A Concept Note on Credit Valuation Adjustment (CVA)

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1. Background

Credit Valuation Adjustment (CVA) is a method by which a market participant can adjust the fair value of the derivative instrument, which they are exposed to. It is the price that the investor would pay to hedge the counterparty risk of the instrument, effectively reducing the market value of the instrument by an equal magnitude. CVA became effective under the International Financial Reporting Standards (IFRS) 13 implementation back in 2013. IFRS 13 required that fair value of a contract be measured based on the assumptions of the market participants, which would consider counterparty credit risk in derivatives valuations. Counterparty Credit Risk (CCR) generally arose from OTC derivative transactions and security financing transactions. It is the risk that a counterparty will default before the maturity of a contract and hence will not be able to fulfil its obligations to the other party, as specified in the terms of the contract.

Counterparty credit risk is the risk that the counterparty to a transaction could default before the final settlement of the transaction. In case of a firm's exposure to credit risk through a loan, the exposure is unilateral in nature, whereby only the lending party faces the risk of the loss. However, in terms of a CCR, there is a chance of a bilateral loss. This is so because the market value of the transaction can be positive or negative to either counterparty to the transaction, as it can vary over the length of time to the maturity of the transaction.

2. Different Types of Valuation Adjustment There are different types of valuation adjustments carried out to adjust counterparty risk in the OTC derivatives market. The umbrella term for all such adjustments is

CVA	• Impact of Counterparty Credit Risk • Applicable to uncollateralized derivatives
DVA	• Impact of default on the defaulter's balance sheet • Mirror image of CVA
FVA	• Impact of the cost of funding the purchase of an uncolleralised derivative on a firm's balance sheet • FVA can be a cost or a benefit adjustment, based upon the derivative purchased
COLVA	• Measures the impact of posting collateral for a derivatives position • Compares the borrowing cost of the collateral against the overnight index swap (OIS) rate, which is the market risk-free rate
KVA	• Measures the cost of holding capital according to the Basel III or similar regulatory norms
MVA	• Measures the impact of posting margin against uncollateralised derivative contracts, which are not centrally cleared • Represents the opportunity cost of capital

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known as X-value adjustments (or XVA), where X stands for all types of valuation. Some prominent value adjustments are Credit Valuation Adjustment (CVA), Debit Valuation Adjustment (DVA), Funding Valuation Adjustment (FVA), Collateral Valuation Adjustment (Colva), Margin Valuation Adjustment (MVA) and Capital Valuation Adjustment (KVA).

3. Delving deeper into the CVA

As explained earlier, Credit Valuation Adjustment can be interpreted as the expected value or price of counterparty credit risk. A positive CVA represents a cost to the counterparty that bears a greater propensity to default.

CVA can be calculated as follows:

$$CVA = LGD * \sum EPE\ (t_i) * PD\ (t_i\ ,\ t_{i-1})$$

where,

- i is the ith cash flow out of m period cash flows
- LGD = Loss Given Default, or how much exposure one expects to lose in the event of a counterparty default
- EPE = discounted expected positive exposures for future dates
- PD = marginal default probability

Credit exposure, or simply the exposure, is the amount of loss in the event of a counterparty default and is also known as LGD. It is defined by two components, namely **Current Exposure** which is the exposure at the present moment and the **Expected Positive Exposure**, which is the possible future value, that depends on market movements and other effects such as contractural terms in a contract.

CVA is therefore the process through which counterparty credit is valued, priced and hedged.

4. CVA Calculation for a risky bond

CVA, DVA and other valuation adjustments are calculated on a portfolio basis, by specialised CVA desks, who use sophisticated models to arrive at the fair value of an asset after accounting for counterparty risk exposure. The example below is a simplified example of how the valuation of a risky asset is performed using the CVA method. Let us assume a bank has purchased a bond with 4-year residual maturity from a counterparty in the OTC market. The following table provides the detail of the bond. The coupon rate is 7% and the risk-free rate used to discount the cash flows is 2.5%. The present value of all the cash flows is ₹117.59.

Table 1: Risk Free Bond Details	
Years	4
Coupon	7%
Assumed Risk free rate (rfr)	2.50%
Future Value	100
Present Value	117.59

To calculate the **EPE** faced by the lender over the duration of the bond, we discount the cash flows using the appropriate discount factors. The total sum of the expected exposure values over the duration of the bond gives us the EPE.

For example, there are four distinct expected cash flows at year 1, as illustrated in Table 2 below (Year 1 Expected Exposure). Cash flow at the end of year 1 (CF1) is confirmed at ₹7 per ₹100 of face value. Cash flow at the end of year 2 (CF2) will be discounted by the risk-free rate (rfr) for a period of 1 year, CF3 will be discounted for 2 years, etc. The final cash flow (CF4), including the principal amount will be discounted for a period of 4 years. Adding all the discounted cash flows will give us the expected exposure till year 4 at the end of the 1st year (₹119.8521). The same methodology is to be repeated to arrive at EPE values at the end of year 2 and 3 respectively. At the end of year 4, the final cash flow (CF4) is to be taken at face value, which shall be its EPE at the end of year 4.

Table 2: Calculation of Expected Potential Exposure

Bond Details		Expected Exposure	CF_1	CF_2	CF_3	CF_4	Total Expected Exposure
4-year bond annual payment	7%	t=0 (FV = 100)	t=1	t=2	t=3	t=4	
Discount Rate (rfr)	2.50%	Year 1 Expected Exposure	7	6.83	6.66	99.36	**119.8521**
Assumed Probability of Default	2%	Year 2 Expected Exposure		7	6.83	101.84	**115.6734**
Assumed Recovery Rate	42%	Year 3 Expected Exposure			7	104.39	**111.3902**
Assumed Default Rate	58%	Year 4 Expected Exposure				107	**107**

In the next part of the calculation, we calculate the present value of expected credit loss (ECL) due to default of the counterparty throughout the life of the bond. We have assumed the initial probability of default at 2%. The EPE values in column 2 are taken from Table 2. The Probability of default (PD) in year 2 is conditional upon the counterparty's survival in year 1, and is given by the formula PD = [(1 - PD) * PD]. Similarly, PD at the end of year 2 = [(1 - PD) *(1 - PD) * PD], which implies survival probability in year 1 * survival probability in year 2 * probability of default at year 3, and so on.

Discount factor (DF) for each of the 4 years is calculated using the risk-free rate of 2.5% as earlier. Loss given default is the amount of exposure that cannot be recovered if default occurs. It is calculated by multiplying the EPE with the default rate, which in this example is calculated exogenously at 58%. Expected credit loss or expected loss (EL) gives the expected loss given the probability of default at the end of each year.

Finally, the sum of all present values of ECL, attained by multiplying ECL at the end of each year with the corresponding DF gives us the CVA.

Table 3: Calculation of ECL						
Year	Expected Positive Exposure (EPE)	Probability of Default [PD = (1-PD) *PD]	Discount Factor (DF)	Loss Given Default = Default Rate * Exposure	Expected Loss (ECL) = PD * LGD	PV of ECL = DF*ECL
1	119.8521	2.00%	0.9756	69.5142	1.3903	1.3564
2	115.6734	1.96%	0.9518	67.0906	1.315	1.2516
3	111.3902	1.92%	0.9286	64.6063	1.241	1.1524
4	107	1.88%	0.906	62.06	1.1682	1.0583
					CVA	**4.8187**

Subtracting the CVA value from the market price of the bond (risk free value) gives us the risk adjusted value of the bond (Table 4).

Table 4: Risk Adjusted Bond Details	
Value of the Risk-Free Bond	117.59
Risk adjusted value (Value of the Risk-Free Bond - CVA)	112.7686
Years	4
Coupon	7
Adjusted YTM	3.77%
Face Value	100
Present Value	-112.77

Conclusion

Measuring counterparty credit risk, particularly for OTC derivatives products, has gained greater significance post the Global Financial Crisis, and the resultant liquidity shocks that followed. CVA is therefore critical to institutions who take regular positions in such markets and products, as they have to make provisions for such in their balance sheet, as per Basel norms. Since the topic is relatively new, an industry norm is yet to take shape on which methodology to use for valuation of all XVA techniques.

Central banks around the world, as well as the Bank of International Settlements (BIS), the global institution for overseeing banking related regulations, have started publishing draft guidelines to measure such risks for member institutions. Till a consensus is developed, banks will continue to use methods ranging from simple mark to market (MTM) values of the exposure and discounting them, as explained above, to sophisticated simulation techniques to measure market risk and revalue derivative exposure using such values in a simulated environment, before they arrive at an expected exposure value for each counterparty. Therefore, institutions need to decide on the proper valuation techniques based on their resource constraints, as well the material impact of CVA on their balance sheet, before adopting CVA, as some of the sophisticated

techniques can be resource and capital intensive to deploy, in the first place. An alternative option would be to outsource the valuation process to a third-party service provider.

Reference:

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- Basics Of Credit Value Adjustments and Implications for The Assessment of Hedge Effectiveness, CME Group
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