APPENDIX 13A: LHP approximation for credit losses

i) The LHP approximation

The large homogeneous pool (LHP) approximation of Vasicek (1997) is based on the assumption of a very large (technically infinitely large) portfolio. The loss distribution is defined via:

$$\Pr(L < \theta) = \Phi\left(\frac{\sqrt{1-\rho}\,\Phi^{-1}(\theta) - \Phi^{-1}(PD)}{\sqrt{\rho}}\right),$$

where $\Phi^{-1}(.)$ represents a cumulative normal distribution function, PD is the (constant) default probability and ρ the correlation parameter.

ii) The IRB formula details

The Basel II internal rating based (IRB) formula given in Equation (13.1) of the book is based on the above approximation together with the so-called granularity adjustment formula of Gordy (2004). This gives a unexpected default probability which is defined by:

$$PD_{99.9\%} = \Phi\left(\frac{\Phi^{-1}(PD) + \sqrt{\rho}\,\Phi^{-1}(99.9\%)}{\sqrt{1-\rho}}\right) - PD,$$

where the functions $\Phi(.)$ and $\Phi^{-1}(.)$ are the standard normal cumulative distribution function and its inverse.

The correlation parameter above, ρ , is linked to the default probability (PD) according to the following equation:

$$\rho = 0.12 \times \frac{1-\exp\left(-50 \times PD\right)}{1-\exp\left(-50\right)} + 0.24 \times \left(1 - \frac{1-\exp\left(-50 \times PD\right)}{1-\exp\left(-50\right)}\right)$$

In Equation (13.1) in the book, the factor $MA(PD, M)$ is the maturity adjustment that accounts for potential credit migration and is calculated from PD and M according to:

$$MA(PD, M) = \frac{1 + (M - 2.5) \times b(PD)}{1 - 1.5 \times b(PD)},$$

where $b(PD)$ is a function of PD defined as:

$$b(PD) = [0.11852 - 0.05478 \times \ln(PD)]^2.$$

Note that the maturity adjustment is capped at 5 and floored at 1.

 jon@oftraining.com

APPENDIX 13B: Standardised CVA capital formula

In this formula (Section 13.3.2), the movement in the CVA can be seen to be proxied by X_i which is a product of three terms:

$$X_i = w_i.M_i.EAD_i^{total}$$

In order to explain this more easily, we first show the formula for capital (K) assuming there are no CDS hedges involved (although this is not shown in BCBS 2009):

$$K = 2.33\sqrt{h}\sqrt{\left(\sum_i 0.5.X_i\right)^2 + \sum_i 0.75.X_i^2}$$

The formula can be thought of as attempting to quantify in simple terms the increase in CVA from a widening in the credit spread of the counterparties. However, these credit spreads will not be perfectly correlated and there will be a diversification effect. This effect can be seen by assuming all counterparties are equivalent and looking at the capital per counterparty:

$$\frac{K}{n} = 2.33.n^{-1}\sqrt{h}\sqrt{\left(\sum_i 0.5.X_i\right)^2 + \sum_i 0.75.X_i^2}$$
$$= 2.33.\sqrt{h}.X^2\sqrt{0.25 + 0.75/n}$$

This shows that the capital charge per counterparty would decrease with increasing numbers of counterparties, approaching a relative value of 0.5 (Figure 13.1A). This is a result of an implicit correlation of 25% assumed between the different counterparty positions in the formula. This is most obviously interpreted as a credit spread correlation.

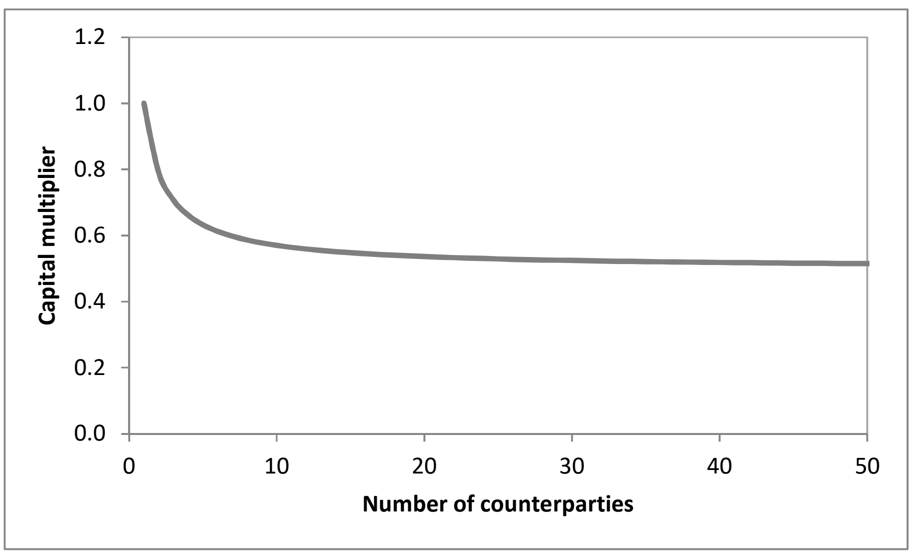

Figure 13.1A. *Impact of increasing number of counterparties on the standardised CVA capital change per counterparty for a homogenous portfolio. The capital multiplier is defined by* $\sqrt{0.25 + 0.75/n}$.

The BA-CVA approach (Section 13.3.3) is similar but with a different parameterisation and the confidence level related term (2.33) and time horizon (h) absorbed into the risk weights.