VIII.5 EXPOSURE AT DEFAULT

The **Exposure at Default** (EAD) represents the bank's exposure at the time of default. There can be certain or uncertain amount exposures. In the context of exposures with an uncertain amount, the EAD forecast differs according to the different technical forms. From a regulatory point of view, banks generally estimate this quantity applying this formula:

$$EAD = U_0 + CCF \cdot M_0 \text{ (Eq. VIII.82)}$$

Where U_0 is the current usage, M_0 is the currently available margin, i.e. the difference between the agreed and the current usage; CCF (Credit Conversion Factor) is the rate according to which M_0 can be transformed into cash exposure.

Considering the above formula, it is clear that CCF plays a crucial role in forecasting the EAD. Araten and Jacobs (2001) show that the CCF is a decreasing function of the time between the reference date and the time to default in years (see Table VIII.26).

In other words, reading Table VIII.26 from right to left, as the default approaches, it is more likely to observe a reduction in exposure rather than an increase; this translates into a value of the CCF equal to 72% five years before default, which is reduced by up to 32% one year before default. This evidence is to be interpreted in the light of the increase in the use of available margins upon approaching the default. The two authors also identify an inverse relationship between the value of the CCF and the creditworthiness of the transaction (facility risk grade): a worse rating is generally associated with a lower CCF value and vice versa. This result could be interpreted with a view to reducing credit lines or imposing stricter covenants. Finally, the authors conclude that certain indicators such as the type and extent of the transaction or the sector to which the debtor belongs do not have any relationship with the CCF.

According to the EAD equation and using the historical data in Table VIII.26, the EAD for an exposure with a credit line of 20,000, an available margin of 5,000, a rating equal to B- one year before default would be:

$$EAD = U_0 + CCF \cdot M_0 = 15{,}000 + 26.5\% \cdot 5{,}000 = 16{,}325$$

The EADprediction(Credit_Line,CCF,Available_Margin) automatically performs this calculation taking into account the proper interpolation of the values in the historical Table VIII.26. Once the characteristics of the CCF have been defined for forecasting purposes, it is necessary to question how it can be estimated. As required by Basel 2, the database must be segmented by size, rating and technical form. In the case of a current account credit overdraft, the CCF can be estimated as follows:

$$CCF = \frac{U_t - U_0}{M_0} \text{ (Eq. VIII.83)}$$

Where U_t is the use at the time of default, U_0 is the current usage and M_0 is the available current margin.

Risk Class	1Y	2Y	3Y	4Y	5/6 Y
1. AAA/AA-		12.10%			
2. A+/A-	78.70%	75.50%	84.00%		
3. BBB+/BBB	93.90%	47.20%	41.70%	100%	
4.BBB/BBB-	54.80%	52.10%	41.50%	37.50%	100%
5. BB	32.00%	44.90%	62.10%	76.00%	68.30%
6. BB-/B+	39.60%	49.80%	62.10%	62.60%	100%
7. B/B-	26.50%	39.70%	37.30%	97.80%	
8. CCC	24.50%	26.70%	9.40%		

Table VIII.26 Average of CCFs for revolving credit transactions

From a mathematical perspective, it is not an easy task to estimate the expected exposure of a generic asset at a future time. The example proposed above is based on cash amounts of a revolving credit, as a result, the NPV is the available quantity at the moment of default, which can be estimated using the described methodology. A more complicated case can be represented by a loan with fixed or floating installments. In this case the asset can be modelized like a bond and, consequently, an analyst should compute its NPV at the time of default. For the case of a straight bullet bond, the future cash flows are pre-determined, but the discount rates seen in today's markets are not the same as the zero rates at time of default t. A Monte Carlo method that numerically integrates an SDE (Stochastic Differential Equation) has thus to be implemented. A motion is usually chosen which embeds a mean-reverting effect to this aim like Vasicek or Hull-White dynamics depending on available data. Obviously, the same reasoning can be applied for floaters: in this case we use the information of the projected rates not only for discounting purposes, but also for the determination of the expected future cash flows through the forward rates. This kind of approach can be used in the case of optionality such as cap/floor instruments on the loan using a numeric technique (Monte Carlo with the direct application of the pay-off on the paths) or the closed formulas, being careful to project all the market input data at the time of default.

The problem of the Expected Exposure estimation is also present in the **Credit Valuation Adjustment** (CVA). According to financial literature, the CVA is the difference between the risk free and its price including the risk of default. In other words, it is the cost that must be incurred to cover the risk of counterparty bankruptcy: it is necessary for derivatives whose fair value is positive. It is considered a financial risk measure and it is mainly applied to derivatives which are not collateralized. From a conceptual point of view, the CVA can be considered as the cost of hedging the counterparty risk. Observing the mathematical formula that defines this credit valuation adjustment, the direct relationship with the modern definition of credit risk is clear.

$$CVA = (1 - R)\int_0^T EE(t)dPD(0,t) \quad \textit{(Eq. VIII.84)}$$

Where R is the recovery rate, EE is the expected exposure and PD is the probability of default. The recovery rate is out of the integral because it is constant in financial markets and usually set equal to 40% in accordance with the standardized CDS premium. This choice is reasonable especially if the PD is estimated from Credit