27.25 25.50	28.00 26.00	27.00 25.25	27.000
13) 12 YR	11:23	4.4610	4.4640	0138	4.4750	4.4750	4,4585	4.4763	31) 30 YR	11:21		27.50	+.13	25.50		20.63	20.875
14) 15 YR	11:23	4.4520	4.4550	0128	4.4650	4.4735	4,4335	4.4663		11.25	14.75	21.00	Ŧ.25	21.00	21.30	20.03	20.010
15) 20 YR	11:23	4.4210	4.4230	0118	4.4325	4.5250	4.3912	4.4338	For UK Go	vt Yield	Curve	Click o	n anv Tir	ckers at	oove & t	Select: I	YC1 I22
16) 25 YR	11:21	4.3175	4.4475	0125	4.3975	4.4367	4.3763	4.3963	For GBP S								
17) 30 YR	11:21	4.3430	4.3550	0078	4.3550	4.4500	4.3225	4.3588									
				Page 1									Page 2				
Australi Hong Kon	a 61 2 g 852 ;	9777 : 2977 6	8600 000 Jaj	pan 81	Brazil 3 3201	5511 8900	3048 4 Singap	500 ore 65 6	Euro 212 1000	oe 44 2 J.S. 1	20 7330 212 3:) 7500 18 200	0 Copyr	ight 2	2005 BI		20410 "g L.P. .:23:44

Figure 1 Bloomberg page IRSB for Pounds sterling, showing GBP swap rates and swap spread over UK gilts

© Bloomberg L.P. All rights reserved. Reprinted with permission.

The spread over swaps is sometimes called the *I-spread*. It has a simple relationship to swaps and Treasury yields, shown here in the equation for corporate bond yield,

Y = I + S + T

where

- *Y* is the yield on the corporate bond
- *I* is the I-spread or spread over swap
- *S* is the swap spread
- *T* is the yield on the Treasury security (or an interpolated yield).

In other words, the swap rate itself is given by T + S.

The I-spread is sometimes used to compare a cash bond with its equivalent CDS price, but for straightforward relative value analysis is usually dropped in favour of the assetswap spread, which we look at later in this section. Of course the basic relative value measure is the Treasury spread or government bond spread. This is simply the spread of the bond yield over the yield of the appropriate government bond. Again, an interpolated yield may need to be used to obtain the right Treasury rate to use. The bond spread is given by:

BS = Y - T.

Using an interpolated yield is not strictly accurate because yield curves are smooth in shape and so straight-line interpolation will produce slight errors. The method is still commonly used though.

Asset-swap spread

An asset swap is a package that combines an interest-rate swap with a cash bond, the effect of the combined package being to transform the interest-rate basis of the bond. Typically, a fixed-rate bond will be combined with an interest-rate swap in which the bond holder pays fixed coupon and received floating coupon. The floating-coupon will be a spread over Libor (see Choudhry *et al* 2001). This spread is the asset-swap spread and is a function of the credit risk of the bond over and above interbank credit risk.¹ Asset swaps may be transacted at par or at the bond's market price, usually par. This means that the asset swap value is made up of the difference between the bond's market price and par, as well as the difference between the bond coupon and the swap fixed rate.

The zero-coupon curve is used in the asset swap valuation. This curve is derived from the swap curve, so it is the implied zero-coupon curve. The asset swap spread is the spread that equates the difference between the present value of the bond's cashflows, calculated using the swap zero rates, and the market price of the bond. This spread is a function of the bond's market price and yield, its cashflows and the implied zero-coupon interest rates.²

Figure 2 shows the Bloomberg screen ASW for a GBP-denominated bond, GKN Holdings 7% 2012, as at 10 August 2005. We see that the asset-swap spread is 121.5 basis points. This is the spread over Libor that will be received if the bond is purchased in an asset-swap package. In essence the asset swap spread measures a difference between the market-price of the bond and the value of the bond when cashflows have been valued using zero-coupon rates. The asset-swap spread can therefore be regarded as the coupon of an annuity in the swap market that equals this difference.

¹ This is because in the interbank market, two banks transacting an interest-rate swap will be paying/receiving the fixed rate and receiving/paying Libor-flat. See also the author's "Learning Curve" article on asset swaps available on <u>www.yieldcurve.com</u>

² Bloomberg refers to this spread as the Gross Spread.

GRAB	Cor	p ASW		
ASSET SWAP CALCULATO		age 1 of 3		
GKN HOLDINGS PLC GKNLN 7 05/14/12 105.1200/105.6800 Currency Bond	(6.05/5.95) BG Underlyin			
From GBP To <mark>GBP</mark> Buy/Sell <mark>S</mark> Par Amt 1000 M	Price Date B	P BP		
Workout 5/14/12 @ 100.0000		2<\$UDF#>22		
Spot F/X 1.000 Coupon Day Count Freq		<mark>aB/A/M></mark> A GN BGN		
Fixed 4.76384% ACT/ACT 1		read		
Trade Settlement Floating 4.64635% ACT/365 2	% ACT <mark>/365 2 118.8 bp</mark>			
<u> </u>				
		Spread(bp)		
Implied Value 112.6477	69.7M =	121.5		
Swapped Spread Det:				
Calculate <mark>3</mark>	Money	Spread(bp)		
1:Bond Price 105.6800/ 5.94627%				
Swap Price 100 Cash Out 5.6800	-56.8M =			
2:Swap Rate 4.76384% Bond Cpn 7.0000	126.5M =	22010		
Redemption Premium / Discount 0.0000%	0.0 = 0.0M =	v. v		
Funding Spread 0.0 bp 3:Swapped Spread	0.011 -	121.5 hp		
1 <mark><go></go></mark> for X-currency spread summary, 2 <mark><go></go></mark> to save, 3	3 <mark><go></go></mark> to upda	te swap crv		
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 Hong Kong 852 2977 6000 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 31	18 2000 Copyright 200	y 49 69 920410 5 Bloomberg L.P. -Aug-05 16:46:57		
Figure 2 Ploomhorg page A SW for CKN hand 10 Augus	4 3005			

Figure 2 Bloomberg page ASW for GKN bond, 10 August 2005 © *Bloomberg L.P. All rights reserved. Reprinted with permission.*

Z-Spread

The conventional approach for analysing an asset swap uses the bond's yield-to-maturity (YTM) in calculating the spread. The assumptions implicit in the YTM calculation (see Chapter 2) make this spread problematic for relative analysis, so market practitioners use what is termed the Z-spread instead. The Z-spread uses the zero-coupon yield curve to calculate spread, so is a more realistic, and effective, spread to use. The zero-coupon curve used in the calculation is derived from the interest-rate swap curve.

Put simply, the Z-spread is the basis point spread that would need to be added to the implied spot yield curve such that the discounted cash flows of the a bond are equal to its present value (its current market price). Each bond cashflow is discounted by the relevant spot rate for its maturity term. How does this differ from the conventional asset-swap spread? Essentially, in its use of zero-coupon rates when assigning a value to a bond. Each cashflow is discounted using its own particular zero-coupon rate. The price of a bond's price at any time can be taken to be the market's value of the bond's cashflows. Using the Z-spread we can quantify what the swap market thinks of this value, that is, by how much the conventional spread differs from the Z-spread. Both spreads can be viewed as the coupon of a swap market annuity of equivalent credit risk of the bond being valued.

In practice the Z-spread, especially for shorter-dated bonds and for better credit-quality bonds, does not differ greatly from the conventional asset-swap spread. The Z-spread is usually the higher spread of the two, following the logic of spot rates, but not always. If it differs greatly, then the bond can be considered to be mis-priced.

Figure 3 is the Bloomberg screen YAS for the same bond shown in Figure 2, as at the same date. It shows a number of spreads for the bond. The main spread of 151.00 bps is the spread over the government yield curve. This is an interpolated spread, as can be seen lower down the screen, with the appropriate benchmark bind identified. We see that the asset-swap spread is 121.6 bps, while the Z-spread is 118.8 bps. When undertaking relative value analysis, for instance if making comparisons against cash funding rates or the same company name credit default swap (CDS), it is this lower spread that should be used.³

The same screen can be used to check spread history. This is shown at Figure 4, the Z-spread graph for the GKN bond for the six months prior to our calculation date.

GRAB	Corp YAS
Enter 11 <go> for Historical Z-spreads</go>	Corp YAS
YIELD & SPREAD ANALYS	IS CUSIPEC563412 PCS BGN
	00/105.6800 (6.05/5.95) BGN @16:00
SETTLE 8/15/05 FACE AMT 100	
1) YA YIELDS 2) YASD	R <mark>ISK & GKNLN 7 0</mark> 5/14/12
PRICE 105.680000 No Rounding N	HEDGE workout HEDGE BOND
YIELD 5.860 Ust	RATIOS 5/14/12 DAS DAS
SPRD 151.00 bp yld-decimals <mark>3/3</mark>	Mod Dur 5.39 5.40 5.47
versus	Risk 5.795 5.801 5.784
	Convexity 0.35 0.35 0.36
PRICE 103.680000 Save Delete	
YIELD 4.350 % sd: 8/11/05	DAS HEDGE Amount:1,003 M
Yields are: Semi-Annual	
3) DAS SPREADS 4) ASW	5) FPA FINANCING
OAS: 151.1 CRV# 110 VOL Opt DAS: 118.7 CRV# I55 TFD:	Repo% 4.540 (360/365) <mark>365</mark> Days 1
OAS: 118.7 CRV# I55 TED: ASW (A/A) 121.6 ZSPR 118.8 11) History	Int Income 191.78 <u>Carry P&L</u> Fin Cost -133.67 58.11
CRV# 155 U.K. POUND SWAP	Amortiz −135.67 50.11
ISPRD 115.9 DSPRD 116.6	Forwrd Prc 105.674189
Yield Curve: I22 U.K. GDVT BNCHMARK	Prc Drop 0.005811
+ 151 v $6.8yr$ (4.353 %) INTERPOLATED	Drop (bp) 0.06
+ 160 v 3yr (4.26) UKT 5 03/07/08	Accrued Interest /100 1.783562
+ 157 v 4yr (4.29) UKT 4 03/07/09	Number Of Days Accrued 93
+ 154 v 5ur (4.32)UKT 4 ³₄ 06/07/10	
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Hong Kong 852 2977 6000 Japan 81 3 3201 8900 Singapore 65 6212	Europe 44 20 7330 7500 Germany 49 69 920410
hong kong dee 237 dood dapan of 3 3201 0000 311gapore 63 6212	0 10-Aug-05 16:47:39
Element 2 Discout and a VAC for CUN have	1 10 4 (2005

Figure 3 Bloomberg page YAS for GKN bond, 10 August 2005 © *Bloomberg L.P. All rights reserved. Reprinted with permission.*

 $^{^{3}}$ On the date in question the 10-year CDS for this reference entity was quoted as 96.8 bps, which is a rare example of a negative basis, in this case of -22 bps.



Figure 4 Bloomberg page YAS for GKN bond, 10 August 2005 showing Z-spread history

© Bloomberg L.P. All rights reserved. Reprinted with permission.

Z-spread is closely related to the bond price, as shown by:

$$P = \sum_{i=1}^{n} \left[\frac{C_i + M_i}{\left(1 + \left(\left(Z + S_i + T_i\right)/m\right)\right)^i} \right]$$

where

- *n* is the number of interest periods until maturity
- *P* is the bond price
- *C* is the coupon
- *M* is the redemption payment (so bond cashflow is all *C* plus *M*)
- Z is the Z-spread
- *m* is the frequency of coupon payments.

In effect this is the standard bond price equation with the discount rate adjusted by whatever the Z-spread is; it is an iterative calculation. The appropriate maturity swap rate is used, which is the essential difference between the I-spread and the Z-spread. This is deemed to be more accurate, because the entire swap curve is taken into account rather

than just one point on it. In practice though, as we have seen in the example above, there is often little difference between the two spreads.

To reiterate then, using the correct Z-spread, the sum of the bond's discounted cashflows will be equal to the current price of the bond.

We illustrate the Z-spread calculation at Figure 5. This is done using a hypothetical bond, the XYZ plc 5% of June 2008, a three-year bond at the time of the calculation. Market rates for swaps, Treasury and CDS are also shown. We require the spread over the swaps curve that equates the present values of the cashflows to the current market price. The cashflows are discounted using the appropriate swap rate for each cashflow maturity. With a bond yield of 5.635 %, we see that the I-spread is 43.5 basis points, while the Z-spread is 19.4 basis points. In practice the difference between these two spreads is rarely this large.

For readers benefit we also show the Excel formula in Figure 5. This shows how the Z-spread is calculated; for ease of illustration we have assumed that the calculation takes place for value on a coupon date, so that we have precisely an even period to maturity.

Issuer settlement date maturity date coupon price	XYZ plc 01/06/05			= (-	1	
maturity date coupon							
coupon							
	01/06/08						
price	5%		YIELD	0.05635			
	98.95		[Cell formula =YIE	LD(C4,C5,C6,C7,C	C8,C9,C10)]		
par	100						
semi annual coupon	2		PRICE	98.95000			
act/act	1		[Cell formula =PR	ICE(C4,C5,C6,C6,C	C8,C9,C10)]		
Bond yield	5.635%						
Sovereign bond yield	4.880%						
Swap rate	5.200%						
3-year CDS price	28 bps						
Treasury spread							
5.635 - 4.88	55 bps						
I-spread							
5.635 - 5.20	43.5 bps						
Z-spread (Z)		0.00194					
The Z-spread is found using	iteration						
	1						Sum of F
Cash flow date	01/12/05	01/06/06	01/12/06	01/06/07	01/12/07	01/06/08	ouni or i
	0.50	1.00	1.50	2.00	2.50	3.00	
Cash flow maturity (years)		4.84%	4.99%	5.09%	5.18%	5.20%	
	4.31%						
0.5-year swap rate (S)	4.31% 2.50	2.50	2.50	2.50	2.50	102.50	
0.5-year swap rate (S) Cash flow (CF)	2.50	2.50 0.951498751	2.50	2.50	2.50	102.50	

Figure 5 Calculating the Z-spread, hypothetical 5% 2008 bond issued by XYZ plc

Cash-CDS basis

The basis is the difference between a bond's asset swap spread, or alternatively its Z-spread, and the CDS price for the same bond issuer. So the basis is given by

B = D - I

where D is the CDS price. Where D - I > 0 it is a positive basis; the opposite is a negative basis.

Figure 6 shows page G $\langle go \rangle$ on Bloomberg, set up to show the Z-spread and CDS price history for the GKN 2012 bond, for the period March-Spetember 2005. We can select the "Table" option to obtain the actual values, which can then be used to plot the basis. This is shown at Figure 7, for the period 22 August to 22 September 2005. Notice how the basis was always negative during August-September; we see from Figure 6 that earlier in the year the basis had briefly been positive. Changes in the basis give rise to arbitrage opportunities between the cash and synthetic markets. This is discussed in greater detail in Choudhry (2004b).

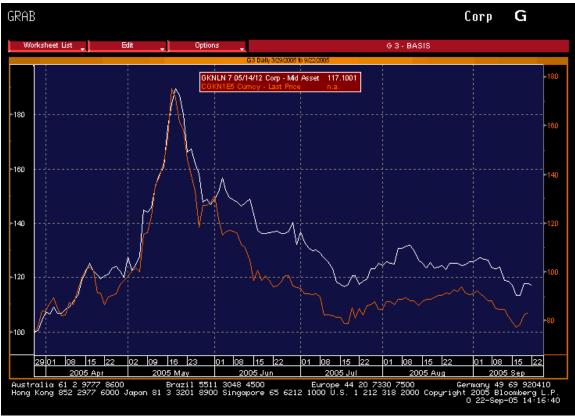


Figure 6 Bloomberg graph using screen G <go>, plot of asset-swap spread and CDS price for GKN bond, April-September 2005

© Bloomberg L.P. All rights reserved. Reprinted with permission.

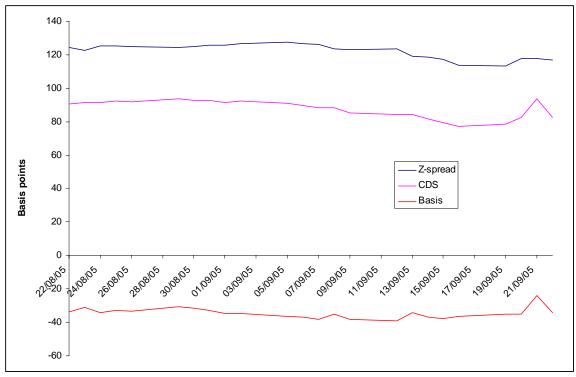


Figure 7 GKN bond, CDS basis during August-September 2005 *Data source: Bloomberg L.P.*

A wide range of factors drive the basis, which are described in detail in Choudhry (2004a). The existence of a non-zero basis has implications for investment strategy. For instance, when the basis is negative investors may prefer to hold the cash bond, whereas if for liquidity, supply or other reasons if the basis is positive the investor may wish to hold the asset synthetically, by selling protection using a credit default swap. Another approach is to arbitrage between the cash and synthetic markets, in the case of a negative basis by buying the cash bond and shorting it synthetically by buying protection in the CDS market. Investors have a range of spreads to use when performing their relative value analysis.

* * *

References

Choudhry, M., "The credit default swap basis: analysing the relationship between cash and synthetic credit markets", *Journal of Derivatives Use, Trading and Regulation*, Vol 10 No1, 2004a, pp.8-26

Choudhry, M., Structured Credit products: Credit Derivatives and Synthetic Securitisation, John Wiley & Sons (Asia) 2004b

Choudhry, M., Joannas, D., Pereira, R., Pienaar, R., *Capital Market Instruments: Analysis and Valuation*, FT Prentice Hall 2001