Sovereign default probabilities online -
Extracting implied default probabilities from CDS spreads
Basics of credit default swaps

- Protection buyer (e.g. a bank) purchases insurance against the event of default (of a reference security or loan that the protection buyer holds)
- Agrees with protection seller (e.g. an investor) to pay a premium
- In the event of default, the protection seller has to compensate the protection buyer for the loss
What are CDS spreads?

**Definition:** CDS spread = Premium paid by protection buyer to the seller

**Quotation:** In basis points per annum of the contract’s notional amount

**Payment:** Quarterly

**Example:** A CDS spread of 339 bp for five-year Italian debt means that default insurance for a notional amount of EUR 1 m costs EUR 33,900 per annum; this premium is paid quarterly (i.e. EUR 8,475 per quarter)

**Note:** Concept of CDS spread (insurance premium in % of notional) ≠ Concept of yield spread (yield differential of a bond over a “risk-free” equivalent, usually US Treasury yield or German Bund yield)
How do CDS spreads relate to the probability of default? The simple case

For simplicity, consider a 1-year CDS contract and assume that the total premium is paid up front.

Let $S$: CDS spread (premium), $p$: default probability, $R$: recovery rate.

The protection buyer has the following expected payment: $S$.

His expected pay-off is $(1-R)p$.

When two parties enter a CDS trade, $S$ is set so that the value of the swap transaction is zero, i.e.

$$S = (1-R)p$$

$$S/(1-R) = p$$

Example: If the recovery rate is 40%, a spread of 200 bp would translate into an implied probability of default of 3.3%.
How do CDS spreads relate to the probability of default?
The real world case

Consider now the case where
Maturity = $N$ years
Premium is paid in fractions $d_i$ (for quarterly payments $d_i = 0.25$)
Cash flows are discounted with a discount factor from the U.S. zero curve $D(t_i)$
For convenience, let

$$q = 1 - p$$

denote the survival probability of the reference credit with a time profile

$$q(t_i), i=1 \ldots N$$

Assume that there is no counterparty risk
Valuation of a CDS contract in the real world case

For the protection buyer, the value of the swap transaction is equal to

\[
\text{Expected PV of contingent payments (in the case of default)} - \text{Expected PV of fixed payments} = \text{Value for protection buyer}
\]
Computation of the fixed and variable leg

With proper discounting and some basic probability math, you get

\[
P V[\text{fixed payments}] = \sum_{i=1}^{N} D(t_i)q(t_i)Sd_i + \sum_{i=1}^{N} D(t_i)\{q(t_{i-1}) - q(t_i)\}Sd_i
\]

\text{Discounted premium payments if no default occurs}

Accrued premium payments if default occurs between payments dates

\[
P V[\text{contingent payments}] = (1 - R) \sum_{i=1}^{N} D(t_i) \{q(t_{i-1}) - q(t_i)\}
\]

Compensation payment

Prob. of default in respect. period

Note that the two parties enter the CDS trade if the value of the swap transaction is set to zero, i.e. \((1)=(2)\)
Sovereign default probabilities online

DB Research provides a web-based tool to translate CDS spreads into implied default probabilities

Access Sovereign default probabilities online

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