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借屍還魂 ： 基差交易重現

Zombie Trade: The Return of Basis Arbitrage From Beyond the Grave

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Abstract
The basis arbitrage trading strategy collapsed at the end of 2008, causing billions of dollars in losses for investment banks and hedge funds. New trading mentalities and practices have revived this trade and adapted it to current market conditions. This paper presents a rigorous analysis of new practices in fixed income credit trading, including what factors affect mark-to-market valuation and long-term returns on the new basis trade. Special attention is paid to the way holding basis affects the relationship between debtor and creditor. Finally, I comment on the long-term sustainability of the new basis trade.

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摘要
基差交易策略在 2008 年完全崩潰瓦解，造成投資銀行和避險基金數十億元的損失。因應現今市場條件，新的交易概念和策略已經復甦。本論文將針對新的交易概念如何影響固定收入信用貿易上，做出精確的分析：包括什麼因素會影響逐日計算損益評估及在基本貿易上的長期獲利。另外論述持有基差如何影響到債務人和債權人之間的關係。最後，我也會針對新基差交易的長期持續性做出討論。

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Introduction

In 1997 a team working for J.P. Morgan Chase invented a new kind of derivative, the "credit default swap (CDS)."[1] For the first time commercial banks could now use market instruments to hedge their loan portfolios. As the popularity of the CDS increased, it quickly became used for more than simple hedging. The structure of the CDS allowed investors to gain exposure to the corporate bond market without having to pay out large face values upfront.

CDS quickly outgrew their original purpose of simply hedging credit risk, and become an important tool for investors to both gain exposure to the credit market and to take advantage of differences between the credit market and other capital markets. The basis trade was one of the first strategies to take advantage of differences between the CDS market and cash bond market. Historically the differences between the cash bond market and the CDS market have been small, generally only a few basis points, thus traders relied on timing and leverage in order to profit from the basis. However, in the last quarter of 2008 as liquidity in the capital markets dried up the basis trade dissolved into hundreds of millions of dollars in losses for those involved[2]. The collapse of the basis trade and widening discrepancies between the bond markets and the CDS market have caused a large shift in mentality and practice of the basis trade, but have not eliminated it.

This paper will provide a rigorous analysis of the basis trade, as it is practiced now. What factors affect returns on a basis package? What factors affect the mark-to-market value of a basis package? Special attention will also be paid to how the basis changes the relationship between creditor and debtor. Finally, I make some comments on the sustainability of the new basis trade.

[1] Wikipedia, "Credit Default Swaps," see references for full citation.
[2] Paterson, S. WSJ, Feb. 9, 2009.

The organization of this paper is as follows: In section 1, I give a brief explanation of the basis as it was practiced before September 2008; in section 2 I explain how the basis trade has changed and how it's currently practiced; in section 3, a sensitivity analysis of the new basis trade; in section 4 a mark-to-market valuation analysis; in section 5 I examine the basis using forward CDS; in section 6 I show how the basis is changing the relationship between creditor and debtor. Finally, I conclude with a few comments on the sustainability of new basis arbitrage trading strategy.

Section 1: Basis Arbitrage Before September, 2008

Anywhere the same underlying asset is traded in two markets there exists a difference between the two markets, when the two markets are the cash bond market and credit default swap market this difference is called "the basis."

Fundamentals of the Trade

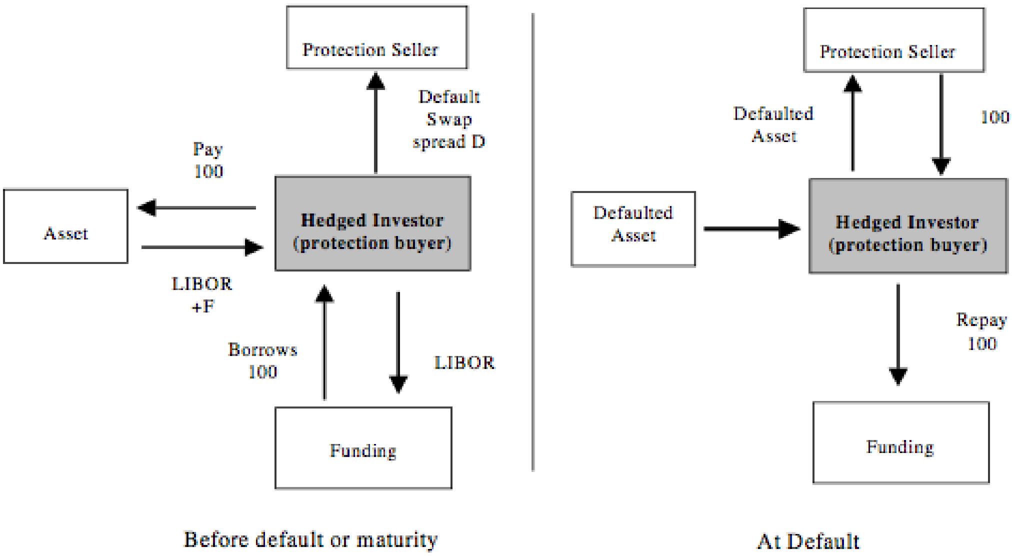
The idea behind the basis trade is to hold a neutral position by buying a corporate bond and buying CDS protection with the same bond as the reference entity. This way any drastic changes in the credit quality of the bond will be hedged by the CDS. The key to a successful trade is to find instances in which the credit spread on the bond diverges away from the CDS spread. By entering the trade at a point when the two markets are divergent, the trader can expect to profit from their convergence.

The trick in basis trading is to create two identical assets, in different markets. CDS are unfunded instruments, in that there is no upfront payment, while corporate bonds require the dirty price of the bond upfront. In order to make the bond more like a CDS it is necessary to go the funding (repo) market to barrow the par value of the corporate bond. Because we now have to pay a floating funding cost, it is useful to swap the bond for a fixed credit premium over the banks funding costs using a par asset swap. After netting the payments, the trader is left paying a fixed CDS premium and receiving the credit spread on the bond (see also figure 1 bellow):

Basis = CDS Spread – Bond Credit Spread Premium

Negative basis trades, where the CDS spread (D) paid is smaller than the credit spread (F) on the bond, are relatively easy to implement and involve a positive carry on the trade. To implement negative basis trades the trader need only buy the bond (funding this purchase in the repo market) and buy protection on the bond in the CDS market. The trader expects either the credit premium (F) on the bond to fall, or the CDS spread to rise such the basis converges to zero. If the trader's expectations prove true, either the value of the bond (already purchased) will rise, or the value of the CDS contract will rise. Because of the relative ease in which negative trades can be implement, negative basis is generally small a few basis points at most) and temporary. Trader's must rely on speed and leverage to make significant profits in the basis trade.

Figure 1. The structure of a traditional basis trade, showing payments before and in the event of default



Source: Lehman Borthers

The collapse of basis arbitrage

The nationalization of Fannie Mae and Freddie Mac, the collapse of Lehman Brothers, the complete freeze in the CP market and illiquidity in the corporate bond market shattered the established norms in capital markets. Losses at Deutsche Bank's credit trading desk topped US$1.8bn[3] in the second half of 2008, primarily from losses on basis arbitrage trades, becoming a symbol of the collapse of the basis arbitrage trade.

At first glance it may appear that, given the neutral position of basis arbitrage it should remain relatively free from changes in the credit bond market. However, your first glance would be wrong. While basis arbitrage does have a neutral position on the credit quality of the reference entity, massive structural shifts in the bond market, as well as the elimination of many market participants, helped cause the basis trade to unravel. A review of the structure of the basis trade under the market conditions at the end of 2008 will clarify the situation.

[3] Paterson, S. WSJ, Feb. 9, 2009.

First lets examine the funding leg of the basis trade. Following the collapse of Bear Sterns, funding costs even at AA rated banks continued to rise above LIBOR throughout the summer. Funding costs of 40bp+ above LIBOR were common even for the best banks, and those with significant perceived risks were topping LIBOR+100bps[4]. While this would normally offset the positive carry on negative basis trades, the growing size of the negative basis allowed these trades to continue. Then Lehman Brothers collapsed. Repo dealers, reeling from their own losses to Lehman (and later WaMu, the Icelandic Banks and others) simply ceased to roll over loans, forcing traders to close their position or move their bonds onto the bank book at the banks funding rate[5]. Even traders who had locked in Repo rates for longer periods of time found their margins increasing enormously. Instead of having to place 2-3% of the par value loaned aside (a leverage ratio 30-50x) as collateral, 10-25% was demanded, forcing banks to use enormous amounts of capital just to maintain the trades. This affect was most severe on hedge funds and other players which did not have ability to move bonds onto the bank book and forced many players out of the bond market entirely [6].

As hedge funds and other players were forced to dump their bonds into the market, liquidity ceased and the bottom fell out of the market. Without demand to support it, the price of bonds fell precipitously regardless of credit quality. Reviewing the bond leg, the trader has entered a par asset swap, paying par at inception and receiving a fixed credit premium above LIBOR. However, the credit premium is implied from the dirty price of the bond, as the dirty price of the bond falls the implied credit risk of the bond is increasing, thus (F) the credit premium above LIBOR rises exponentially. Traders who had locked in lower credit premiums suddenly saw the mark-to-market value of their trades drop at phenomenal rates.

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[4] Shah, A, *et al.* 2008.
[5] McAdie, R. 2008
[6] Shah, A, *et al.* 2008.

The real danger was that a lack of liquidity caused bond prices to fall and the "credit premium" on corporate bonds to rise, even though the credit risk on those bonds did not rise by a proportional amount. Deep liquidity in the CDS market and the simplicity of CDS (which are related only to credit quality, as they are unfunded derivative instruments) meant that the CDS market was *relatively* unchanged. While the credit crunch did signal rising default risks, which was reflected in the rising short-term CDS premiums, this effect was dwarfed by the titanic movements in the bond market. The net effect is that trades that began as "risk free" positive carry trades, suddenly began amassing massive mark-to-market losses as the bond market dislocated itself from other capital markets. Finally losses went from the tens of millions of dollars to the hundreds of millions (and even billions) based on the leverage involved. Basis arbitrage was a "no money upfront" trade, which allowed for bank and hedge funds to leverage, and eventually led to collapse of basis arbitrage.

Section 2: The New Basis

The liquidity crisis, and ensuing drop in demand for risky bonds caused prices to plummet and helped cause the basis arbitrage to unravel. However the dislocation between the credit and bond markets also created great opportunities, but the changing risk profile required a change in both the mentality and substance of the basis trade.

Under normal conditions, falling corporate bond prices should mean the markets assessment of the risk of default on those bonds was rising. However, in the market conditions of the last quarter of 2008, bond prices where falling for reasons unrelated to the credit quality of the bonds. For traders who were already locked into basis trades, that meant huge mark-to-market losses. For those standing on the sidelines, opportunities where growing.

The new basis, like the old basis, involved opposing trades in the credit and bond market. The par value of the bond should be hedged by the notional value of the CDS. However, unlike the old basis, the new basis did not focus on convergence of the credit premiums on the bond and the CDS spread. Not only was that not happening, the opposite tend was continuing in the market. Instead, the new basis focused on long term gains possible from the rising possibility of a bond issuer defaulting.

By hedging the par value of a bond in the CDS market, while the actual bond was trading well away from par, traders could profit from the default of the bond (see figure 2 bellow). If a bond defaulted, the CDS returned the full notional value of the CDS (minus the actual recovery rate), while at the same time the trader only paid a portion of the par value initially (still receiving the recovery value of the bond). Instead of receiving a fixed credit premium on the bond, determined by the now spurious par asset swap, traders receive the bond coupon and pay the CDS premium. Additionally, the bond coupon is often larger than the CDS spread, allowing traders to receive a positive carry until the bond either matures or defaults.

There are a few important points to note on the new basis. First, in a rising default environment, recover rates are uncertain[7]. The advantage of fully hedging the par value of the bond in the CDS market is that no matter what the actual recovery rate of the bond, the basis package returns par on default. Second, the new basis does not rely on leverage, *per se*. The expected gains available to traders from a basis package are large enough that leverage is not necessary. However, the upfront

[7] Gosh, A. 2009.

payment on the bond means that players such as banks and hedge funds still face significant funding costs, reducing the positive carry on the trade. Finally, the mark-to-market volatility on both the bond and the CDS will be great, both in a systematic market wide sense, and specifically for those names nearing default. I deal with both of these issues directly in the next two sections.

Section 3: Sensitivity Analysis

In this section I present a sensitivity analysis of a basis package. To do this I first introduce a new method of presenting a basis package, the Barclays Capital® "Basis Representation Diagram," or BRD. I analyze the effects of different characteristics, such as coupon size and dirty price, as well as different CDS characteristics, including the shape of the CDS curve, parallel shifts in the CDS curve and the assumed recover rate on the CDS. I analyze how these characteristics affect the expected payoffs on a basis package.

Traditionally the size of the basis, and the expected returns generated from a basis package, have been represented by difference between the CDS spread and the Z-spread, the credit premium above LIBOR. This *was* sufficient because returns from a traditional basis package are simply based upon the convergence of these two numbers. However, because the new basis trade has a large distribution of possible returns, depending upon the timing of the bond's maturity or default, thus a new way of measuring and analyzing the basis is important.

The BRD plots the annualized hold-to-default or hold-to-maturity returns that can be expected from entering a basis package, superimposed over the default probability implied by the CDS curve. The expected return on the package is simply the average return on the package.

Figure 2 bellow, the dotted line plots the annualized return (Y axis) if the bond defaults (or matures without default) after a number of years (X axis). The light blue bar graph bellow is the marginal probability of default implied by the the CDS curve for Cable & Wireless.

Figure 2: The BRD for Cable & Wireless 8⅝, 2019

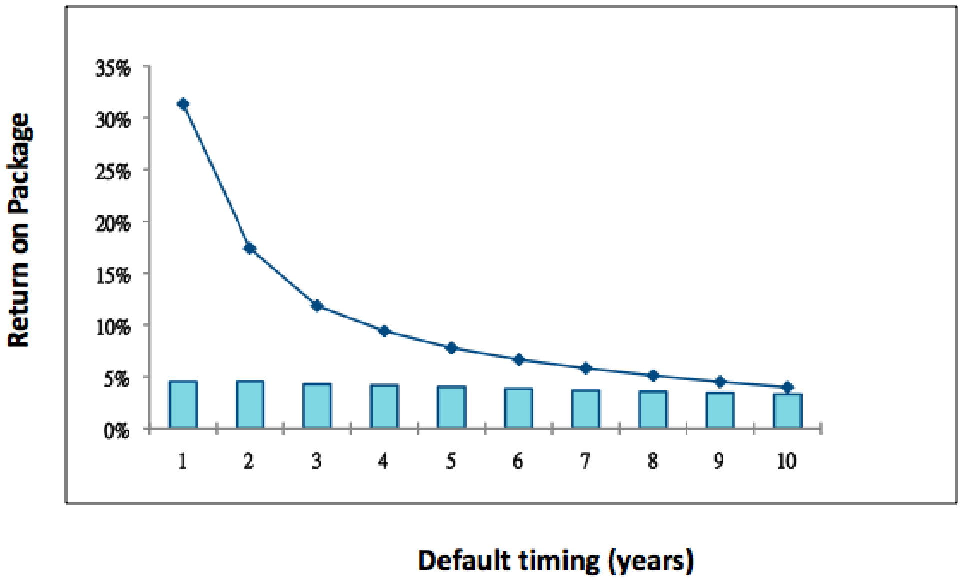


Figure 3: The Basis Package for Cable & Wireless 8⅝, 2019

	Bond	CDS	Net
Initial outlay	-£79.0	£0	-£79.0
Annual cash flow	862.5bp	-408.5bp	454bp
Value on default	Recovery	£100-Recovery	£100
Value on Redemption	£100	£0	£100

Note: Data from Nov. 11, 2008, collected on DataStream and Bloomberg.

The return generated by a basis package can be expressed as[8]:

$$R_T = \frac{-\text{Dirty Price} + \text{Par} \times D_T + \sum_{t=1}^{T} (CF_t \times D_t)}{\text{Dirty Price} \times T}$$

where:

T = date at which the bond defaults or matures, ending the basis trade
CF_t = bond coupon – CDS premium, or the net carry on the trade
D_t = discount rate at time t

[8] Gosh, A. 2009.

The expected return on the package can be written as:

$$E[R] = \sum_{t=1}^{n-1} R_t(p_t - p_{t-1}) + R_n(1 - p_{n-1})$$

where:

n = maturity date of the bond

p_t = probability of survival up to time t implied by the CDS curve.

Baclays Capital used Cable & Wireless, 2019 (CWLN) as their example trade. I choose to continue using CWLN because it's flat CDS curve and moderate discount, allows for easy comparison across different scenarios. The purpose of this section is not to examine a particular trade, but instead to examine the how different characteristics affect the basis trade. CDS curve data was obtained from DataStream. The average CDS premiums used are the Cable & Wireless, plc. 1-10yrs Senior CDS ask premiums quoted on November 11, 2008. Bond data was obtained from Bloomberg, bond ID: B74675, a graphic approximation of the closing price on November 11, 2008 was used.

The discount rate used in calculations was taken from the UK Gilt strip bond market, as Cable & Wireless plc. is based in the UK and traded on the London Stock Exchange. The data for the discount rate used was taken form the UK Debt Management Office website (www.dmo.gov.uk).

Implied default probabilities were calculated with a 20% assumed recovery rate which roughly corresponds with actual recovery rates. The marginal default probability (MPD) can be calculated by rearranging the CDS no-arbitrage condition (more later in this section):

$$pre \sum_{t=1}^{n} (1-p_t)D_t = (1-R)\sum_{t=1}^{n} (p_t - p_{t-1})D_t$$

Where:

pre = credit premium for the life of the contract

D_t = discount rate at year t

p_t = cumulative probability of default implied by CDS curve

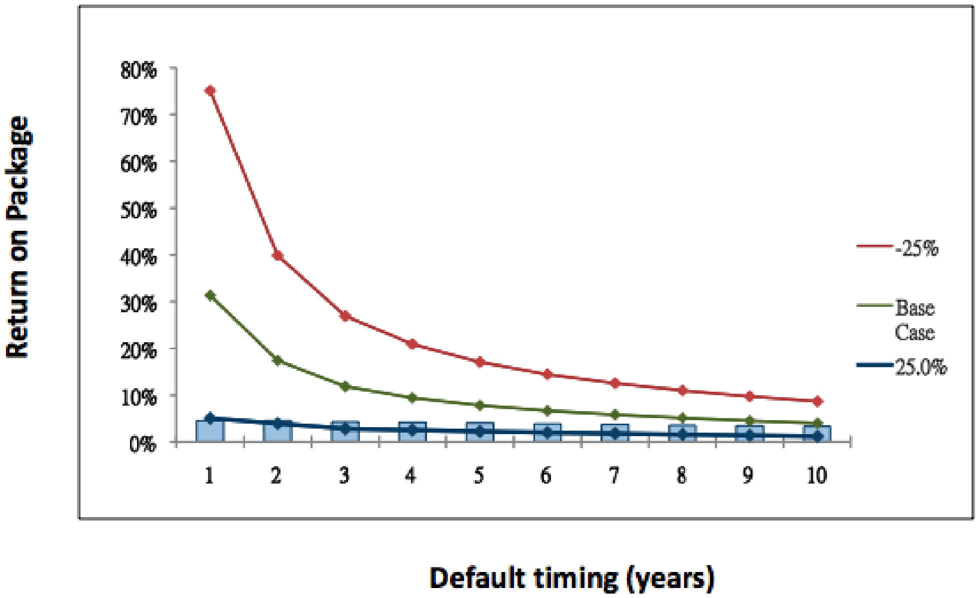
n = maturity of the contract in years

Sensitivity to Changes in the Dirty Price

The returns on a basis package are most sensitive to changes in the dirty price on the bond. There are two reasons for this. First, changing the bond price changes the initial cost of buying a basis package, which changes the return on that outlay. Second, if the bond defaults the gain generated from receiving par pack on the package is inversely proportional to the market price of the bond. The effect of reducing the market price of the bond can be clearly seen in Figure 4 bellow.

Isolating the change in market price, without adjusting the CDS spread, is a somewhat unrealistic example. However, the key to finding profit on the basis trade is to search for dislocations between the CDS market and corporate bond market.

Figure 4: Sensitivity of the basis package to changes in the bond price



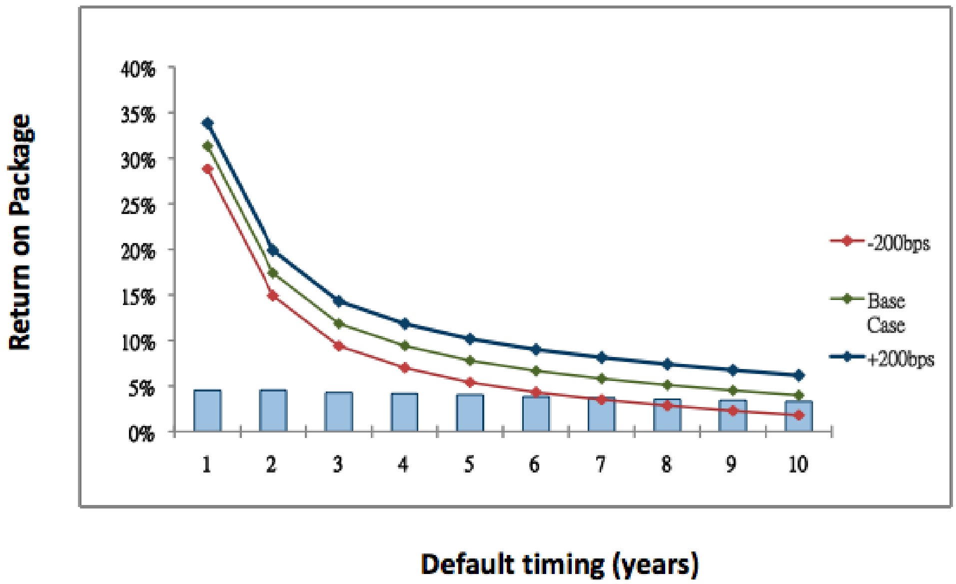
Expected Returns on the CWLN Basis Package with Changes in Bond Price										
-25%	-20.0%	-15.0%	-10.0%	-5.0%	0.0%	5.0%	10.0%	15.0%	20.0%	25.0%
E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]
15.22%	13.11%	11.25%	9.60%	8.12%	6.79%	5.59%	4.50%	3.50%	2.58%	1.74%

The figure above shows the affect of a 25% increase and decrease in the (dirty) price of the bond on the returns generated by a basis package. The table bellow the figure shows expected returns on the CWLN basis package given a variety of different change in bond price. This figure highlights the importance of the gain made on the package when the bond defaults. The greater the discount on the bond, the greater the gain on the package, and the earlier that gain is realized (on default) the greater the return on the basis package.

Sensitivity to changes in coupon size:

The bond coupon is the second bond characteristic I analyze. The importance of this factor is that changes in coupons size represent changes in the net carry on the trade. Even as the net carry goes negative, the expected returns on the basis remain can positive due to the discount on the bond. Changing the coupon is also a proxy for funding costs, which directly reduce the carry on the trade and have not been included in our analysis thus far.

Figure 5: Sensitivity of basis package to changes in the Coupon Size



BRD Sensitivity Changes in Coupon Size										
-400bp	-200bp	-100bp	-50bp	-25bp	+0bp	+25bp	+50bp	+100bp	+200bp	+400bp
E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]
2.27%	4.53%	5.66%	6.23%	6.51%	6.79%	7.08%	7.36%	7.92%	9.05%	11.31%

Notice that while changing the bond price produced an exponential shift BRD curve, changing the bond coupon produces only a slight parallel shift of the curve. Despite the relatively small visual effect, the change in net carry is quite significant as the implied survival probability after 10years is still around 60%. This can be seen from the change in expected returns on the basis package (bellow figure 5).

Sensitivity to parallel shifts in CDS curve:

Changing the CDS curve affects both the expected timing of default and the net carry on the trade. The implied default probabilities change the timing of the arrival of par, and thus the return. Only the 10yr CDS spread affects the net carry on the trade, while earlier CDS maturities help determine the implied marginal probability of default.

Figure 6: Parallel shifts in CWLN CDS curve

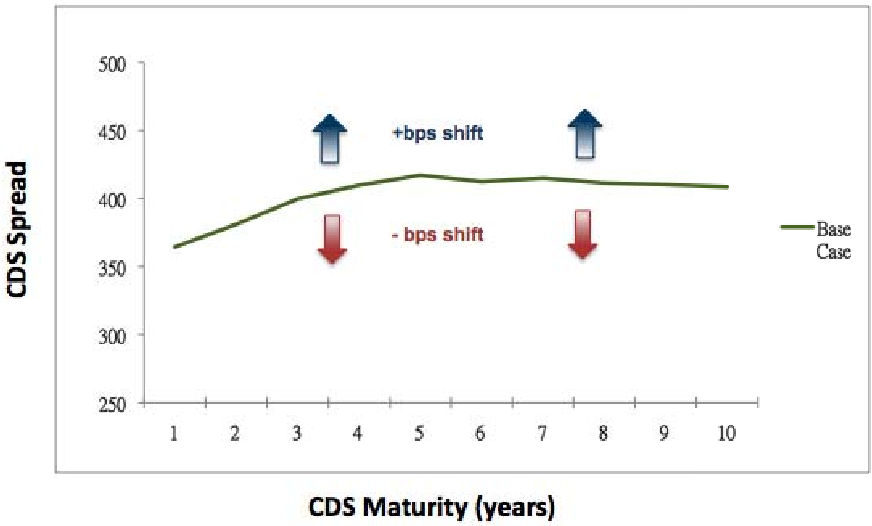


Figure 7: Implied survival probability with a parallel shift in CWLN CDS curve

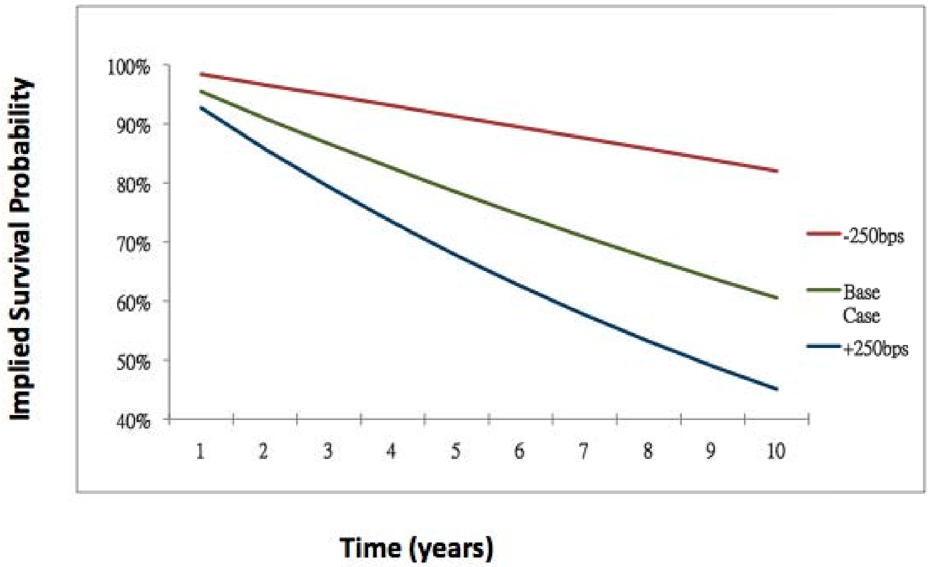
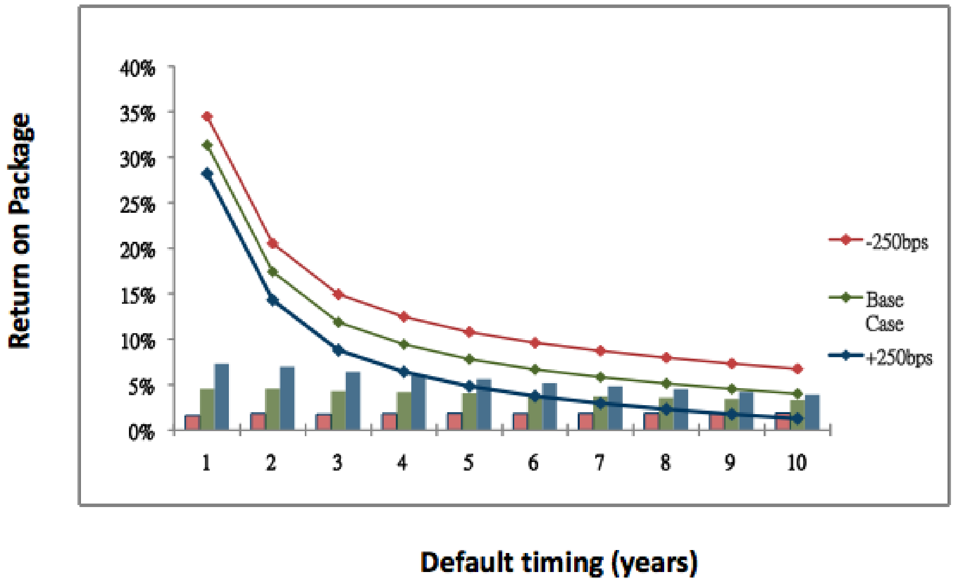


Figure 8: Affect of parallel shifts in the CDS curve on basis package



Expected Returns on Basis Package with Parallel Shift in CDS Curve										
-250bp	-200bp	-150bp	-100bp	-50bp	+0bp	+50bp	+100bp	+150bp	+200bp	+250bp
E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]
7.87%	7.68%	7.48%	7.27%	7.04%	6.79%	6.54%	6.27%	5.99%	5.70%	5.40%

The parallel shift on the CDS curve has a similar effect on the BRD curve as changing the bond coupon size, both change the net carry on the trade.   However, the shift of the CDS curve has a large impact on the marginal probability of default, shown by the difference between the red and blue bars at the bottom of the BRD.   This means for negative shifts in the CDS curve, while the probability of default shrinks, the value of the the risky cash flow on the basis package increases.

The effect of falling(rising) implied default probability is dominated by the effects of the growing(shrinking) net carry, as shown by the proportional relationship between expected returns and a shift in the CDS curve.

Sensitivity of the basis to changes in the slope of the CDS curve:

A more positive change in slope means a “steeper” credit curve, while a negative change in slop means a “decreasing steepness” of the credit curve. This is relatively easy to imagine on the CWLN credit curve, as in our base case the slope is near zero. To change the slope of the curve we rotate the credit curve around a point. Changing the slope does not necessarily mean an equal shift on short and long term CDS maturities, as I have shown. Changing the CDS premium on only short or only long term maturities would also be a change in slope.

Figure 9: Changing the slope of the CDS curve

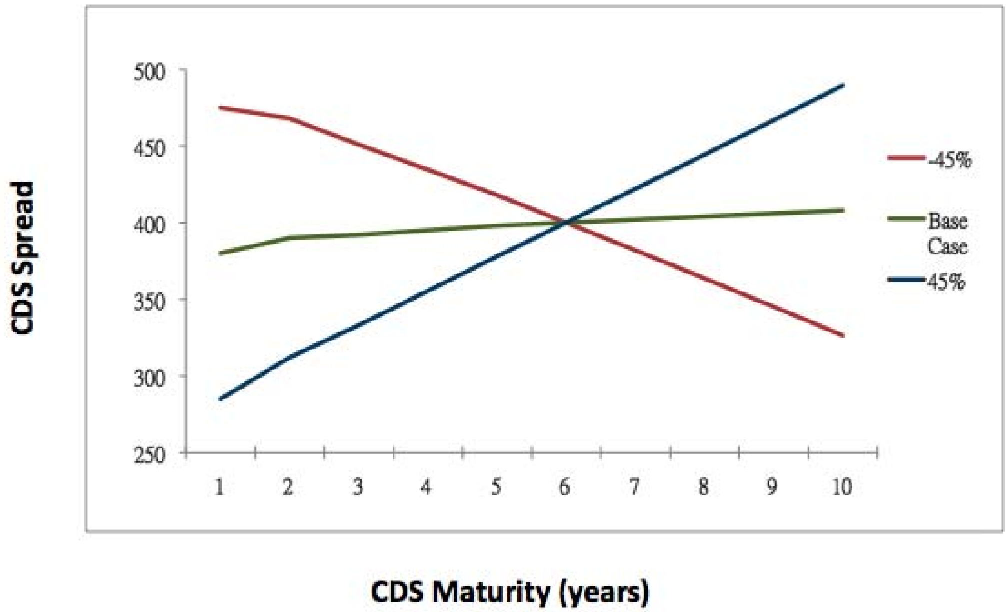


Figure 10: Affect of changing slope on implied survival probabilities

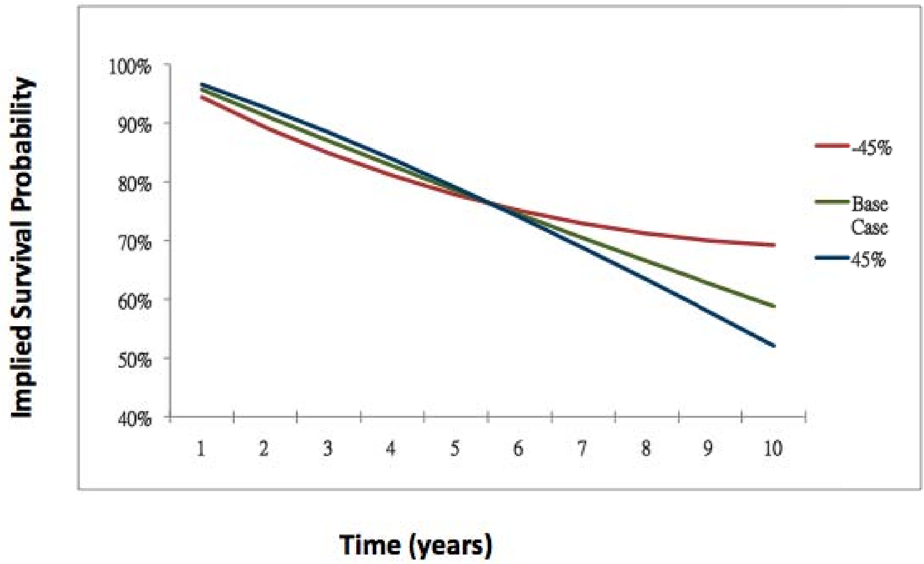
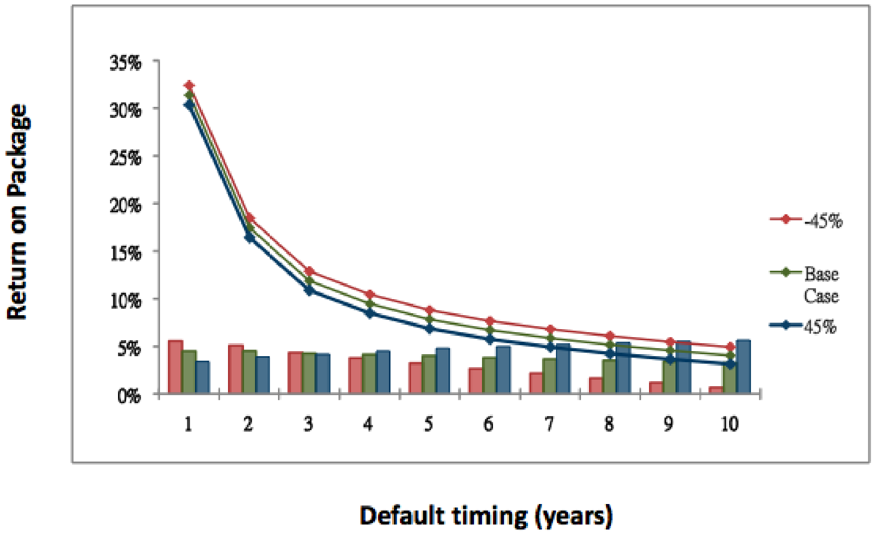


Figure 11: Affect of changes in slope of CDS curve on basis package



Expected Returns on Basis Package with Changes in Steepness

-45%	-36%	-27%	-18%	-9%	+0%	+9%	+18%	+27%	+36%	+45%
E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]
7.95%	7.72%	7.49%	7.26%	7.03%	6.79%	6.56%	6.33%	6.10%	5.86%	5.63%

In this case, the basis package benefits from the increases in the steepness of the credit curve, both as implied defaults rates are higher early on (when they have the greatest effect on returns), and as the net carry on the trade is larger. Even given other manipulations in the credit curve, a steeper curve is a more profitable curve, as either the default probability is increased or the net carry is increased (or both).

Sensitivity of the basis package to recovery rate assumptions:

Recovery rate assumptions are unlike other factors that affect the basis. First, they are not explicitly quoted in the market. CDS contracts are quoted by their premium, which affects the implied survival probability of the reference entity. However, the recovery rate also affects the implied survival probability, thus in order to understand your counterparties true beliefs, you must accurately guess *their* assumed recovery rate. Changing market conditions can also change the recovery rate on a bond after you have entered into the contract, we deal with that issue in the next section on mark-to-market valuations.

Mathematically we can see this by looking at the no arbitrage condition on a CDS contract:

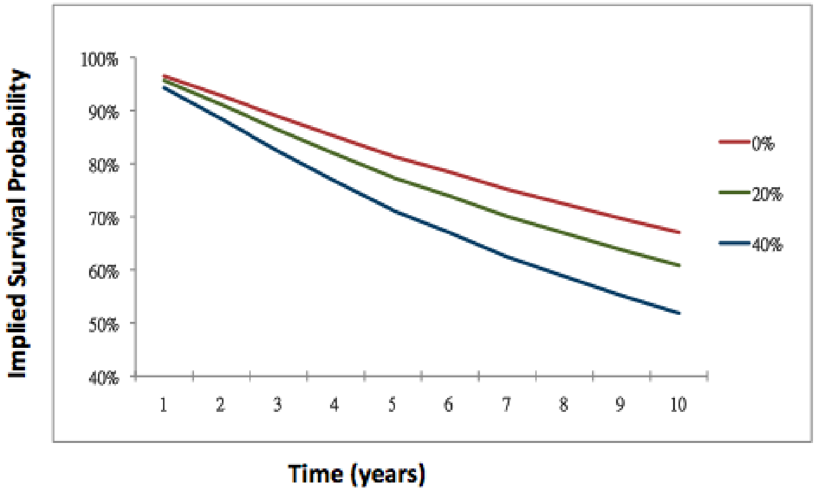
$$pre\sum_{t=1}^{n}(1-p_t)D_t = (1-R)\sum_{t=1}^{n}(p_t - p_{t-1})D_t$$

Where:

pre = credit premium for the life of the contract
D_t = discount rate at year t
p_t = cumulative probability of default implied by CDS curve
n = maturity of the contract in years

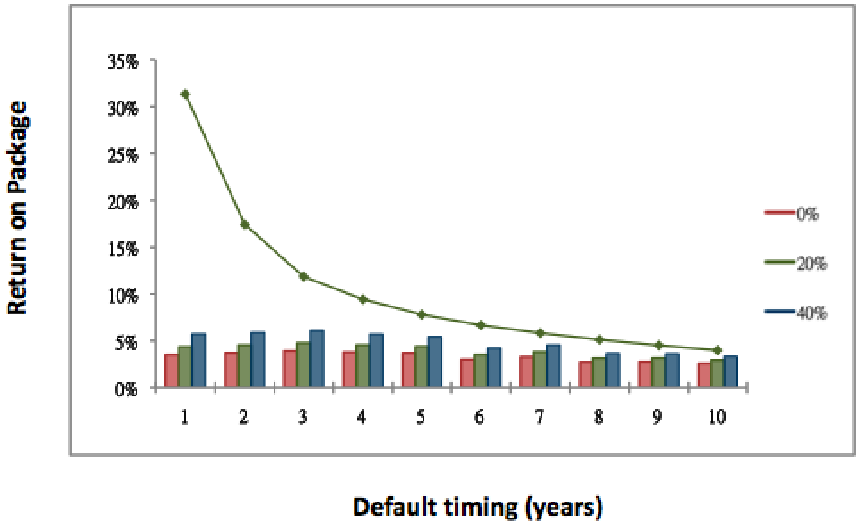
The left side of the equation is the premium leg, which must be equal to the right side of the equation, the default leg. By raising the recovery rate (R) we decrease the value of the default leg. To balance this we must increase marginal probability of default $(p_t - p_{t-1})$, which has a greater effect on the default leg then the premium leg.

Figure 12: The affects of recover rate assumptions on implied default probabilities



The second important difference between assumed recovery rates and other factors analyzed, recovery rates assumptions have no direct affect on cash flows. Because they do not effect affect either the initial outlay or the net carry on the trade, the BRD curve remains unchanged from our base case of a 20% recovery rate. Recovery rates do, however, affect the marginal default probability (see the bar graph at the bottom of the BRD) and thus have a significant affect on the expected returns on a basis package.

Figure 13: The effect of recover rate assumptions on the basis package



Expected Returns on Basis Package Under Different Recovery Rate Asummptions										
0%	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%
E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]
6.29%	6.39%	5.81%	6.65%	6.79%	6.96%	7.14%	7.35%	7.59%	7.87%	8.19%

Section 4: Mark-to-Market Changes in the Value of a Basis Package

The purpose of this section is to analyze the mark-to-market risks associated with changing factors after a basis package has been entered, as opposed to before entering the basis package. mark-to-market values are calculated by product, and not explicitly ‘netted’ by trading activit. The mark-to-market value associated with the changing market price of a bond is simplistic, the current traded price of the bond minus the price at which the bond was purchased. Thus, I only analyze the mark-to-market effects on the CDS leg of the basis package. Finally, while it is unlikely these factors will actually move in isolation, the basis is exploiting dislocations between markets, thus understand the effects of different factors individually is important.

It is worth noting that because basis trade is a fully hedged position, Mark-to-market changes should be largely offsetting; i.e. an increased default risk portrayed in CDS market, increases CDS contract value while at the same time bond values are falling. However, while some changes may be offsetting in sign they may not be in magnitude. Also, some changes are unique to one market. For example, when an issuers credit rating is downgraded, it triggers step-up covenants on bonds, rising bond value and cash flows on the basis trade, while leaving the CDS leg unaffected.

The initial market-to-market value of a CDS on inception is always zero. From the protection buyer perspective this means at inception value of the default leg minus the value of the premium leg must be zero. As the CDS curve changes the mark-to-market value of the CDS is commonly written as[9]:

$$MTM = \sum_{t=1}^{n} Annuity(S) \times p_t \times D_t$$

Where:

[9] Professor Shyan Yuan Lee, “Credit Derivatives and Structured Finance” class notes, Fall Semester 2008.

Annuity($) = value of CDS premium cash payments and default payments
p_t = survival probability of default implied by CDS curve
D_t = discount rate at year t

I expand this formula to calculated based on the change in fair value of the CDS as:

$$\Delta MTM = \sum_{t=1}^{n}(\Delta pre \times D_t \times \psi_t)$$
$$+ \sum_{t=1}^{n}[par \times \omega \times [\,(1\text{-}\psi_t) - (1\text{-}\psi_{t-1})] \times D_t\,] - \sum_{t=1}^{n}[par \times R \times [\,(1\text{-}p_t) - (1\text{-}p_{t-1})] \times D_t\,]$$

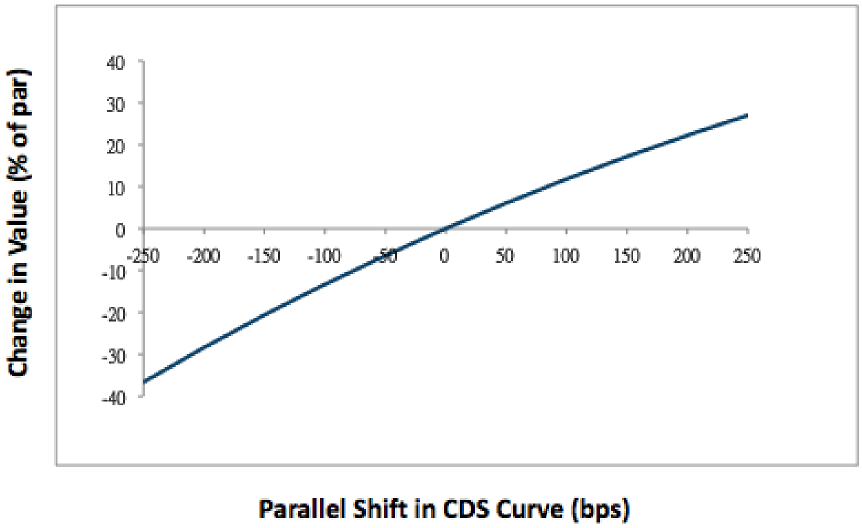
Where:
Δpre = change in carry
= current market CDS spread - beginning CDS spread
D_t = discount rate at year t
p_t = survival probability of default implied by beginning CDS curve
Ψ_t = survival probability of default in year t implied by the current market CDS curve
R = beginning recovery rate assumption
ω = current recovery rate assumption

The first term is simply the present value of the change in expected cash flows, implied by the new market rate CDS curve. The difference between next two terms is the change in present value of the expected payoffs on default. This change in mark-to-market value is, in effect, the fair price which one counterparty would pay to “tear” up the contract by bring it up to market value, where the contract value for both parties is zero.

Mark to market sensitivity to parallel shifts in CDS curve:

Changes in the CDS leg of the trade affect the mark-to-market value of basis package in two ways. First, they affect the net carry coming from the basis package. By raising or lowing the CDS spread matching the maturity on the bond (the 10yr spread in this case) we change the present value of the carry on the basis package changes. Second, by changing the expected timing of bond default we change the present value of payoffs received on default. While the value received never changes, par × (1-R), changing the expected time of receiving par changes the number of years discounted, and thus the mark to market value.

Figure 14: Mark-to-market sensitivity to parallel shifts in CDS curve



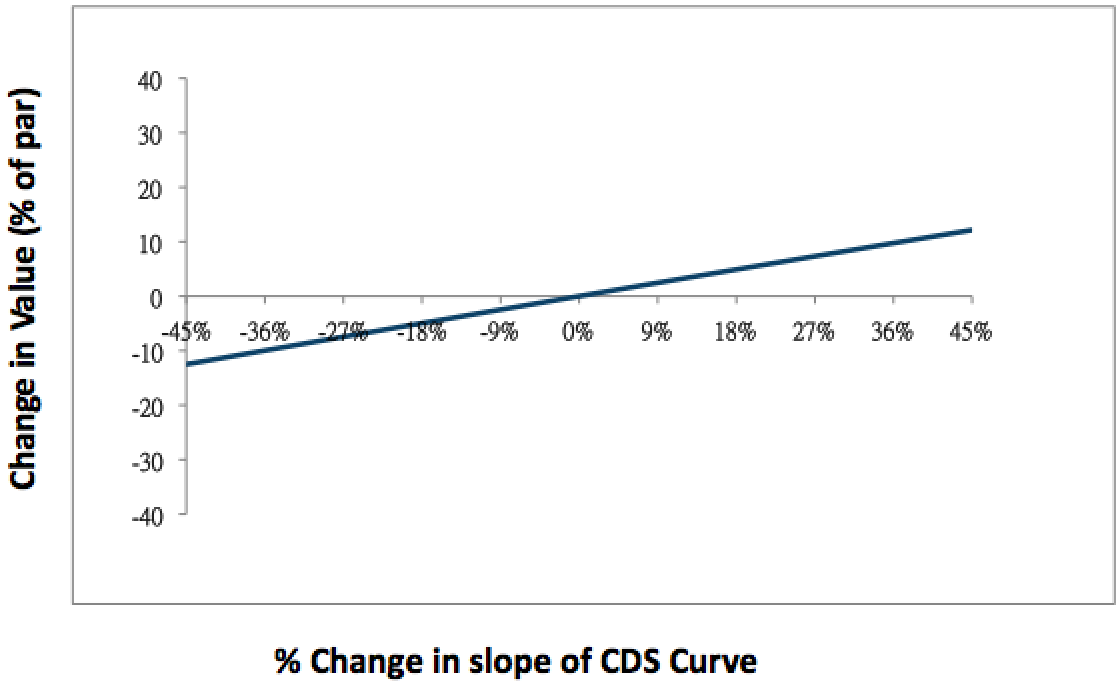
As the credit curve shifts up(down), toward the right(left) side of the horizontal axis, contract value is gained(lost). The gain recorded is equal to the present value of the difference between the original contract premium and the current market premium, plus the increased probability of a default pay-out. Gains from upward shifts in the credit curve are smaller than losses for downward shifts because upward shifts increase the probability of default, lowering the expected value of the credit premium.

Despite the nearly linear relationship between mark-to-market values and parallel shifts in the CDS curve, it is important to remember that credit risk is a one-sided jump risk, thus volatility is asymmetric. This means that sudden upward shifts of the credit curve are likely, given a deterioration in the credit quality of the reference entity. Whereas downward shifts are generally slow and downward volatility small.

Mark-to-market sensitivity to changes in the Slope of the CDS curve:

Like parallel shifts, changing the slope of the credit curve has the two effects on the fair value of a CDS contract, it changes the present value of the credit premium and the probability of default payouts. Unlike parallel shifts, the effects are offsetting based on the structure of our steepness changes. Negative changes in slope increase the chance of early default payments, a gain, while at the same time the reduced premiums and increased cumulative survival rates reduce contract value. The loss on the reduction in premiums and cumulative survival dominates the gain on default payments. Positive changes have equal and opposite effects.

Figure 15: Mark-to-market sensitivity to changes in the steepness of the CDS curve:

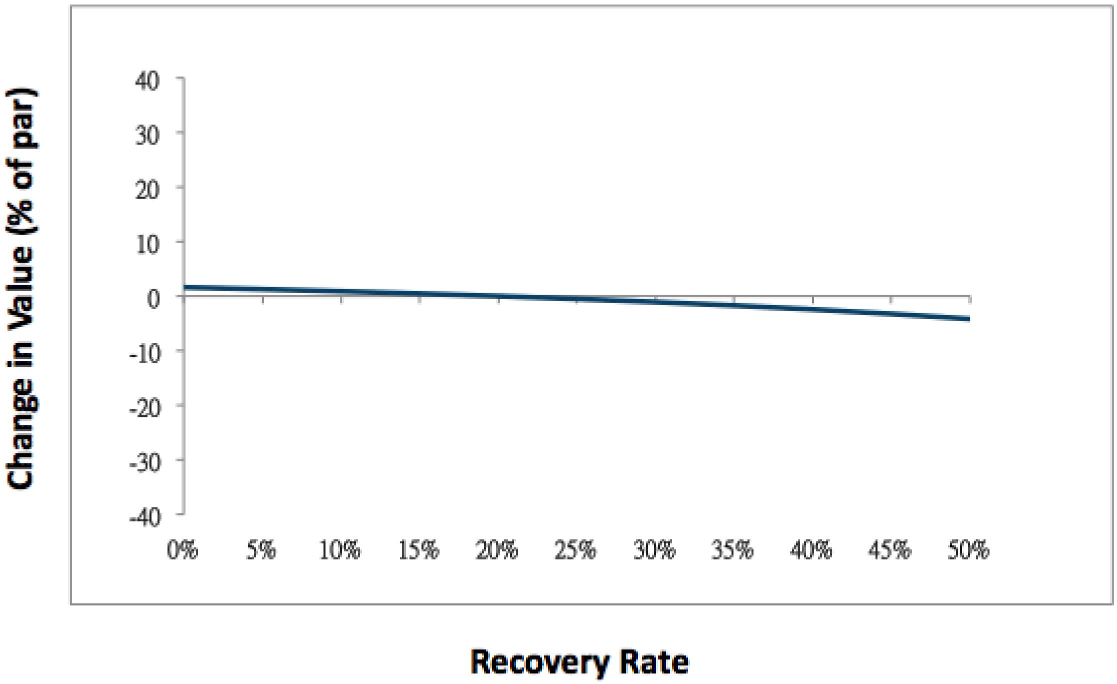


Mark to market sensitivity to changes in the recovery rate:

Making mark-to-market changes in value based on changing recovery rates is tricky because the recovery rate is not a quoted rate. As I showed before recovery rates have a significant effect on the implied default probability, and thus has an effect on the fair value of the CDS contract.

The recovery rate on a bond is less volatile than the credit premium, however unlike CDS premiums volatility is relatively symmetrical. Larger changes in recovery rate are likely when a reference entity issues more debt (reducing recovery rates) or retires debt (increasing recovery rates). Recovery rates are also related to the default cycle. Periods with high default rates tend to have lower recovery rates, while periods with low default rates have high recovery rates. However, recovery rates, in general, are very idiosyncratic and the variance on realized recovery rates for single name CDS is large.

Figure 16: Mark-to-market sensitivity to changes in the recovery rate



Mark-to-market changes in value tend to move in the opposite direction expected returns on the basis package. However, these changes are not necessarily bad for the basis investor. Bond prices may fall significantly as credit risk increases; however, this means companies are closer to default, the scenario in which a basis holder receives the largest pay-out. Thus basis holder must be prepared for significant mark-to-market volatility, and expect volatility to increase as default pay-outs become more likely.

Section 5: Basis package using forward CDS

One possible modification to the basis package is using forward CDS. A Forward CDS is a contract to buy protection in the future at a pre-specified premium for set length of time. By entering into a forward CDS contract today, the CDS trader locks in a lower premium for the period in which the CDS contract is effective, but assumes the risk of CDS spread changes in the intervening period. The forward CDS contract is also of a shorter duration, as the contract's effective date is later than a vanilla CDS while having the same maturity date. No premiums are exchanged until after the effective date, even if the reference entity defaults. I show this relationship mathematically below:

$$pre \sum_{t=1}^{n} (1-p_t)D_t = (1-R)\sum_{t=1}^{n} (p_t - p_{t-1})D_t$$

The CDS no-arbitrage condition above, states that the premium leg must equal the default leg (value to a protection sell must equal the value to a protection buyer). I modify this condition slightly to get the no arbitrage condition for a *k* to *n* year forward CDS:

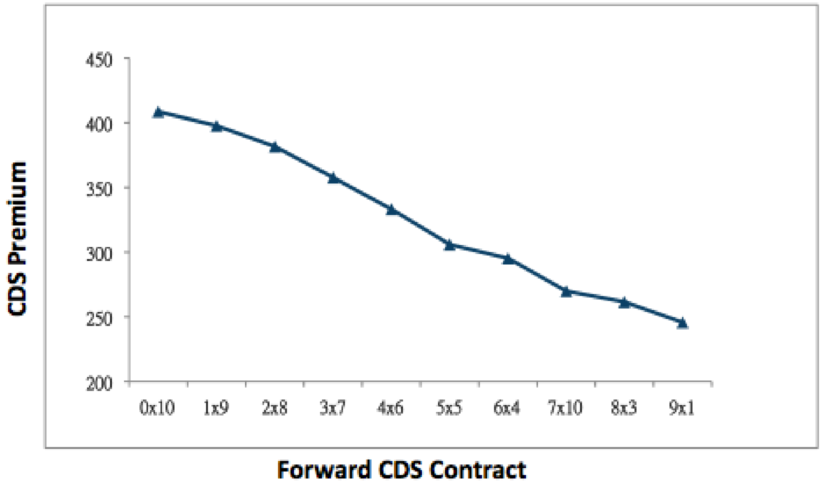
$$pre \sum_{t=k}^{n} (1-\Phi_t)D_t = (1-R)\sum_{t=k}^{n} (p_t - p_{t-1})D_t$$

Where:

n = the contract maturity date
k = the contract effective date
p_t = the cumulative default probability
Φ_t = cumulative probability of default *conditional* on survival until $t=k$
= [the sum marginal default probabilities from k to t *and* the probability of survival from 0 to k] divided by probability of survival from 0 to k
=(probability of default from k *to* t) / cumulative survival probability at k
= $[p_t - p_k)] / (1 - p_k)]$ (by Bayes' theorem)

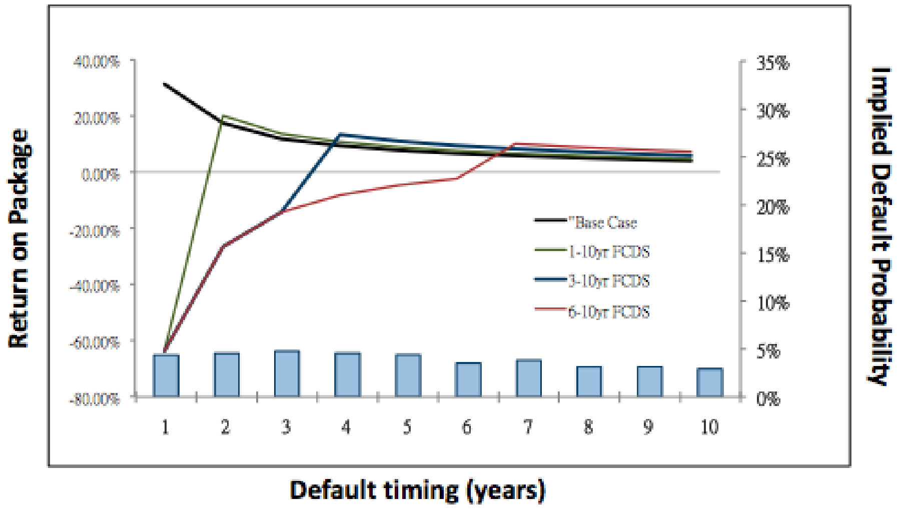
The net effect is that the orward CDS contracts with later effective dates have lower the credit premium. Figure 17 shows that as *k*, the effective date of the contract, becomes further distant, the credit premium falls, assuming the final maturity date of the contract is unchanged (all contracts pictured mature in 10 years).

Figure 17: Changes in the CDS premium for forward CDS contracts



A basis package holder, however, must assume the credit risk on the bond until the effective date of the forward CDS. Thus while the net carry on a basis package with forward CDS is increased, the loss in the event of an un-hedged default dominates the gain off the carry. Figure 18 bellow shows the BRD for different forward CDS contract options. The base case is a 0x10 year forward CDS, which is the same as a vanilla CDS. In each case, the returns are highly negative if the bond defaults before the effective date of the forward CDS, but positive and slightly higher (due to the increased carry) if the bond matures or defaults after the effective date. The expected return on the basis package quickly decreases bellow zero as the effective date is extended.

Figure 18: BRD for CWLN with Forward CDS



Expected Returns on a Basis Package with Forward CDS

0x10	1x9	2x8	3x7	4x6	5x5	6x4	7x10	8x3	9x1
E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]	E[R]
6.79%	3.47%	2.05%	1.24%	0.75%	0.43%	0.25%	0.10%	0.01%	-0.06%

While using forward CDS on the Cable & Wireless basis package may not be a good idea, not all basis packages are the same. In cases of extreme credit risk, where the credit curve has an extreme negative slope, forward CDS reduce the carry on the trade significantly. Forward CDS premiums are based on the conditional marginal default probabilities, which, in the case of steep credit curves can be comparatively small. Given that bond prices on extreme risk names can hover at or around estimated recovery rates, the astute trader could purchase a bond with the expectation if it defaults quickly the loss will be minimal, while if it defaults after the effective date of the FCDS, the gain will be tremendous.

Basis packages utilizing forward CDS can also be useful if the investor has inside information on the credit quality of the reference entity. If an investor is sure the firm will not default before the effective date of the FCDS, using an FCDS greatly increases the cash flow on the basis package. More important, if the investor has some control over the timing of the default of the reference entity, great profits can be achieved by 'guiding' the default past the effective date on the FCDS. The next section deals directly with this kind of manipulations.

Section 6: How CDS Change the Rules of the Game

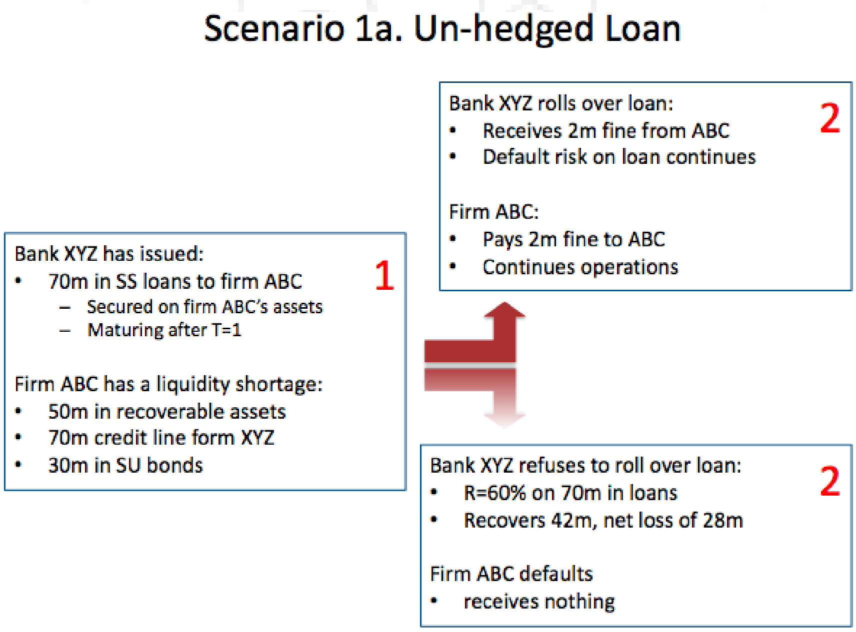
The pay-outs and strategies for lenders and bond holders are relatively well defined in recent finance literature. A creditors optimal contract is based on his information set, payouts on refinancing or liquidation and his beliefs about the lender's reaction set. As a hedging instrument, credit default swaps are fundamentally changing the relationship between creditor and debtor. In this section I briefly discuss how CDS affect this relationship broadest sense. I use several different scenarios as illustrations of this change. I focus primarily on the basis trade, including hedging, predatory behavior and the affect of changing capital structures on basis holders.

At the most fundamental level, credit default swaps are changing the optimal contracting decisions of lenders. When choosing the optimal debt contract, lenders estimate their payoffs on refinancing or liquidating a loan, and make their contract decision based on these factors. The premium on CDS contracts lower's lenders payoffs if it choose to refinance a poorly performing firm, while raising the liquidation payoff if the firm defaults. By definition this changes the lender's optimal contract on an *ex ante* basis, and changes the lenders decision if CDS contracts are entered into after loan issuance on an *ex post* basis.

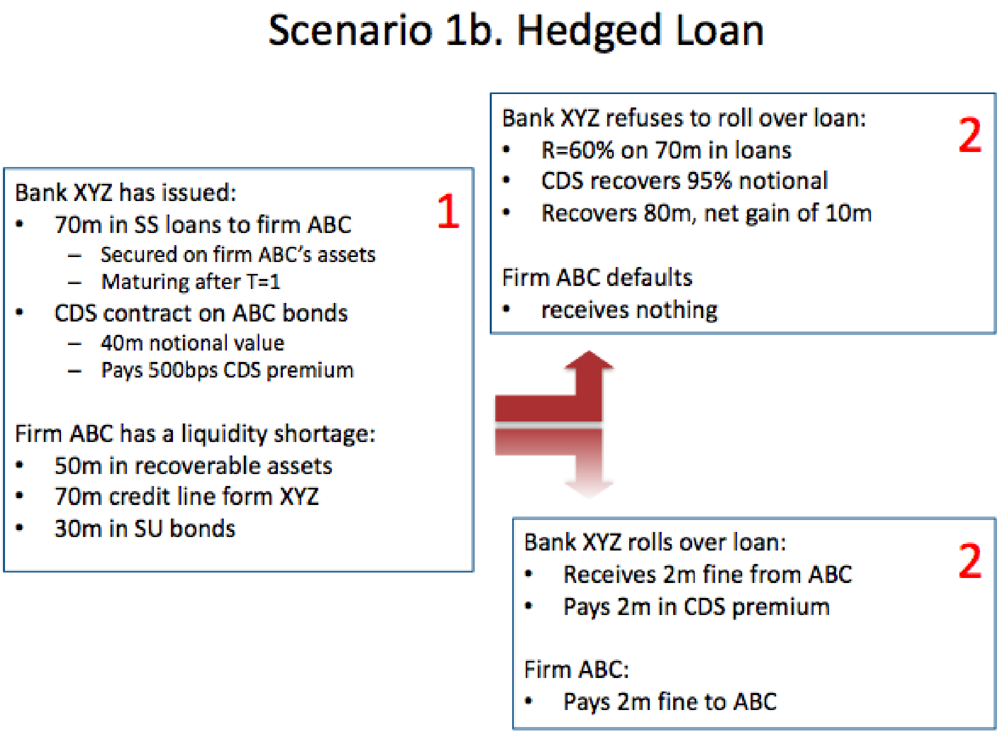
The key factor in this equation is that it is within the lender's power to decide if the firm is refinanced, or liquidated. Everything discussed in the previous sections up to this point, including CDS pricing and implied survival probabilities, has assumed that default timing is independent and beyond the influence of creditors. Clearly that does not conform to other areas of the finance literature.

Scenario 1: The hedged loan

In this scenario the bank has an outstanding credit line with an 'at risk' firm. The credit line is "senior secured," in that it has prior claim on the recoverable assets of the firm, compared to other forms of debt. However, it is still impaired such that in the event of default, the liquidation value of the loan is less than the face value. The credit line is set to mature after time 1, but the firm does not have sufficient liquidity to repay the outstanding balance, nor does it have access to other capital markets. Thus it is the banks decision to roll over the loan or force the company to default.



I analyze this scenario not from an optimal contracting framework, but from an *ex post* renegotiation standpoint. Clearly the banks best option is to roll over the loan in this situation.



By hedging it's loan book in the CDS market, the bank has drastically changed its payout structure such that the bank's optimal decision is to refuse to roll over the credit line. The banks alternate option, to roll over the loan, leaves the bank with no net profit while credit risk of the firm remains on the banks loan book. While this may be a somewhat extreme example, it is not far from current market conditions and clearly shows how CDS are changing the relation between bank and creditor.

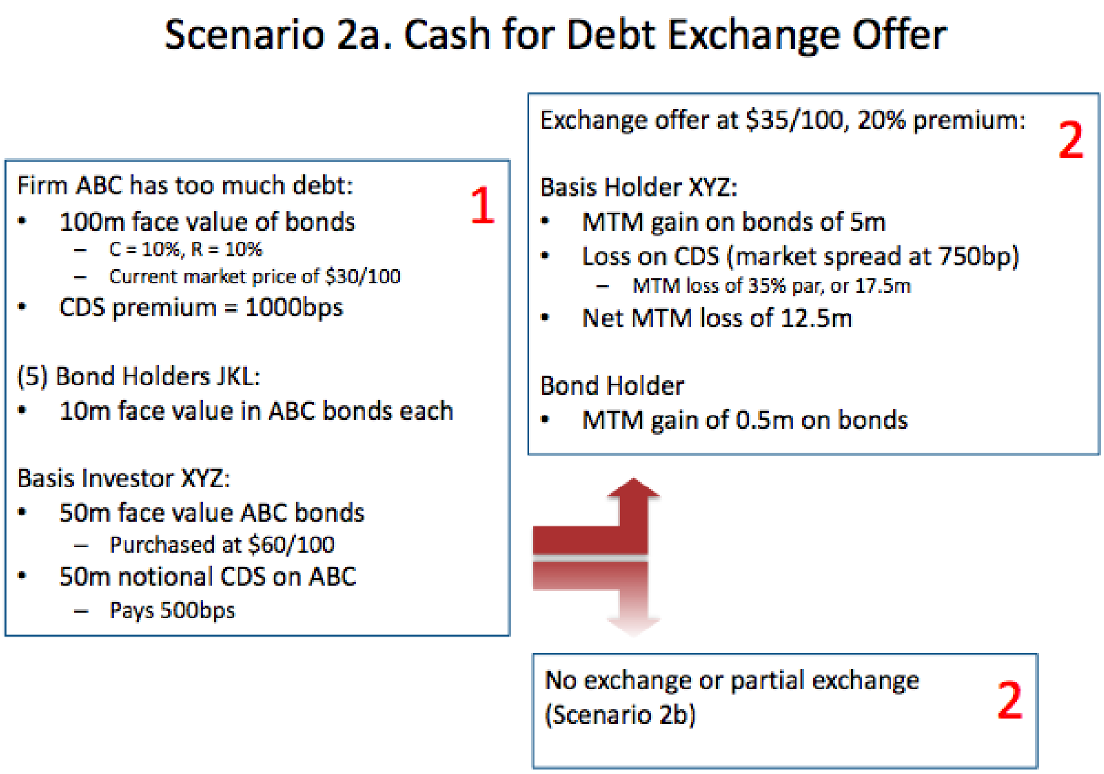
This hedging need not be done in the single name CDS market, index based hedges on a banks entire loan book may also have similar payout profiles to scenario 1b.

Scenario 2: Predatory behavior by basis holders and the effects of capital structure changes

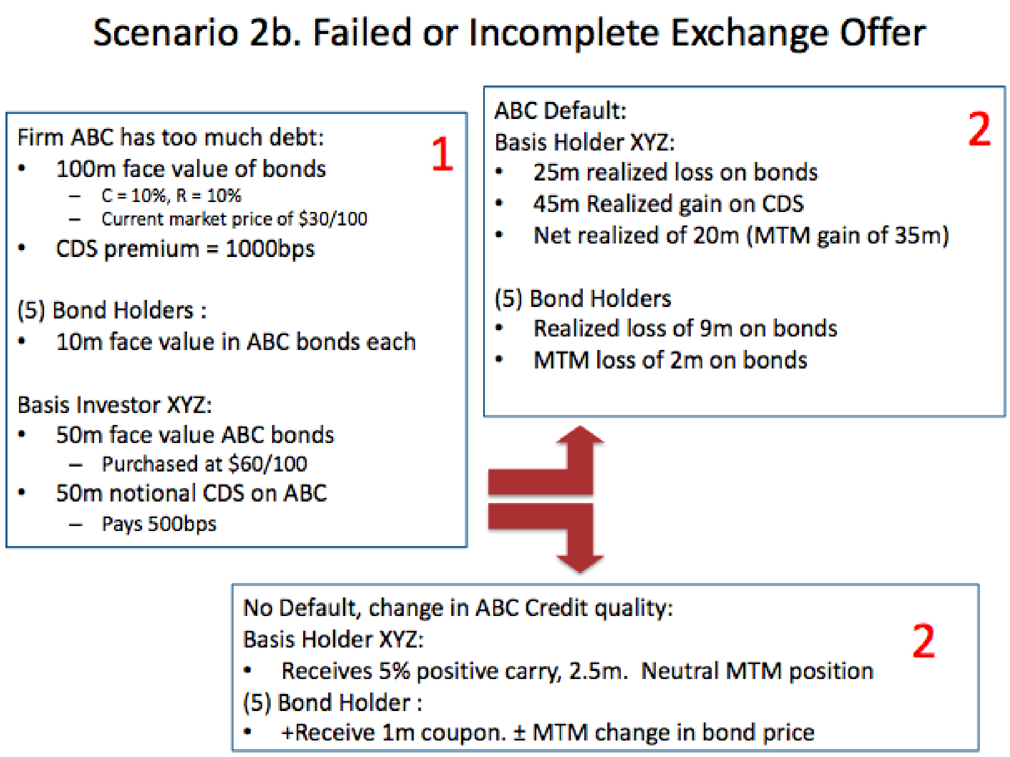
Section 3 clearly shows that basis holders benefit from early bond default. Returns on the basis are calculated using the implied survival probabilities, which assume the protection buyer has no influence on the default timing of the reference entity. If the basis holder has influence over the default timing on bonds, abnormal returns can be made.

In general, because bonds are arms-length transaction between single issuer and a dispersed group of investors, bondholders have less control over firm refinancing decisions. However, bond/basis holders can gain significant influence in several ways. First, bonds can be held by a small number of investors, either by private placement on issuance or aggressive open market operations. Second, while absolute control may be impossible, veto power over refinancing decisions is all that's necessary to force a company into default. Thus the voting rules for bond holders can be very important. Even if bonds can be renegotiated individually, a single missed payment or broken covenant classifies as a default and triggers CDS payment.

Exchange offers are one example of a decision in which a bond holder can greatly influence the timing of default. Because of recent developments in the credit markets, exchange offers have become a relative common corporate action for firms facing significant default risk. Exchange offers can come in many forms, debt for equity, debt for senior debt and debt swaps for cash are all forms of exchange offers. The key to understanding this scenario is the difference is in payoffs to bond investors vs. payoffs to basis holders.



Clearly scenario 2a represents a loss to holders of the ABC basis package, despite the premium offered by the company in exchange for their bonds. On the other hand bond holders gain (on a mark-to-market basis) from the exchange offer. Thus, if possible ABC basis holder will seek to block the exchange offer. Alternatively ABC company could seek to purchase its debt through open market operations, however the increase in demand would affect market price of debt. If ABC company retires none, or only a portion of its debt scenario 2b begins.



In scenario 2b, if ABC defaults basis holder's receive the maximum payout, while bond holder's lose the most. If ABC does not default basis holder's continue to receive the positive carry off the basis package, while bond holders receive the larger coupon, but face mark-to-market risks on the bond.

Scenario 2 has been played out many times over the last year as companies offer cash for debt exchanges, and will likely continue as the default cycle heats up. Equity for debt exchanges generally leave basis holder worse off, however the change is difficult to quantify. Exchange senior secured debt for unsecured debt generally adds value for basis holders, as they move into a scenario 1 like situation. In general, negotiations surrounding exchange offers are unlikely to be as straightforward when hedged investors, like basis holders, are present. This is a significant change when compared to previous default cycles before the advent of credit default swaps.

Conclusion

Any serious dislocation between markets, such as the basis, can be expected to revert over time. We should expect the large dislocations in the bond market, which occurred during the credit crisis in late 2008 to revert over time. We should expect basis returns on a basis package converge towards zero. However markets to not always move as expected, and this process is still ongoing.

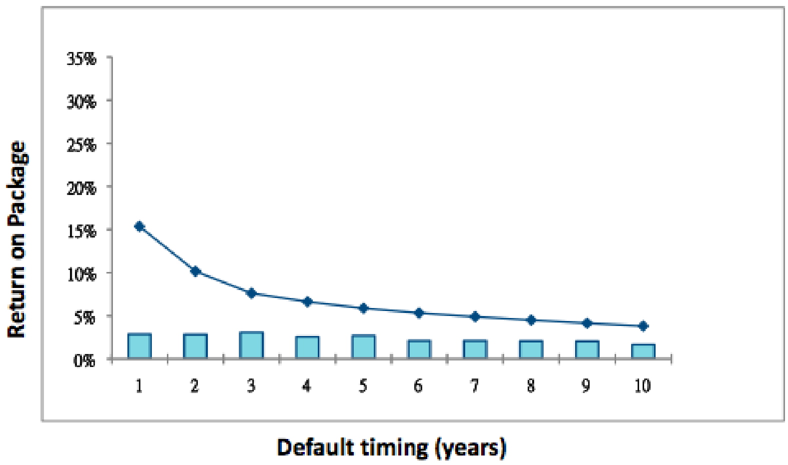
Despite the rally in the credit market, CWLN continues to present attractive returns on a basis package. Expected returns on the basis package have diminished and the positive carry on the trade as increased to nearly 600bps, while at the same time the bond continues to trade at a discount. Opportunities for profit taking remain.

Figure 19: The Basis Package for Cable & Wireless 8⅝, 2019

	Bond	CDS	Net
Initial outlay	-£90.5	£0	-£90.5
Annual cash flow	862.5bp	-225.7bp	636.8bp
Value on default	Recovery	£100-Recovery	£100
Value on Redemption	£100	£0	£100

Note: Data from May 22, 2009, collected on DataStream and Bloomberg.

Figure 20: The BRD for CWLN as of May 22, 2009



Expected returns on the CWLN basis package = 4.63%

As expected the increase in the market price of the bond has lowered the return on default. At the same time the smaller CDS premium increases both the size of the positive carry and the risk adjusted present value of the carry. The next effect is a reduction in expected returns, but also a reduction in risk, as the distribution of possible returns is cut in half.

Mark-to-market volatility is always high when investing in the 'dislocations between markets' as dislocations, by their nature, do not move as expected. Here again the CWLN basis package is instructive. The mark-to-market gains on the bond of £90.5 - £79= £11.5 of par £100. The using my past analysis, the mark-to-market losses on the CDS leg come to £25.81 on par £100, due to an almost parallel shift in the CDS curve. The net mark-to-market losses for the CWLN basis package between November 11, 2008 and May 22, 2009 total £14.3 of par £100.

This large mark-to-market loss highlights the danger in the basis trade. In this case, an un-hedged bond investor would outperform the basis holder significantly (or this period). Despite these losses, this basis trade is far from over, and closing the trade would be a mistake. The purpose of the new basis trade is to highlight the *long-term* profits, which can be made. The ability to handle significant mark-to-market losses such as these is critical to success in the new basis. Even under the original credit curve, the highest marginal default probability was in the second and third year. Investors in basis trades should be prepared for this volatility and be prepared to invest with a long term horizon.

Clearly the mark-to-market risks are considerable on a basis package, but the risks are not limited mark-to-market values. Funding risks clearly present an on going concern, as funding costs are usually at a floating rate, while the basis returns a fixed carry until default or maturity. Interest rate risk is also important, both from price risk on the bond and from a funding perspective. Finally, given the default of a number of major dealers in the CDS market, counter party risk can no longer be ignored. This should become doubly clear after section 5, where I showed how certain counterparties can manipulate default timing for their own benefit. It important to remember than CDS are zero-sum games, the protection buyer's gain is a protection sellers loss, and *visa versa*.

This paper has provided a rigorous analysis of new practices in fixed income credit trading, including what factors affect long-term returns on the new basis trade. Further research into this area could be conducted by comparing the different factors, proportionally adjusted for each factor's volatility. However, this will be difficult because credit volatility is often one-sided with jump risk being a major factor in volatility. Thus past may be a very poor predictor of future, esp. with severe idiosyncratic risks involved in single name CDS. Further research on the affect of CDS on debt contracts, under an optimal contracting framework is also warranted. CDS and other credit transfer mechanism clearly change the optimal debt contract in equilibrium, and this paper presents only the most cursory of analysis.

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