# What central banks can learn about default risk from credit markets

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## 1. Introduction

The benchmark source of information from the credit markets is the credit spread, usually expressed as the difference between the yield offered on defaultable bonds and the yield on default-free bonds. Versions of this spread, and simple transformations of it, are used within central banks in at least three ways:

*The assessment of default probabilities.* The raw credit spread is used in the assessment of the financial stability conjuncture and outlook as an indicator of credit risk. Absent taxation asymmetries between corporate and default-free bonds, the textbook treatment of corporate bonds assumes that some corporate bonds will default and that investors require a higher yield to compensate for expected default losses (see, for example, Bodie et al (1993)). We demonstrate below how expected default probabilities can be extracted from credit spreads.

*The assessment of market functioning.* The dispersion of credit spreads on equally rated individual names or sectors is used as one of several indicators of the efficient functioning of credit markets. For example, a widening of spreads of A-rated bonds of a particular group of issuers relative to other A-rated corporates might be indicative of credit rationing were it also observed that issuance of new bonds by those issuers was low. The dispersion of the spreads reveals information about the influence of sectoral versus macroeconomic shocks. The dispersion can also indicate the ability of the market to differentiate creditworthiness. This is of interest if "unwarranted" contagion is suspected.

*As a leading indicator of macroeconomic developments.* Gertler and Lown (2000) suggest that the high-yield credit spread has been a superior leading indicator of the US business cycle. They argue that competing spreads (term spread and paper-bill spread) have lost explanatory power due to changes in monetary policy while the credit spread is a good and stable proxy for the premium for external funds which is central to financial accelerator models. Cooper et al (2001) is a recent application from a central bank perspective.

The remainder of this paper will focus on the first of these uses. In particular, we compare the information content of credit spreads with that of the relatively new credit default swap (CDS) market. We show that, theoretically, both corporate bond and default swap prices are formed from the same raw information. Indeed, the market practice is to base default swap prices on the credit spread although it is recognised that prices in the two markets are in two-way dynamic equilibrium. We demonstrate that analysis of the two markets should yield the same information. However, we also consider the imperfections of the credit markets and show why these may drive a wedge between CDS prices and credit spreads.

The paper proceeds as follows. In Section 2 we outline the credit default swap market. Section 3 demonstrates that theoretically this market should contain no additional information to that contained in credit spreads. However, it also highlights and attempts to explain the divergence between information on default probabilities extracted from default swap and bond markets. Section 4 draws some conclusions.

[1] Anne-Marie Rieu very generously gave me permission to use her work on this topic, and I draw on this widely. I am also grateful to Alex Bowen, Jean-Sebastien Bret, Simon Hayes and David Rule for valuable comments. Unfortunately I must remain responsible for any errors. The views expressed are those of the author.

## 2. Introduction to credit derivatives

The simplest instrument traded under the title of credit derivatives is the single name credit default swap. In a credit default swap, one counterparty (the "protection seller") agrees to compensate another counterparty (the "protection buyer") if a particular company or sovereign (the "reference entity") experiences one or more defined credit events. The protection seller is paid a premium, usually expressed as an annualised percentage of the notional value of the transaction, over the life of the transaction.

A CDS is often compared to a guarantee or insurance policy. The key difference is that a guarantee would compensate a protection buyer for its losses following a credit event and so is state-dependent (there has been a credit event) and outcome-dependent (the buyer has suffered losses), whereas a CDS is only state-dependent (compensation is paid by the protection seller irrespective of whether the buyer has experienced losses).

Despite moves to standardise the market, several features need to be defined before the CDS trade is executed:

- The *reference entity* must be specified.
- The *credit event(s)* that would trigger a payment to the protection buyer may include some or all of the following non-exhaustive list:
  - bankruptcy;
  - failure to pay;
  - obligation acceleration or default;
  - repudiation/moratorium (for a sovereign reference entity);
  - restructuring of the reference entity's debt.
- A *reference asset* is sometimes specified. This allows the precise specification of the capital structure seniority of the debt covered, and can give a better indication of the recovery rate after default.
- The *settlement convention* following the credit event. The contract is either physical or cash-settled. Physical settlement would entail the delivery of the defaulted security to the protection seller in exchange for par value in cash. Cash settlement would entail the protection buyer receiving par minus the default price of the reference asset in cash (usually gathered via a poll of dealers). The default price is market-determined (although a fallback arrangement ought to also be included in the documentation should it not be possible to market-price the asset).

## 3. Information from credit derivatives

### 3.1 A theoretical treatment of risky bond prices and credit default swap rates

In this section we briefly outline a method for the extraction of information from credit default swap rates. In parallel we do the same for defaultable bonds to highlight the theoretical linkages between the information contained in the two sets of market prices. This section draws heavily on Rieu (2001), which contains much greater detail of some steps made in this paper.

We start with a cash flow analysis. Assume we have a risky bond of maturity $T_n$, of nominal value 100, paying fixed annual coupons *C*. Should it default, the bond would pay a recovery rate of $\pi$. Assume also that we have a credit default swap with annual premium *s*. On default, the protection buyer receives $\pi$ of the par value of the reference asset. The cash flows are summarised in the following table. Should default occur, of course, only one of the payments in the column headed default is received.

| Time | Bond cash flows to holder | | CDS cash flows to protection buyer | |
|---|---|---|---|---|
| | Survival | Default | Survival | Default |
| 1 | C | $\pi$.(100+C) | –s | 100.(1-$\pi$) |
| 2 | C | $\pi$.(100+C) | –s | 100.(1-$\pi$) |
| 3 | C | $\pi$.(100+C) | –s | 100.(1-$\pi$) |
| | … | … | … | … |
| $T_n$ | 100+C | $\pi$.(100+C) | –s | 100.(1-$\pi$) |

We assume that the default can only occur on the coupon payment dates or maturity. This simplifies the analysis since we do not then have to worry about claims on accrued interest payments for mid-coupon date defaults. While somewhat unrealistic, Hull and White (2000) show that this assumption has little impact on extracted default probabilities.

The probability of default is time-varying. Define $q(0, k, k+1)$ to be the risk neutral conditional probability of default between period $k$ and $k$+1, and $Q(0,T_k)$ to be the cumulative risk neutral probability of default between 0 and $T_k$. Similarly, define $P(0,T_k)$ to be the cumulative risk neutral probability of survival over the same period.

By Bayes' Rule we know that the conditional probability of survival between $k$ and $k$+1 is

$$p(0,k,k+1) = \frac{\Pr[(\text{Survival until } k+1) \text{ AND } (\text{Survival until } k)]}{\Pr[\text{Survival until } k]} = \frac{P(0,k+1)}{P(0,k)}$$

and so $P(0,T) = \prod_{k=1}^{T} p(0,k-1,k) = \prod_{k=1}^{T} [1-q(0,k-1,k)]$.

Define $B(0, t)$ to be the spot price of a risk-free zero coupon bond paying one at time $t$. The present value of the risky coupon bond is then

$$PV_{bond} = C\sum_{i=1}^{T_n} B(0,i)P(0,i) + 100B(0,T_n)P(0,T_n) + \pi(100+C)\sum_{i=1}^{T_n} B(0,i)q(0,i-1,i)P(0,i-1) \qquad (1)$$

and the credit default swap is priced such that

$$0 = -s\sum_{i=1}^{T_n} B(0,i)P(0,i) + 100(1-\pi)\sum_{i=1}^{T_n} B(0,i)q(0,i-1,i)P(0,i-1). \qquad (2)$$

These equations express the present values of both risky bonds and credit default swaps in terms of zero coupon risk-free bond prices, conditional probabilities of default and the recovery rate. The important issue then is that since the prices of the risky coupon bond and the credit default swap are functions of the same recovery rate and default probabilities, the information extracted from both should theoretically be equivalent. This result is important. CDS prices are easy to observe directly whereas computing credit spreads involves the preliminary step of determining risk-free rates, which can be problematic where government bond yields are distorted by regulation or supply shortages (see Anderson and Sleath (1999) for a discussion of the Bank of England's methodology of deriving yield curves). Further, while indicative CDS prices are relatively easily available for maturities of three, five, seven and 10 years, credit spreads can only be observed at the maturities of outstanding bonds, which are sometimes not so widely or evenly dispersed. However, CDS prices are only quoted for a subset of reference entities that have issued bonds, and firm CDS prices are hard to find away from the most liquid points (typically five years). Being able to use information interchangeably from both markets would allow a more comprehensive picture of default risk.

We now show how to extract the risk neutral conditional probabilities of default from risky bond prices. The period $t$ price of a risk-free zero coupon bond is

$$B(t,T_k) = \exp\left(-\int_t^{T_K} f(t,u)du\right) = \exp(-R(t,T_k)(T_K - t))$$

where $f(t, T_k)$ is the continuous-time instantaneous forward rate at $T_k$ seen from $t$, and $R(t, T_k)$ is the risk-free rate over $(t, T_k)$.

Similarly, the price of a risky zero coupon bond is

$$V(t,T_k) = B(t,T_k)\exp(-S(t,T_k)(T_k - t)) \tag{3}$$

where $S(t, T_k)$ is the credit spread at $t$ for a claim of maturity $T_k$.

If we make the usual but critical simplifying assumption of independence between risk-free rates and default, then following the model of Jarrow and Turnbull (1995) we can define the price of a one-period risky zero coupon bond as

$$V(0,1) = B(0,1)\{[1 - q(0,0,1)] + \pi.q(0,0,1)\}. \tag{4}$$

Similarly, the expected value of a two-period risky zero coupon bond in the Jarrow-Turnbull model is

$$V(0,2) = B(0,2)\{[1 - q(0,0,1)][1 - q(0,1,2)] + [1 - q(0,0,1)]q(0,1,2)\pi + q(0,0,1)\pi\} \tag{5}$$

This assumption of independence is widespread in the literature and Moody's Investor's Service (2000) provides evidence that the correlations are small enough for this assumption to be warranted.

Rearranging (3) gives

$$\frac{V(t,T_k)}{B(t,T_k)} = \exp(-S(t,T_k)(T_k - t)) \tag{6}$$

which when combined with (4) gives the conditional default probability between [0, 1]

$$q(0,0,1) = \frac{1 - V(0,1)/B(0,1)}{1 - \pi} = \frac{1 - \exp(-S(0,1))}{1 - \pi}. \tag{7}$$

Substitution into (5) yields

$$q(0,1,2) = \frac{\exp(-S(0,1)) - \exp(-S(0,2)\times 2)}{\exp(-S(0,1)) - \pi}. \tag{8}$$

This process can be rolled forwards $n$ periods revealing the generalised conditional risk neutral probability of default to be

$$q(0,k,k+1) = \frac{\exp(-S(0,k).k) - \exp(-S(0,k+1).(k+1))}{\exp(-S(0,k).k) - \pi} \tag{9}$$

and the cumulative probability of default to be

$$Q(0,T) = 1 - \frac{\exp(-S(0,T).T) - \pi}{1 - \pi}. \tag{10}$$

That is, we can express the conditional and cumulative risk neutral probabilities of default in terms of the observable credit spread and the (ex ante unobservable) recovery rate. The standard financial pricing model says:

$$P = E(mx) \tag{11}$$

where $P$ is the price of the asset, $m$ is the stochastic discount factor, $x$ is the payoff of the asset, and $E$ denotes conditional expectations. In a state-price density framework we can rewrite this as

$$P = \sum_s \pi(s)m(s)x(s) \tag{12}$$

where $\pi(s)$ denotes the true probability of state $s$. However, if we denote the risk-free rate of interest by $R^f$, the risk neutral probabilities we have extracted ($\pi$*) are such that

$$P = \frac{1}{R^f}\sum_s \pi^*(s)x(s). \tag{13}$$

The transformation between risk neutral and true probabilities is

$$\pi^*(s) = \frac{m(s)}{E(m)}\pi(s). \tag{14}$$

That is, the risk neutral probabilities give greater weight to states with higher than average marginal utility. Since default is likely to coincide with periods of economic downturn, when the marginal utility of an extra dollar is higher than average, the extracted probabilities are at best an upper bound on the true probabilities of default. Nevertheless, even though they may not be true default probabilities, the risk neutral probabilities extracted from the bond market should still equal those from the CDS market.

Duffie (1999) shows that the credit default swap price should equal the spread over Libor on a par floating rate note by arbitrage. He also argues that spreads on par fixed rate bonds and par floating rate notes are essentially equal (to within 1 basis point per 100 basis points of credit spread). Hull and White (2000) confirm this result in the presence of a flat (Libor) term structure but show that a steeply sloping term structure can lead to an imprecise arbitrage argument (approximately 7 basis points per 100 basis points of credit spread). Hull and White also examine the effect of using non-par bond spreads. They demonstrate that for spreads characteristic of BBB-rated issuers, the error is rather small in the presence of a flat term structure (5 basis points per 100 basis points of credit spread).

We read this literature as suggesting that the credit spread over Libor on fixed rate bonds and the CDS price should be (approximately) equal, and hence that either par bond credit spreads or credit default swap prices can be used in equations (9) and (10). To obtain true (risk neutral) default probabilities, the spread between Libor and the risk-free rate needs to be added to the CDS price and credit spread over Libor. Note that this reintroduces the problem of observing the risk-free rate given government bond market supply effects referred to above. The implication is that using CDS prices does not make this problem go away if the object of the exercise is to compute default probabilities.

This theoretical equivalence between CDS prices and credit spreads is violated in reality. The following section demonstrates the divergence between credit spread curves derived from bond prices and CDS rates, and the divergences between inference regarding default probabilities that result. The subsequent section considers reasons for the divergence over and above the imprecise arbitrage arguments already noted.

### 3.2 An empirical example

As an empirical example, we will consider implied default probabilities for a single company (Citigroup) on a given day (2 October 2001) derived from quoted bond and credit default swap prices.

*Credit default swap prices*. These were available for annual maturities between one and 10 years from the JP Morgan website. JP Morgan is a leading market-maker in credit default swaps. The prices are indicative middle-market rates. Firm bid and ask quotes are available from the same site for three-, five-, seven- and 10-year maturities. The additional information from the indicative prices makes them more attractive for our purposes. As noted above, CDS prices are a spread over Libor. Fair comparison against a (bond) credit spread over risk-free rates implies adding the Libor-risk-free spread to the CDS price at each maturity.

*Risky bond prices.* Middle-market prices on all Citigroup US dollar-denominated bonds were collected from Bloomberg. Only straight fixed coupon bonds with no embedded options were considered. Bonds with a maturity of less than one year were dropped since such short-dated bonds are infrequently traded and prices are likely to be either stale or misleading. If, for any given maturity, more than one bond was quoted, we took the price of the bond with the largest amount outstanding, all other things being equal. We did not exclude bonds priced far from par since this would have excluded too many bonds for subsequent optimisation (the furthest departure was a clean price of 109.5). Despite choosing a large player in the debt markets, we only found six suitable fixed coupon bond spreads. The implied zero coupon spread of the risky bonds over the risk-free zero coupon curve was then computed for each bond.

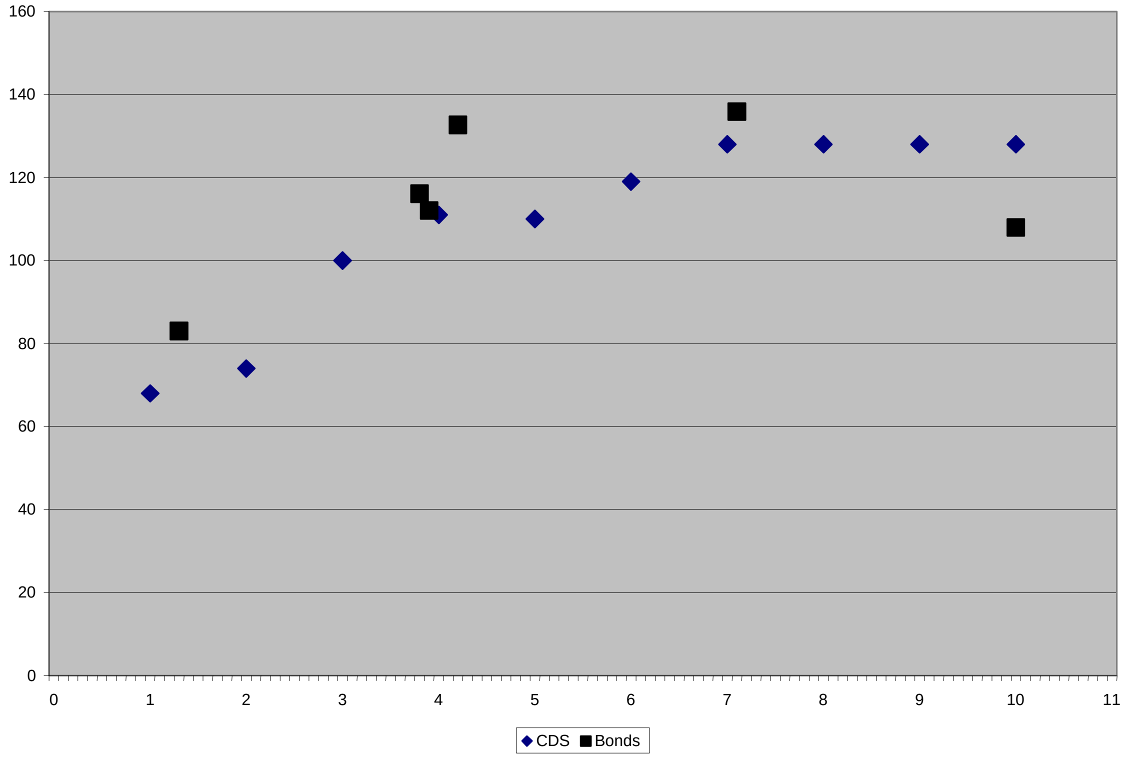
*Default probabilities.* A parametric curve of the form $s = a + b.t + c.t^2$ (where t denotes maturity and s is the spread over the risk-free rate) was fitted to both sets of spreads. Conditional and cumulative default probabilities were then calculated as in equations (9) and (10) with a recovery rate of 40% assumed.

Figure 1 reveals the raw spread data being analysed. The bond data are well dispersed by maturity, yet the tight grouping of three bonds around four years reveals a wide disparity of spreads.[2] The 10-year bond spread also appears out of alignment. The CDS spreads, while appearing smoother, also show some idiosyncracies. The lower cost of five-year protection relative to four-year reflects the concentration of CDS liquidity around the five-year horizon. The other “jumps” in CDS spreads are largely driven by jumps in the Libor-risk-free spread.

[2] Duration effects can account for some but not all of this disparity. At least part of the remainder is due to relative liquidity.

Figure 1

**Observed CDS and bond spreads over risk-free rates**




Figures 2 and 3 reveal the different profiles of default probabilities extracted from the two markets. Cumulative and especially conditional probabilities are markedly different, even for a company such as Citicorp that is relatively creditworthy (Aa2/AA- rating at time of quotes), and has a reasonably active portfolio of bonds outstanding capable of providing yields over a wide spread of maturities. The differences in inference are robust to alternative functional forms for the spread curve and alternative, plausible, recovery rate assumptions. In the next subsection we discuss reasons why the two markets provide conflicting information.

### 3.3 Why bond spreads and credit default swap spreads may diverge

Define the swap basis to be the CDS price minus the par bond spread. Although the two components should be equal in theory, even in perfect markets there could be a non-zero swap basis. O'Kane and McAdie (2001) split the reasons into two groups. They term the first group "fundamental" factors and argue that these arise because of the simplifying assumptions made when describing the credit default swap and risky bond. The main elements in this group are:

- *Funding issues*. Trading in the bond is a funded transaction where the funding rate depends upon the credit rating of the market participant. Credit default swaps are unfunded and lock in an effective funding rate of Libor. Highly rated investors (or investors with natural funding such as pension funds and retail banks) may fund sub-Libor, which would lead them to prefer to buy the bond rather than sell protection. Conversely, lower-rated investors wishing to acquire credit risk would prefer the unfunded CDS transaction. Obviously, the exact circumstances of market participants will determine the effect this has on the swap basis. O'Kane and McAdie (2001) assert that most participants fund above Libor, which tends to narrow the basis since they will be willing to accept a lower CDS spread to obtain the funding advantage.

Figure 2

**Cumulative risk neutral default probabilities**

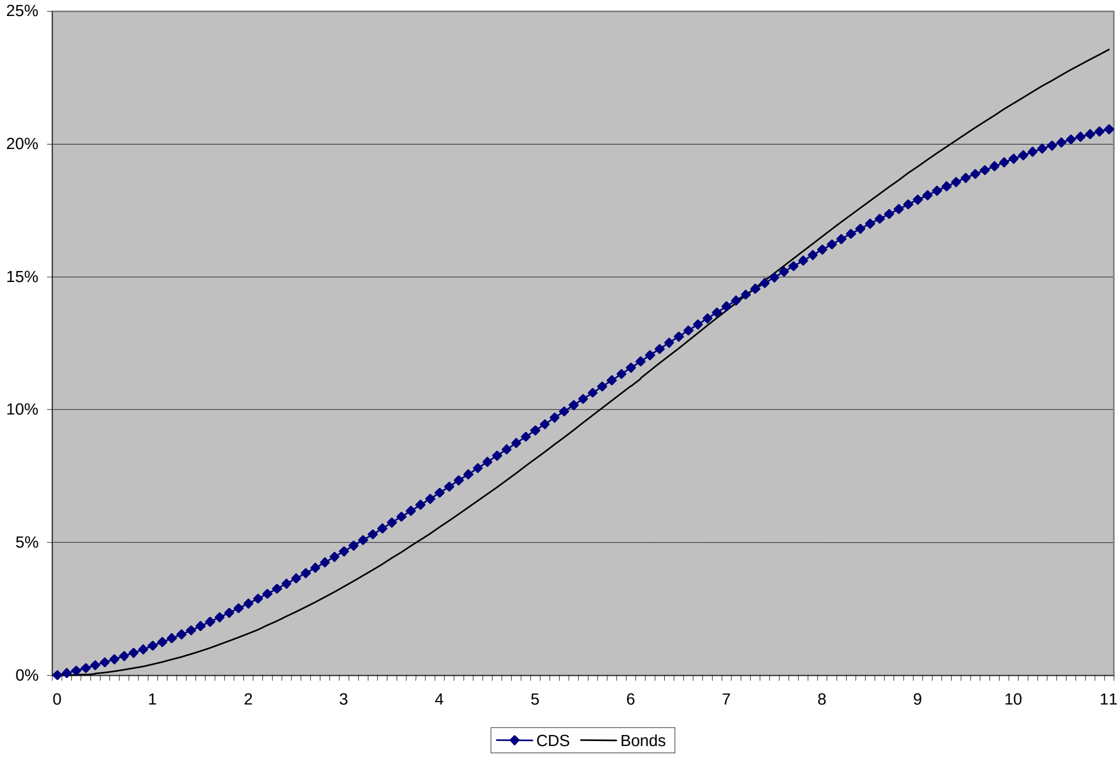
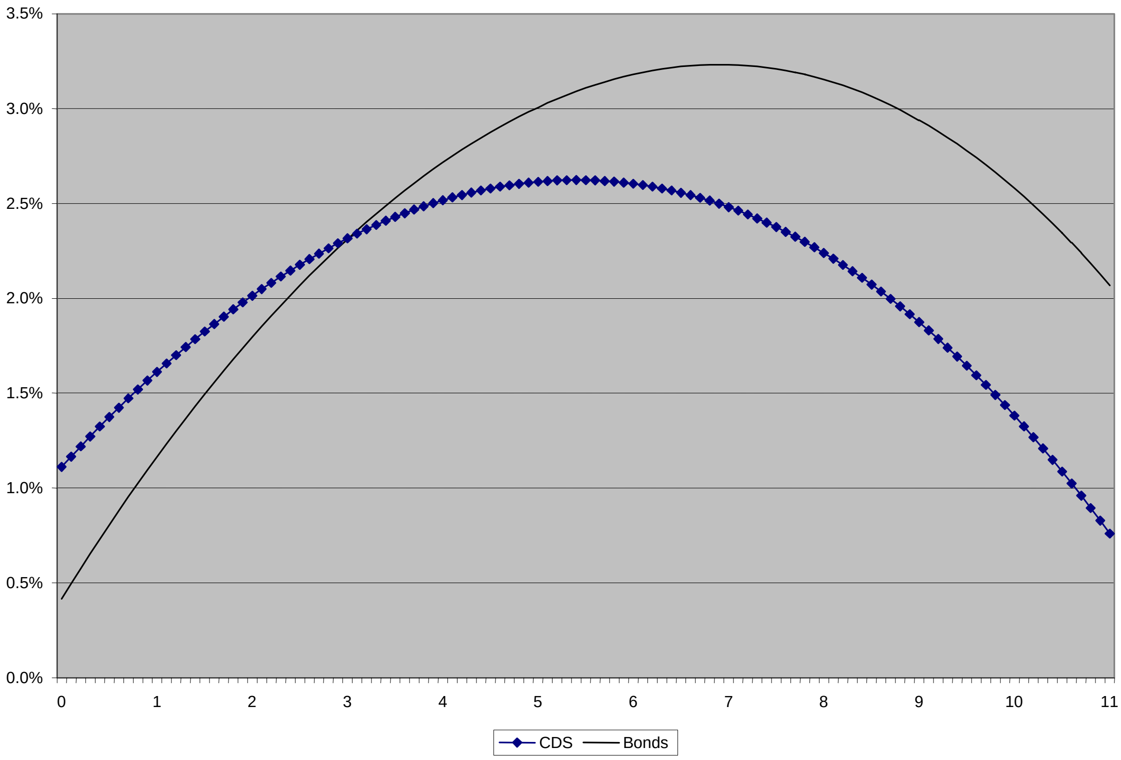



Figure 3

**Conditional risk neutral default probabilities**



- *Counterparty risk*. After settlement, the purchase of a bond is free from counterparty credit risk. A credit default swap is a bilateral transaction, which does entail counterparty risk. Protection buyers face by far the greater proportion of this risk and hence will pay a lower rate than in the absence of counterparty risk. This also tends to narrow the swap basis. Jarrow and Yu (2001) provide a method of pricing CDS subject to counterparty risk.
- *The delivery option in a physically settled CDS*. As mentioned above, it is possible that the protection buyer in a CDS contract has a choice of which exact asset to deliver to the seller. While in theory all equally senior assets issued by the reference entity should trade at the same price following a credit event (since bondholders of pari passu assets have equal claims to company assets), this does not always occur in practice if the event is less than "full default" (defined to be when all obligations become immediately due and payable). The delivery option may be potentially valuable in this situation and this should increase the swap basis. Recent changes to the ISDA documentation on credit swaps relating to restructuring have reduced the value of this option.

Other reasons for the swap basis not being equal to zero are grouped under the heading of "market" factors. These can be further separated into liquidity and demand and supply factors.

- *Liquidity factors*. The relative liquidity of the bond and CDS markets is very different. But the difference is not systematic across maturities. Typically, the CDS market is most liquid at the five-year maturity, followed by the three-year then 10- and one-year points. The bond market is usually liquid wherever on the yield curve the largest outstanding notional amounts lie. Not only is this likely to be at different maturities for different issuers, but it will shift over time for a given issuer as the bonds age.
- *Demand and supply factors*. It is sometimes claimed that the majority of participants in the single name CDS market are risk-takers that want to sell protection (O'Kane and McAdie (2001)). Financial institutions have a comparative advantage in assessing and managing credit risk, and this is most cleanly done by selling CDS contracts. This preponderance of "technical shorts" puts downward pressure on the swap basis.

  The other side of the coin is that shorting a credit can be difficult in bond markets since the supply of bonds on repo is often limited. Market-wide sentiment against a credit will raise the credit spread of that entity's bonds and its CDS rate. But the difficulty of shorting the bond may cause the latter to rise by more, and hence the swap basis increases.

  New issuance in the bond or loan markets leaves banks and underwriters long credit, leading them to buy protection via CDS either to reduce exposure or to free up regulatory capital. While the increased supply should make shorting the bond easier, market participants argue that the demand effect dominates and so the net effect is that the basis again widens.

It is of interest to examine whether the observed divergences between CDS prices and credit spreads demonstrated in Section 4.2 can be explained by fundamental factors, or whether there are serious discrepancies between the two markets. For example, after controlling for fundamental factors, a widening of the swap basis for financial institutions in liquid markets may be indicative of rising fears about general counterparty risk.

There are reasons why the two markets may be separated. Participation in the CDS market is limited to relatively highly rated entities due to the counterparty risk inherent in the swap. However, the bond market is a cash market. It is possible that the more constrained CDS market prices less information, or at least prices it more slowly, than the bond market. However, it is worth mentioning that CDS dealers view the basis as an indicator of credit pressure, given that commercial banks have better information about creditworthiness. They see a widening basis for an individual name, ceteris paribus, as a leading or, at least, current indicator of credit deterioration as informed banks take positions in the CDS market that are subsequently priced into bond spreads, reversing the supposed pricing efficiency.

Apportioning the differences between CDS prices and credit spreads econometrically is hampered by the fact that several of the factors mentioned are difficult to proxy. Essentially, all of the fundamental factors need contract-specific or transaction-specific information. Fortunately, the directions of the impacts of these factors are either indeterminate or partially offsetting. Rieu (2001) contains some initial work in explaining the swap basis for France Telecom in terms of liquidity and demand/supply factors which we now summarise, highlighting areas where further work is needed.

The market factors are more amenable to econometric investigation. Rieu (2001) uses three proxies for relative liquidity:

- *Maturities quoted*. Traded volume is not available for either the CDS or the bond markets. Instead the number of different CDS and bond prices actively quoted each day is used as a proxy. Typically, the higher the liquidity in the two markets, the more bonds/CDS maturities are quoted. The indicator used is simply the number of CDS prices minus the number of bonds quoted on any given day, a rising number indicating relatively more liquidity in the CDS market.
- *Bid-ask spreads*. A more liquid market is usually associated with a tight bid-ask spread. This is just one dimension of liquidity, but it has the clear advantage that it is the easiest to observe. The indicator used is relative spreads (CDS minus bonds), with rising numbers indicating lower relative liquidity in the CDS market. This indicator was maturity-specific since relative spreads could be computed for different maturities.
- *Deviation of observed prices from theoretical levels.* Following Monkkonen (2000), the difference between the largest and smallest absolute deviation of observed bond yields from the fitted yield curve is computed. Similarly, the difference between the largest and smallest absolute deviation of CDS prices from the CDS curve is calculated. The indicator used is the CDS difference minus the bond difference. Again, a higher number would be indicative of lower relative CDS market liquidity.

Finally, a credit protection demand indicator is included. An obvious factor likely to lead to an increased demand for protection is industry downgrading by credit rating agencies. The sample period considered runs from October 2000 to February 2001. The first wave of telecoms downgrades is in the middle of this sample. Rieu (2001) computed a simple indicator that increased (decreased) by unity every time a European telecoms company was downgraded (upgraded), but which decayed towards zero as demand pressures were satisfied in the credit markets. An increase in the demand indicator would suggest an increase in the swap basis as credit protection is more easily acquired by buying protection in the CDS market than by shorting the bonds.

Rieu (2001) applies a fixed-effects panel estimation procedure to the daily swap basis between curves fitted to France Telecom CDS prices and credit spreads over several maturities, using the above four independent variables. The model has to explain large time series changes (the swap basis moves between zero and 100 basis points during the sample) and cross-sectional variation (the term structure of the swap basis altered significantly during the sample, with the basis for longer maturities becoming much more positive than for the short end).

Key findings from the regressions include:

- All four explanatory variables are highly significant with the expected signs. The third liquidity factor (relative divergence from the theoretical spread curves) is statistically and economically the most important of the liquidity factors.
- Over 77% of the variance of the swap bases at various maturities is explained by the four variables.
- The fixed-effects terms indicate relative bond market liquidity at horizons between two and three years and in excess of five years. The CDS market is relatively more liquid below two years and around the five-year mark. This accords with the perceived liquidity rankings across maturities in the CDS market noted above.

These initial results highlight the importance of considering the impact of market conditions on the default probabilities extracted from either credit spreads or CDS prices. The swap basis for the single name considered by Rieu (2001) reached one percentage point during an admittedly volatile period for credit markets. However, a large proportion of the basis can apparently be explained in terms of liquidity and supply/demand imbalances.

Further work is needed to examine whether a similar picture emerges for other reference entities (we are applying similar tests to rates on leading banks), and whether some of the other factors detailed above are important in explaining the swap basis. In particular, we will address the supply side of the credit market. We noted above that new bond issuance by the reference entity (or a similar entity if cross-hedges are employed) increases the supply of shortable bonds but also increases the demand for protection. Incorporating new bond and debt issuance will allow us to test the dominance of one over the other.

## 4. Summary

The academic literature suggests that the credit default swap price should almost exactly equal the credit spread on par floating rate notes. Since par floating rate notes are rare, par fixed rate bonds provide a reasonably accurate alternative. Since par fixed rate bonds are not common, non-par fixed rate credit spreads are often used as an alternative. This paper has shown how expected default probabilities can be extracted from either credit spreads or CDS prices. We have also shown that the two probability profiles can be substantially different.

There are fundamental reasons why the relationship between CDS prices and non-par fixed rate credit spreads are not exactly equivalent. These are recognised by academics and market participants. For example, focusing on one key reason for a deviation, Scott (1998) notes:

"The market convention for pricing new default swaps is to take the credit spreads in the bonds of the reference entity and adjust up or down depending on the expected financing rates for the bonds."

We have also described market conditions that will drive a wedge between the credit spread and CDS price. Further, we have presented preliminary research that suggests that, for one prominent reference entity, the majority of the, sometimes large, observed deviations could be explained by relative liquidity and demand factors.

Some potentially important factors remain unmodelled. The ongoing research project will attempt to incorporate these factors and more fully account for the difference between CDS prices and credit spreads for a wider selection of names. Accounting fully for the swap basis could allow CDS and credit spread data to be pooled, giving a fuller picture of default expectations across a wider range of horizons.

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