A Literature Review Comparing IFRS and Basel CVA Methodologies

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ABSTRACT

The financial crisis caused the attention of the financial world to shift to Counterparty Credit Risk (CCR) since it verified that no counterparty could ever be regarded as risk free. Major topics of discussion at this point were the pricing of CCR in the valuation of derivatives and taking CCR into consideration when determining required capital. This is done through a Credit Value Adjustment (CVA), which is the adjustment made to the value of a derivative to include the credit quality of the counterparty. Even though CVA has been used before the crisis, major changes in regulation of both IFRS and Basel concerning CCR now requires bank to calculate CVA.

This study clarifies the concepts necessary to understand and calculate CVA. The regulation of IFRS and Basel regarding CVA are discussed after which the different approaches that are used to calculate CVA are considered. Since IFRS does not specify a method of calculation, the approaches in published guidance of four auditing companies, PwC, EY, Deloitte and KPMG, are discussed.

Differences in the approaches used to calculate CVA for Basel and IFRS were found. This is due to a considerable difference in their objectives. Basel's main focus is on enhanced risk management by including CVA in capital requirements while the IASB's objective is greater transparency and a convergence in approaches of fair value calculations. Another major difference is their stance on Debit Value Adjustment (DVA) which the adjustment made to fair value if there is a change in the credit quality of the entity itself. Basel does not allow DVA to be included for capital requirement purposes while from an accounting point of view it is imperative to consider DVA in fair value calculation.

Key words:

CCR; CVA; DVA; Fair Value; Basel; IFRS; PD; Exposure; LGD; Derivatives

OPSOMMING

Die finansiële krises het veroorsaak dat die aandag van die finansiële wêreld geskuif het na teenparty-kredietrisiko, aangesien dit bewys het dat geen teenparty ooit weer as risiko-vry beskou kon word nie. Groot onderwerpe onder bespreking was die insluiting van teenparty-kredietrisiko in die waardasie van afgeleide instrumente om teenparty-kredietrisiko in berekening te bring wanneer vereiste kapitaal bepaal word. Dit kan gedoen word deur 'n kredietwaarde-aanpassing, wat die aanpassing is wat gemaak word tot die waarde van 'n afgeleide instrument om die kredietwaardigheid van die teenparty in die prys van die instrument in te sluit. Kredietwaarde-aanpassings is al voor die krises ook gebruik, maar groot veranderings in regulasies van IFRS en Basel het daartoe gelei dat kredietwaarde-aanpassings se berekening nou 'n vereiste is.

Hierdie studie verduidelik die konsepte wat nodig is om kredietwaarde-aanpassings te verstaan en te kan bereken. Die regulasies van IFRS en Basel wat verband hou met kredietwaarde-aanpassings word bespreek en daarna word daar gekyk na die verskillende benaderinge in die berekening van kredietwaarde-aanpassings. Aangesien IFRS nie 'n metode van berekening spesifiseer nie, word die benaderings soos gepubliseer deur vier ouditfirmas, PwC, EY, Deloitte en KPMG, bespreek.

Verskille is gevind in die benaderings wat gebruik word on kredietwaarde-aanpassings te bereken vir Basel en IFRS. Dit is as gevolg van beduidende verskille in hul doewitte. Basel se fokus is gevorderde risikobestuur deur kredietwaarde-aanpassing in te sluit in die berekening van kapitaal vereistes terwyl die IASB se doelwitte 'n toename in deursigtigheid en 'n konvergensie in metodes van billikewaarde berekening is. Nog 'n groot verskil is hul siening aangaande Debietwaarde-aanpassing, wat die aanpassing is wat gemaak word tot billike waarde wanneer daar 'n verandering in die kredietwaardigheid van die entiteit self is. Basel laat nie toe dat debietwaarde aanpassings ingesluit word vir kapitaal vereiste berekeninge nie terwyl dit uit 'n rekenkundige oogpunt noodsaaklik is vir billike waarde berekening.

Sleutelwoorde:

Teenparty-kredietrisiko; kredietwaarde-aanpassing; debietwaarde-aanpassing; Billike waarde; Basel; IFRS; blootstelling; Afgeleide Instrument

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LIST OF ABBREVIATIONS

BCBS	Basel Committee on Banking Supervision
CDS	Credit Default Swap
CEM	Current Exposure Method
CCP	Central Counterparty
CCR	Counterparty Credit Risk
CSA	Credit Support Annex
CVA	Credit Value Adjustment
DCF	Discounted Cash Flow
DVA	Debit Value Adjustment
EAD	Exposure at Default
EBA	European Banking Authority
EE	Expected Exposure
EFE	Expected Future Exposure
ENE	Expected Negative Exposure
EPE	Expected Positive Exposure
FASB	Financial Accounting Standards Board
FVA	Funding Value Adjustment
IASB	International Accounting Standards Board
IFRS	International Financial Reporting Standards
IMM	Internal Model Method
IOSCO	International Organisation of Securities Commissions
IRB	Internal Ratings-based

IRS	Interest Rate Swap
LGD	Loss Given Default
MNA	Master Netting Agreement
MtM	Marked to Market
NF	Netting Factor
NN	No Netting
NS	Netting Set
OTC	Over-the-Counter
PD	Probability of Default
PFE	Potential Future Exposure
PVBP/PV01	Present Value of a Basis Point
Repos	Repurchase Agreements
RR	Recovery Rate
RWA	Risk-weighted assets
SA-CCR	Standard Approach for Counterparty Credit Risk
SFT	Securities Financing Transaction
S&P	Standard and Poor’s
VaR	Value at Risk
WWR	Wrong Way Risk

CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

Credit Value Adjustment (CVA) is the reduction in the risk-free value of Over-the-Counter (OTC) derivative assets compensating for the probability of default of the counterparty (European Banking Authority, 2015:32). Even though financial institutions have occasionally applied CVA since the 1990's, it has been one of the main areas of interest since the financial crisis of 2007/2008. CVA losses accounted for nearly 66% of total losses due to counterparty credit risk during the crisis (Bank for International Settlements, 2011; Černý and Witzany, 2014:2).

After the Bretton Wood system collapsed in 1973, many banks suffered large foreign currency losses. In response to these and other disruptions in the international financial markets, the central bank governors of the G10 countries established a Committee on Banking Regulations and Supervisory Practices at the end of 1974. Later renamed the Basel Committee on Banking Supervision, the Committee was designed as a forum for regular cooperation between its member countries on banking supervisory matters (Bank for International Settlements, 2014b:1).

The Basel Committee on Banking Supervision (BCBS) published the first version of Basel III in 2009. Basel III was developed in response to the financial crisis and builds on the Basel I and II. The objective of the reforms is to improve the banking sector's ability to absorb shocks arising from financial and economic stress and thereby reducing the risk of spillover from the financial sector to the real economy. While Basel II specifies a capital charge for counterparty default risk and credit mitigation, risk Basel III now adds a capital charge on CVA, consequently specifying the calculation of CVA (Basel Committee on Banking Supervision, 2011:1-3).

The International Accounting Standards Board (IASB) issued International Financial Reporting Standards (IFRS) 13 *Fair Value Measurement* in May 2011, which is effective from the financial period starting 1 January 2013. The development of IFRS 13 began in 2005 as part of an effort with the Financial Accounting Standards Board (FASB) of the United States of America, to create a common set of global accounting standards. The financial crisis highlighted the importance of a common fair value measurement and disclosure requirements, which IFRS 13 now provides (International Accounting Standards Board, 2011a:1).

1.2 PROBLEM STATEMENT

The financial crisis of 2008/2009 made it clear that no counterparty could ever be regarded as risk-free. CVA charge, which is pricing counterparty credit risk (CCR) into trades, was now becoming the rule and not the exception. Regulatory response to the financial crisis mostly entailed CCR (Gregory, 2012a:6). Due to these changes in regulation, there has been much confusion regarding CVA and related components, such as fair value and Debit Value Adjustment (DVA) (Gregory, 2012a:8). Areas of confusion are for example where IFRS 13 states that credit risk should be considered in the calculation of fair value but there is no specification on how adjustments to include credit risk should be done. There is also the issue of DVA, as Basel III specifies that DVA should not be considered while IFRS 13 emphasises that an entity's own credit risk should be included.

1.3 RESEARCH QUESTION

Can the assumption be made that, when Basel III's requirements regarding CVA are met, compliance to IFRS 13 is implied?

1.4 LITERATURE REVIEW

The objective of this study is to clarify the concepts concerning CVA as defined by Basel and IFRS individually. This entails the calculation of CVA and then comparing the calculation under Basel to generally accepted methods of calculation under IFRS, to determine whether the assumption that the methods are equivalent can be justified.

1.5 IMPORTANCE/BENEFITS OF THE STUDY

The comprehensive literature review will clarify uncertainties regarding fair value adjustments and related terms, since there have been much uncertainty after the IASB implemented IFRS 13. If it can be verified that there is substance in the belief that CVA calculation as defined in Basel III satisfies IFRS, it will simplify the job of risk managers who have to calculate the CVA.

1.6 CONCLUSION

The next chapter will be a literature review to clarify concepts related to CVA, such as fair value, counterparty risk, expected exposure, DVA and other concepts necessary to calculate fair value.

Chapter three will entail two sections: CVA as stipulated by Basel and CVA as described in IFRS. This will also be a literature review of the two parts, providing definitions and explanations of regulation and the methods of calculation of CVA.

In the fourth chapter the methods used to compare the two approaches to CVA calculation will be discussed after which the results will be provided. In the final chapter, a deduction will be made whether or not fulfilling Basel III implies that the requirements of IFRS 13 will be met.

CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION

The CVA calculation can be very technical and there are many terms that need to be understood prior to CVA calculation. In this chapter these concepts (which varies from credit risk to the present value of a basis point) that are necessary to determine CVA will be defined and elaborated on to some extent. The difference between CVA and DVA will be explained, as well as the difference between unilateral and bilateral CVA.

2.2 COUNTERPARTY CREDIT RISK

Counterparty credit risk, or counterparty risk in short, is the risk that an entity accepts when entering a financial contract as there is a probability that the counterparty will fail to fulfil their side of the contract (Brigo, Morini & Pallavicini, 2012:6). We will mainly be considering OTC contracts such as Interest Rate Swaps (IRS) and Credit Defaults Swaps (CDS) however there are other financial contracts such as repurchase agreements (repos) or reverse repos that also include a counterparty risk component. Gregory (2012a:9) considers counterparty risk the most complex financial risk for a number of reasons. Financial risk can be divided into a number of different types of risk such as market risk, credit risk, liquidity risk and operational risk. CCR is a combination of different types of financial risk (mainly market risk and credit risk) which is sensitive to systematic traits and it also mostly involves derivatives which are already very complex financial instruments. In the following subsections rating agencies and Central Counterparties that both involve CCR will be elaborated on, after which the difference between CCR and lending risk will be discussed.

2.2.1 Rating agencies

Rating agencies provide independent analysis on the creditworthiness of a counterparties — they rate their ability to make timely repayments of debt. The three rating agencies that are generally referred to are Moody's, Standard and Poor (S&P) and Fitch. Each company has their own rating notation. Following Moody's notation, the best rating is Aaa, followed by Aa, A, Baa and so forth. Investment grade bonds are bonds with a Baa or higher rating (Hull, 2012:521). Financial risks are difficult to calculate individually, so calculating a risk that is an intersection of two or more risks might seem impossible. Before the financial crisis, companies mainly managed counterparty risk by only entering into contracts with large, triple-A rated companies. This view dramatically changed during the crisis as it became obvious that even triple-A rated companies could default (Gregory, 2012a:18).

2.2.2 Central Counterparties

A Central Counterparty (CCP) is an entity that created to manage risks by superficially creating a market that is between the OTC market and exchange trading. In the trade of a derivative, the CCP positions itself between the counterparties thus becoming the counterparty to both parties in the transaction. The CCP takes all rights and responsibilities of the parties in the transaction and consequently reduces the risk the parties are exposed to as they no longer need to worry about the creditworthiness of their counterparty. Centrally cleared derivatives need to be standardised but still has features of OTC contracts such as being bilateral. The entity trading a centrally cleared derivative does not need as great measure of liquidity that is necessary in exchange traded contracts. CCP's reduce the effects of default of even large counterparties since it fills the position of a type of shock absorber in the market. In a transaction with a CCP, an initial margin needs to be posted. This serves as a shock absorber in the closing out of positions so there is no loss to the CCP in an extreme event. The initial margin will mostly depend on the market risk of the trade while the creditworthiness of the clearing member will have a small impact, if any at all. There is a need for CCPs to find a balance between requiring high margins, to maximize their own credit quality, and low margins which will increase competitiveness (Gregory, 2012a:16, 95, 100, 108).

Regulatory response to the financial crisis mainly concerned counterparty risk which gave rise to the reality that no counterparty could be regarded risk free (Gregory, 2012a:6). In an attempt to try to reduce counterparty risk, there has been an increase in the use of centrally cleared derivatives in the last few years. An OTC contract is a non-standard derivative and is normally private, bilateral contracts and therefore not insured by a form of protection programme. A bilateral contract is a two-sided contract in which the value of the contract can be positive or negative and hence both sides of the contract involves CCR. Centrally cleared derivatives are appealing to investors as they have characteristics of OTC contracts (like being bilateral) but contain less risk (Gregory, 2012a:15-16).

2.2.3 CCR vs lending risk

Credit risk was traditionally considered equivalent to lending risk. Lending risk is the risk that is applicable for funded investments such as bonds, mortgages and credit cards. The main characteristic of lending risk is that there is a notional amount at risk. One of the parties in the contract can lose a maximum of said amount if the other fails to pay. Counterparty risk however differs from the traditional credit risk since the value of the contract is uncertain. The value of a derivative at possible date of default of a counterparty, is the present value of the net future cash flows under the contract. These future cash flows can be very uncertain at the time of calculation and can be either positive or negative. The contract is therefore bilateral so both parties face counterparty risk. The major characteristic that differentiates counterparty risk from other credit risks is that the value of the contract is uncertain not only in size but also in position, as it can change from being an asset to a liability (Gregory, 2012a:22).

There are three levels in which counterparty risk can be considered: trade level, counterparty level and portfolio level. Trade level only considers a specific trade while counterparty level has a broader scope which includes features such as netting agreements and collateral. CVA only deals with the first two levels. Counterparty risk at portfolio level is much more complex and factors such as correlation between the different counterparties (Gregory, 2012a:37).

2.3 INTEREST RATE SWAPS

A plain vanilla IRS is a contract in which one entity pays a fixed rate of interest on a certain notional amount while receiving a floating rate on the same amount for a specified period of time and frequency. A simplified method of calculating the value of an IRS is by considering each part of the IRS as a bond that has coupons equal to the applicable interest rate. The difference between the two bonds can be taken to determine the value of the IRS (Hull, 2012:148,167). The relationships between the various components in this chapter, some which have already been discussed and the others that will follow in the subsequent sections, are illustrated in Figure 1. It indicates that CCR is a result of an OTC contract, an IRS in this case, which can be mitigated by netting or collateralisation. CCPs can also influence the CCR by taking a central role between the entity and it's counterparty. If there is no CCP in a contract, CCR will lead to a CVA when there is a change in the credit quality of the counterparty. For large institutions, credit quality is assessed by rating agencies. The main components used to calculate CVA, as illustrated in figure 1, are Probability of Default (PD), exposure and Loss Given Default (LGD). Exposure can be defined in different ways, depending on the type of calculation done. Expected Exposure (EE) can be divided into two parts: Expected Positive Exposure (EPE) and Expected Negative Exposure (ENE). The adverse correlation of the underlying market variables is known as Wrong-way Risk (WWR) which can lead to a great increase in exposure.

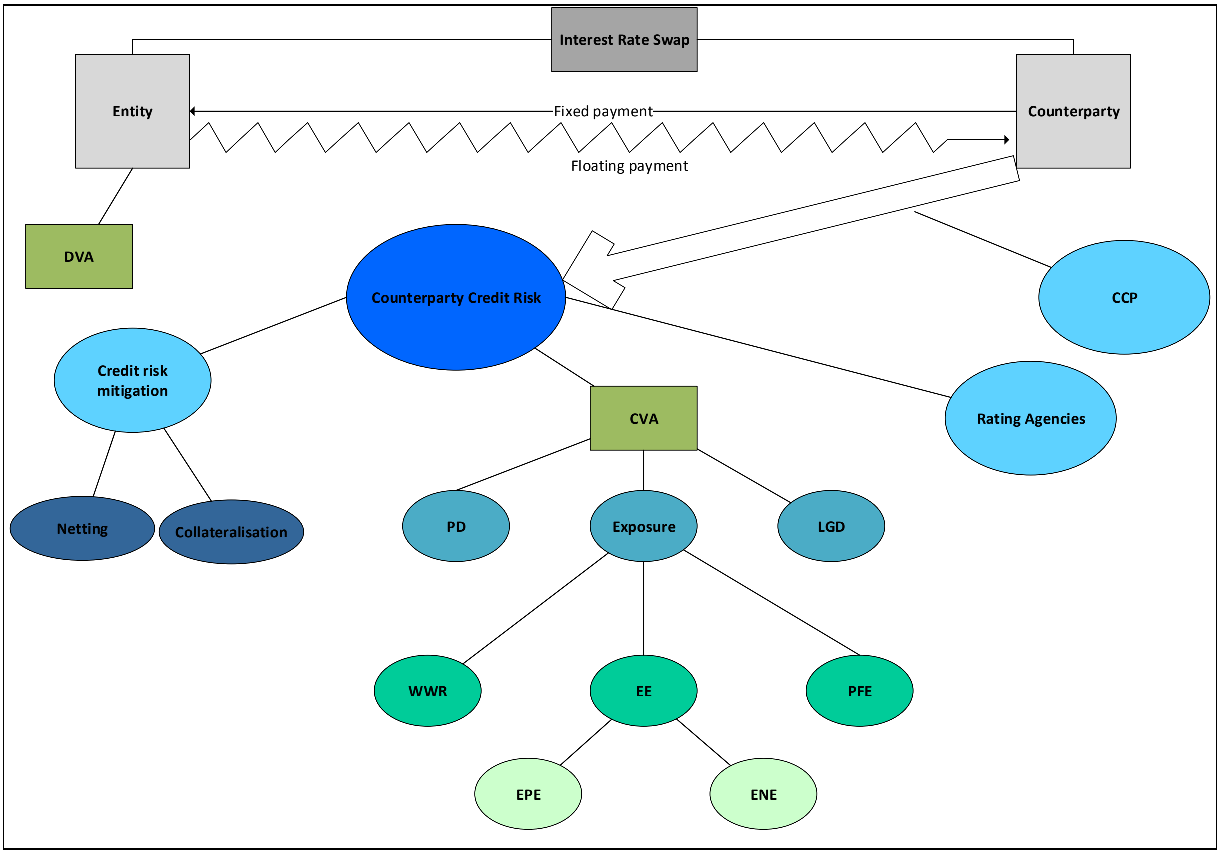

Figure 1: The Risk Components of an Interest Rate Swap

2.4 PROBABILITY OF DEFAULT

PD is the probability of a counterparty not honouring its commitments which mainly occurs due to default of the counterparty (International Valuation Standards Council, 2013:4). In this regard the event of default has to be carefully defined in order to calculate the probability of the event occurring.

Rating agencies produce data that describes the default experienced by bonds with particular ratings consequently simplifying the process of obtaining PDs (Hull, 2012:522). On the contrary, calculating PDs for counterparties in OTC transactions is usually not that simple since it deals with contracts that are not standardised.

2.5 LOSS GIVEN DEFAULT

When an entity goes into default, there will usually be some recovery of losses. A Recovery Rate (RR) is the percentage of the total amount outstanding that the entity will be able to recover given default of the counterparty. The LGD is the percentage that the entity will not be able to recover, i.e. $LGD = 1 - RR$ (Gregory, 2012a:32).

Therefore, the LGD is the percentage of actual loss an entity will encounter when a counterparty defaults (Deloitte, 2013:3).

2.6 EXPECTED EXPOSURE

The estimate of the future portfolio is the exposure profile of the portfolio. Exposure can be divided into positive exposure and negative exposure as the entity can either owe a counterparty money or vice versa. The International Valuation Standards Council (2013:4-5) defines EPE as the discounted value of the forecasted receipts and unrealised gains an entity will receive from their counterparty. Alternatively, ENE is the discounted value of the forecasted payments and unrealised losses an entity will pay their counterparty. A counterparty can default at any time thus the measurement of exposure is very sensitive to change in time (Gregory, 2012a:30).

Say exposure to a specific counterparty at time t can be calculated as a value x, which will be the market value of trades with positive positions at that time. Then the $EPE_t = \max(0, x)$ and alternatively, the $ENE_t = \min(0, x)$ where x will be the market value of trades with negative positions at time t (International Valuation Standards Council, 2013:21). This is due to the bilateral nature of counterparty risk and symmetry which stems from the fact that an entity will make a profit when the counterparty makes a loss and vice versa (Gregory, 2012a:122). Expected Exposure (EE) is conditional on default of the counterparty at a specific time, therefore EE should also comprise of a link between exposure and time of default of the counterparty.

Another risk variable that is of critical importance when calculating expected exposure is Potential Future Exposure (PFE). PFE is the maximum level of exposure in a certain period of time. PFE is calculated at a certain confidence level and therefore is very similar to Value at Risk (VaR) with the main difference being that PFE measures gains and not losses (Gregory, 2012a:127). The difference between PFE and EE is illustrated in Figure 2 below. In this figure, the value of a portfolio is simulated using Monte Carlo Simulation, after which the exposures are determined.

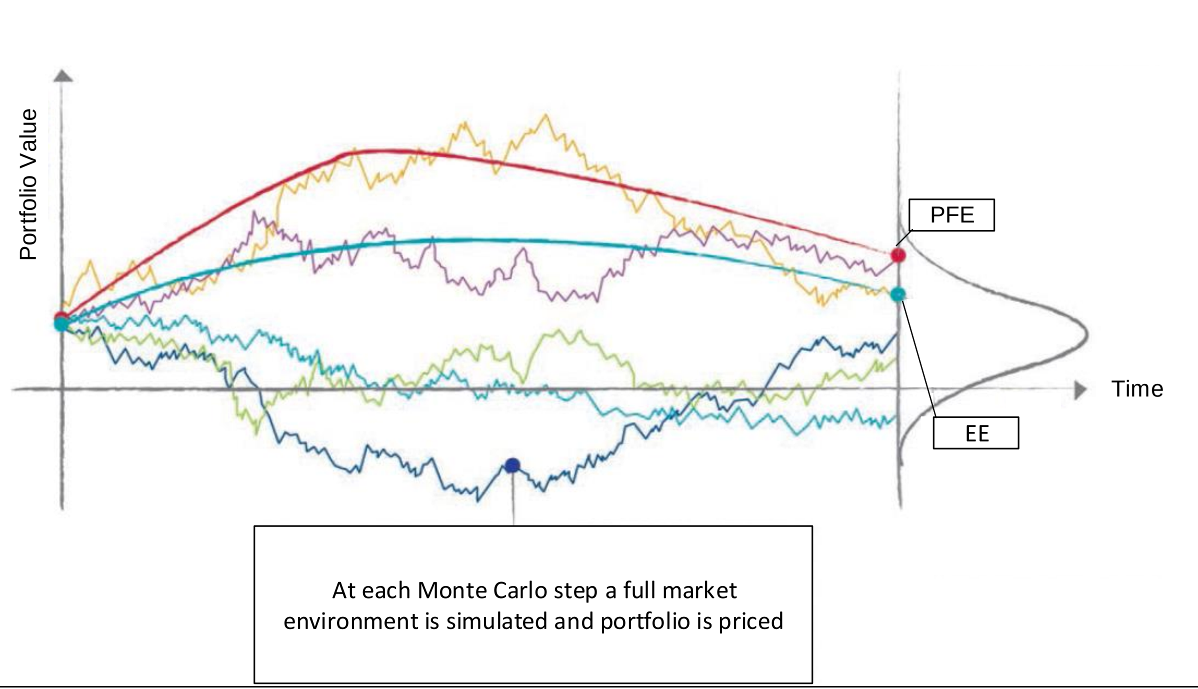

Figure 2: Relationship between EE and PFE

Source: Pugachevsky, Douglas, van den Berg & Silverman, 2014a:3

2.6.1 Wrong Way Risk

The assumption is often made that the credit quality of the counterparty and underlying market factors is uncorrelated; however this is generally not the case. WWR is the event when underlying market risk factors and the credit quality of the counterparty are adversely correlated, which can dramatically increase exposure (Noh, 2013:347).

2.7 CREDIT VALUE ADJUSTMENT

CVA is the adjustment made to the risk free value of a transaction to include the credit quality of the counterparty in the price of the derivative (or other asset). This also is the first type of value adjustment applied in accounting (Pugachevsky, van den Berg & Silverman, 2014b). In the calculation of the value of a derivative, an entity has to consider EPE to calculate CVA while ENE together with the company's own PD and LGD will be used to calculate DVA (International Valuation Standards Council, 2013:8). A simplified calculation of CVA is generally accepted to be:

$$CVA = PD \times LGD \times EE \quad (2.1)$$

The notion of CVA is simplified by Gregory (2012a:6) as the price of counterparty credit risk. It is a convenient measure since it captures both credit risk (through PD) and market risk (through expected exposure) in a single measure (Gregory, 2012a:19). It calculates the price of default risk, after considering the effect of netting agreements and collateral for a specific counterparty and can be priced into trades by means of the CVA charge (KPMG International Standards Group, 2012:18).

2.7.1 The difference between banking book CVA and trading book CVA

Trading book CVA is a Marked to Market (MtM) item and thus is regularly reevaluated to reflect current market conditions of the underlying variables while banking book CVA is a quantitative estimate (Hull, 2012:777). Because the banking book CVA is an estimate and not MtM, trading book CVA is naturally much more volatile and also more important as it reflects market conditions.

2.7.2 CVA prior to the crisis

CVA is not a new concept but rather an old concept now applied in a new way. Before the crisis, CVA was a quantitative estimation of expected losses owing to counterparty risk. This was treated as a banking book item which is an item on a bank's balance sheet that is expected to be held until maturity, while trading book items are required to be MtM daily. Hence, since CVA did not change very often, as it was not MtM daily since it was not a trading book item (Gregory, 2012a:19).

Credit limits were traditionally used in counterparty risk management. These limits would then allow an entity to decide whether or not to enter into a contract with a specific counterparty. If the given contract would lead to a credit risk level greater than the limit, the entity would not enter into the contract. In other words, an entity would decide whether or not to enter a contract only based on the risk of the contract and would measure the return related to that risk. By using CVA to price the risk, an entity can see the bigger picture in order to determine if the contract would be profitable considering the risk it entails (Gregory, 2012a:36-37).

2.7.3 Unilateral and bilateral CVA

There are two forms of CVA: unilateral and bilateral. Bilateral CVA can further be split up in contingent and non-contingent. This simplest form of CVA is unilateral CVA in which only positive exposures are used to calculate the value of the derivatives after an adjustment for probability of default is made. This valuation is considered as a charge which is done relative to the risk-free valuation. In the case of unilateral CVA, DVA, which considers negative exposures, is not calculated.

Non-contingent bilateral CVA models are very similar to that as unilateral CVA. The calculation of CVA is done in the same way as in the instance of unilateral CVA but a unilateral DVA which is symmetric to the unilateral CVA is computed in an equivalent approach.

Therefore the CVA and DVA are essentially calculated individually after which they are added together to determine a net value.

The second form of bilateral CVA is contingent bilateral CVA. In this approach, the CVA and DVA is calculated at each time step after which the difference between the two is determined to calculate the net value at each point in time. These net values can be either positive or negative, subject to which counterparty has the greatest probability of default and the relative exposures. The final contingent bilateral CVA is then determined by calculating the sum of the net CVAs or DVAs at each point in time (International Valuation Standards Council, 2013:15-16).

2.8 DEBIT VALUE ADJUSTMENT

Debit Value Adjustment is the adjustment made to the value of derivative liabilities to reflect an entity's own creditworthiness (International Valuation Standards Council, 2013:3). It reduces the effects of losses due to increases in CVAs by taking the PD of the entity itself into account. Hence DVA is CVA from the counterparty's perspective.

There is a great deal of controversy regarding DVAs since in an accounting environment; an increase in DVA (which is a measure of the deterioration of an entity's own credit quality) will increase the entity's profits in their financial statements (Gregory, 2012a:7). DVA is the amount added to MtM value to account for expected gain from own default. Many companies use an accounting system that incorporates the impact of bilateral counterparty risk. Allen (2013:521) argues that no matter what this method's worth is in an accounting environment, it should under no circumstances be used in risk management calculations like CVA. He continues by stating that a firm cannot find any advantage in its own default and thus, by including it in calculations, creates a distorted picture. This approach is questionable even in accounting as a decrease in a company's own credit quality will increase profits in short term but it will be at the expense of investor confidence.

A study done by the European Banking Authority (EBA) confirms that DVA remains a controversial issue. Their studies found that while some banks do not include DVA for pricing and risk management purposes, they would still include it for accounting purposes. The EBA also came to the conclusion that certain banks will use different methods of calculation for accounting purposes than for pricing and risk management. They consider one of the main issues regarding DVA: the reality that DVA cannot easily be hedged against since it would result in WWR. Consequently, banks rather hedge unilateral CVA (European Banking Authority, 2015:21).

2.9 MITIGATION OF CCR

2.9.1 Netting

The Master Agreements is a document that govern transactions between two parties. It has become standard in the Master Agreements for OTC transactions to include a clause regarding netting referred to as the Master Netting Agreement (MNA) (Hull, 2012:534). The netting clause states that when counterparty A defaults on a transaction with counterparty B, A defaults on all transactions with B. The net amount of all the transactions between the parties can be calculated. This in effect reduces the credit risk an entity is exposed to quite significantly. Hull (2012:534-535) illustrates this by considering an entity that has a portfolio of k transactions with a specific counterparty, V_i is the present value of transaction i and RR the recovery rate. If netting is ignored, the entity could lose

$$(1-RR)\sum_{i=1}^{k}\max(V_i,0)\,,$$

while when netting is considered the loss is

$$(1-RR)\max\left(\sum_{i=1}^{k}V_i\,,0\right)$$

The objective of a netting agreement is not to help the defaulting entity, but rather for the benefit of the remaining counterparty. The implementation of netting can reduce the level of exposure to the counterparty significantly however the exposure will be much more volatile (Gregory, 2012a:43). This level of reduction ($\%R$) in exposure levels can be calculated as

$$\%\mathrm{R} = 1 - \mathrm{NF} = 1 - \frac{\sqrt{n+n(n-1)\bar{\rho}}}{n}\,, \qquad (2.2)$$

where NF is the netting factor, n the number of exposures and $\bar{\rho}$ the average correlation between the exposures. The netting factor is the percentage of exposure after netting has been implemented (Gregory, 2012a:140). For the derivation of Equation 2.2, see Appendix A.

2.9.2 Collateralisation

Collateralisation, otherwise known as margining, is another process that can be implemented to reduce credit risk. A collateralisation clause will specify that an entity must value their derivative transactions with a counterparty periodically. This valuation is to determine whether the value of the transactions is above a specified level. When the value is above that level, the entity must have a cumulative collateral of at least the difference between the threshold level and the current value. Alternatively, if the value of the transactions moves so the cumulative value of the margin posted is greater than the calculated difference, the margin can be reclaimed. However, if the entity defaults, the counterparty can claim the collateral. So the use of collateralisation decreases potential future losses due to default of a counterparty (Hull, 2012:537). The Credit Support Annex (CSA) is at the core of collateral agreements. The parameters of the agreement such as the threshold and the minimum transfer amount will be defined and the CSA will govern all issues regarding the collateral agreement.

2.11 CREDIT DEFAULT SWAPS

Hull (2012:802) defines a CDS as an instrument in which the holder has the right to sell an asset at face value in the event of default of the issuer. In a CDS the risk of default of a counterparty is shifted from one entity to another. An entity can buy protection by paying a premium (which can be either periodic or upfront) to the seller. This will then serve as an insurance for a specific notional amount for a given reference entity. If this entity experiences a credit event, the seller must compensate the buyer for the loss. Compensation will happen according to a pre-specified procedure. It is not necessary for the buyer or seller to obtain the reference entity's permission to enter into a CDS since the entity is not a party to the contract (Gregory, 2012a:212).

2.12 SECURITIES FINANCING TRANSACTIONS

Transactions in which securities are used to borrow or lend cash are known as Securities Financing Transactions (SFTs). Examples of SFTs are repos, reverse repos and securities borrowing and lending. In these transactions the ownership of the security will temporarily be exchanged for cash or vice versa. After the transaction both parties will be in the same position as before, except for a small fee which will depend on the type and purpose of the transaction (London Stock Exchange Group, 2015).

2.13 RISK NEUTRAL VS REAL WORLD MEASURE

A risk neutral world is an environment where the assumption is made in valuing a derivative that investors are risk neutral and consequently there are no adjustments made to the required return to compensate for an increase in risk (Hull, 2012:257).

Gregory (2012a:150) states that in risk management applications risk neutral measure should never be used, concluding real world measure should be used instead. Risk-neutral variables are generally used in pricing CVA but real-world parameters are necessary for models such as PFE.

2.14 RISK FACTOR SENSITIVITIES

2.14.1 Duration

Conradie (2014:63) defines duration (or Macauly duration) for a bond that has cash flow c_i at time t_i with $0 < t_i < n$ and a yield y_i (compounded continuously) as:

$$\mathrm{D} = \frac{\sum_{i=1}^{n} t_i c_i e^{-y_{ti}}}{\sum_{i=1}^{n} c_i e^{-y_{ti}}}$$

2.14.2 Present Value of a Basis Point Move (PV01)

Another measure of interest rate sensitivity is the Present Value of a Basis Point Move (PVBP) or PV01 in short. This measures the impact of a one basis point downward move of the entire zero curve on the present value of a sequence of cash flows. An important feature of PV01 is that it can be applied to any sequence of cash flows, whether positive or negative (Conradie, 2014:66-67).

If a vector $\boldsymbol{c}$ of cash flows with c_i the cash flow at time i and an associated set of zero coupon risk-free spot rates as vector $\boldsymbol{r}$ are defined as $\boldsymbol{c} = [c_1, \dots, c_n]'$ and $\boldsymbol{r} = [r_1, \dots, r_n]'$, then the present value of the set of cash flows will be:

$$PV(\boldsymbol{c}, \boldsymbol{r}) = \sum_{i=1}^{n} \frac{c_i}{(1 + r_i)^i}$$

Now define $\boldsymbol{r}^- = [r_1 - 0.01\%, \dots, r_n - 0.01\%]'$ .The present value of a basis point for cash flows $\boldsymbol{c}$ and spot rates $\boldsymbol{r}$ is:

$$PV01(\boldsymbol{c}, \boldsymbol{r}) = PV(\boldsymbol{c}, \boldsymbol{r}^-) - PV(\boldsymbol{c}, \boldsymbol{r})$$

2.15 CONCLUSION

The various component necessary to understand and calculate CVA were described in this chapter. This serves as a basis for the calculation of CVA and will now be utilised in the subsequent chapters. Chapter 3 will focus on the regulations that govern accounting and capital requirements of banks, i.e. IFRS and Basel, with a focus on the changes made in the past few years. The fourth chapter will describe various approaches of the calculation as applied in practise and includes a summary of a study done by the EBA. The final chapter is a summary of the research and states open questions on the topic of fair value and CVA calculation.

CHAPTER 3
THE BASICS OF THE REGULATION

3.1 INTRODUCTION

In this chapter, the regulatory bodies that determine requirements regarding CVA will be discussed. The first of these is the Basel Committee on Banking Supervision, with the objective of providing guidelines and standards to improve banking internationally. The second entity is the IASB which is the body that is responsible for the development of the IFRS. A brief history of the development of the three Basel accords will be given with a focus on Basel III, which is the latest edition to these accords. Furthermore, IFRS will be discussed with special attention to IFRS 13 which concerns CVA.

3.2 BASEL

3.2.1 The history of Basel I and II

A committee on banking regulations and supervision was established in 1974 by the leaders of the central banks of the G10 countries in a time of financial market turmoil owing to the breakdown of the Bretton Woods exchange rate system. The committee was later renamed the BCBS. Their objective is to enhance international financial stability by reducing the effect conflicting regulation has on banks with international operations and improving the quality of banking supervision universally (Bank for International Settlements, 2014a:1).

The BCBS is not a formal authority and has no legal force. They only provide supervisory guidelines and recommendations to reflect their interpretation on the current best practice (Gregory, 2012a:372-373). This is done by setting a minimum standard and by sharing approaches on banking methods and developments which national authorities can apply accordingly in the development of their national banking regulation (Bank for International Settlements, 2014a:1).

After the groundwork on supervision was done, the Committee's attention shifted to capital sufficiency as there were concerns that the capital ratios of foremost international banks were declining at a time of great increase in international risks. *The Basel Capital Accord*, otherwise known as Basel I, is a capital measurement outline and was introduced in July 1988. This Accord specified a minimum capital to risk-weighted assets ratio of 0.08. Some amendments to improve precision were made in 1991, 1995 and 1996 (Bank for International Settlements, 2014a:2-3).

The BCBS released a proposal in 1999 for a new capital adequacy framework to replace Basel I. This is now known as the *Revised Capital Framework* or Basel II and was issued in June 2004. Basel II has three pillars: the first is an expanded version of the minimum capital requirements as in Basel I; the second pillar is a supervisory review process that evaluates a bank's internal systems and capital adequacy; and finally the third is a disclosure requirement that is implemented to enhance market discipline. These pillars of Basel II are regarded as the pillars to financial stability (Bank for International Settlements, 2014a:3).

After Basel II, which mainly concerned the banking book, was issued, the BCBS's attention shifted towards the trading book. A document concerning the treatment of trading books was issued in 2005 while working in collaboration with the International Organisation of Securities Commissions (IOSCO). In the following year, this document was combined with Basel II in *Basel II: International Convergence of Capital Measurement and Capital Standards: A Revised Framework-Comprehensive Version* (Bank for International Settlements, 2014a:3).

3.2.2 Basel II to Basel III

It became clear even before the financial crisis of 2008 that it was necessary to revise the Basel II framework. The BCBS issued *Principles for sound liquidity risk management and supervision* in the month that Lehman Brothers collapsed. New capital and liquidity standards were approved at the G20 Summit in November 2010. These standards were issued in December of the same year and titled *Basel III: International framework for liquidity risk measurement, standards and monitoring* and *Basel III: A global regulatory framework for more resilient banks and banking systems* (Bank for International Settlements, 2014a:4). Figure 2, adapted from Chabanel and Wyle (2012:3), describes the framework of Basel III and where CVA fits into the Basel framework. The three pillars as mentioned in the previous section are illustrated. The first pillar consists of three subsections which are the leverage ratio, capital requirements and the liquidity ratio. CVA forms part of the capital requirement under the Risk-Weighted Assets (RWA) section. RWA is the requirement that a bank's assets and off-balance sheet exposures should be weighted according to risk. These risks, as illustrated, are Market Risk, Credit Risk and Operational Risk. There were no changes made from Basel II to III in the operational risk requirements, but major changes were made to the credit and market risk requirements. One of these, which is a combination of credit and market risk is CVA and falls under CCR. Another new concepts included in this figure is internal ratings-based (IRB) approach. IRB approach is the capital requirement method that only banks that meet certain requirements and that are approved may apply and will be discussed in more detail in the next chapter.

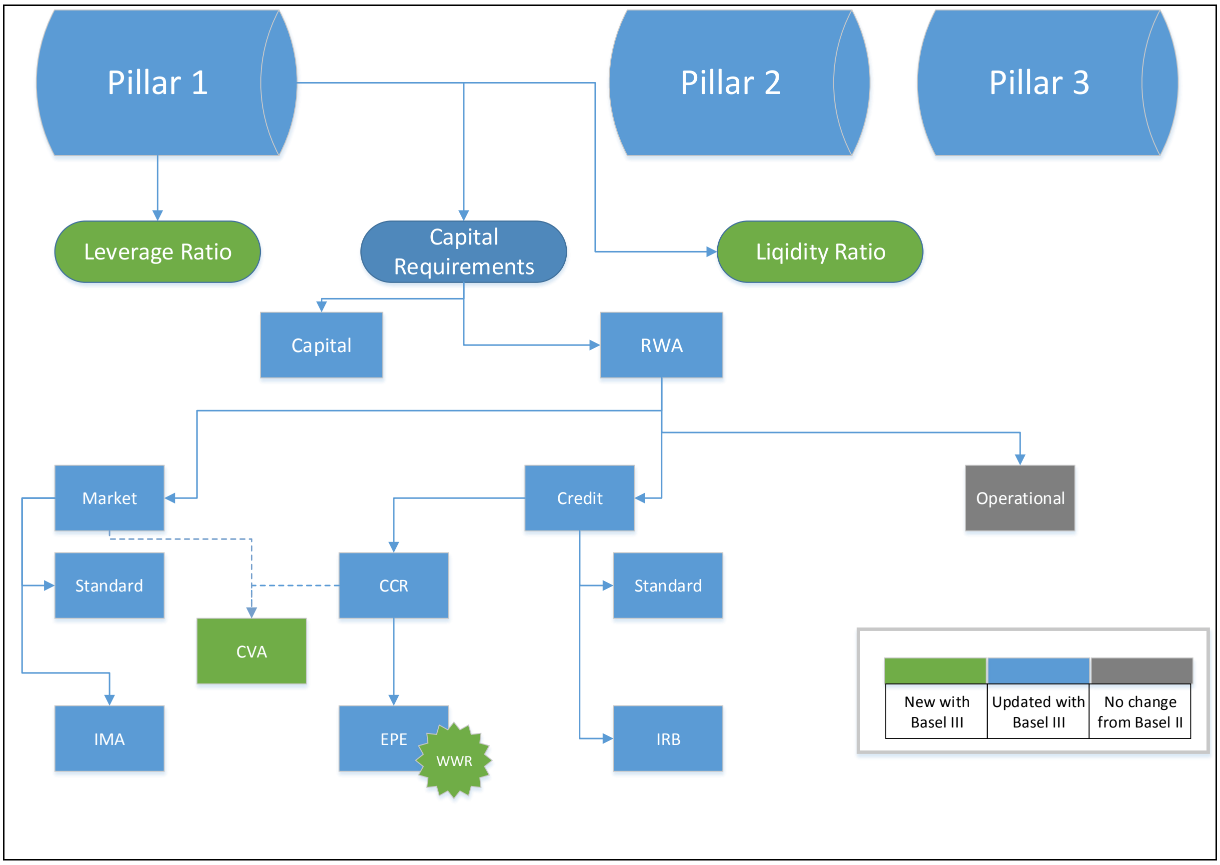

Figure 3: Basel III framework

3.2.3 Capital requirements

In correspondence to Basel III, the total regulatory capital that a bank is required to have will consist of two parts referred to as Tier 1 and Tier 2. The first tier has two subsections which are Common Equity Tier 1 and Additional Tier 1. Each of the sections of capital has specific requirements as stipulated in Basel III (Basel Committee on Banking Supervision, 2011:12-27). Since banks are businesses with a natural desire to increase profit, they try to maximise the amount of business they do by holding the minimum amount of capital possible. For this reason there is a minimum capital requirement that a bank needs to hold in order control the amount risk exposure (Gregory, 2012a:371). In Basel III, banks are required to allocate CVA capital for possible MtM losses owing to deterioration in credit quality of a counterparty (Noh, 2013:347). The approaches that are applied to calculate the CVA charge differ for various banks and will be dependent on whether a bank has the approval to use the internal method model or not (International Valuation Standards Council, 2013:27).

The BCBS does not deem it appropriate to consider DVA when determining a bank's required capital. The reason for this is that, when an entity's creditworthiness decreased, it will lead to an increase in DVA. This will cause a decrease in the liabilities of the entity and consequently increase its equity. Even though there has then been an increase in equity, the creditors' claims have not decreased nor has the bank's solvency position changed (International Valuation Standards Council, 2013:27).

In Basel III paragraph 75, which is added as an excerpt in Appendix B, the Basel Committee on Banking Supervision (2011:23) states that any unrealised gains or losses due to a change in fair value of liabilities, because of a change in creditworthiness of the entity, should not be recognised in the calculation of Common Equity Tier 1. This implies that even though DVA is calculated and declared in an entity's financial statements, it should not be included when calculating regulatory capital (International Valuation Standards Council, 2013:27). CVA for the capital risk charge should be calculated for all OTC transactions except those with a qualifying CCP (European Banking Authority, 2015:32).

3.3 IFRS

The IFRS is a set of accounting standards developed by the IASB which is an independent non-profit organisation in the private sector. IFRS 13, the standard on fair value measurement, was the result of a need for common practice in fair value measurement. Certain IFRSs either allow or require entities to report assets, liabilities or equity at fair value. These standards were established over many years which gave rise to a lack in common practice of fair value disclosure. Some of the standards that incorporated fair value gave restricted guidance in fair value measurement while others gave more detailed guidance. As a result discrepancies in the requirements have created some uncertainty regarding financial statements' comparability (International Accounting Standards Board, 2011b:A498). The IASB (2011b:B983) emphasises that IFRS 13 does not describe what is being measured but rather how it is measured, therefore providing a single framework for the measurement of fair value.

Before understanding IFRS's regulation on fair value, there are a few additional terms that have to be defined. The first is that of an exit price, as it is key the explanation of fair value. The IASB (2011b:A523) defines an exit price as the price that would be received to sell an asset or paid to transfer a liability. Fair value is calculated as the exit price of an asset or liability in an orderly transaction between market participants at the measure date (International Accounting Standards Board, 2011b:A501). Using an exit price to define fair value is, according the IASB (2011b:B981), always the appropriate method as it is a reflection of expected future cash inflows and outflows for the entity that holds the asset or owes the liability. The second concept is that of non-performance risk as it slightly differs from credit risk. Non-performance risk is the risk that an entity will not fulfil an obligation which includes but is not merely an entity's credit risk (International Accounting Standards Board, 2011b:A525).

The inputs used in valuation techniques has a specific order of preference and is displayed in Figure 4 below. It is referred to as the IFRS hierarchy with level 1 inputs being preferred above level 2 and level 2 above level 3. The hierarchy's purpose is to maximise the use of market observable inputs and to minimise the use of unobservable inputs (International Accounting Standards Board, 2011b:A515-A518).

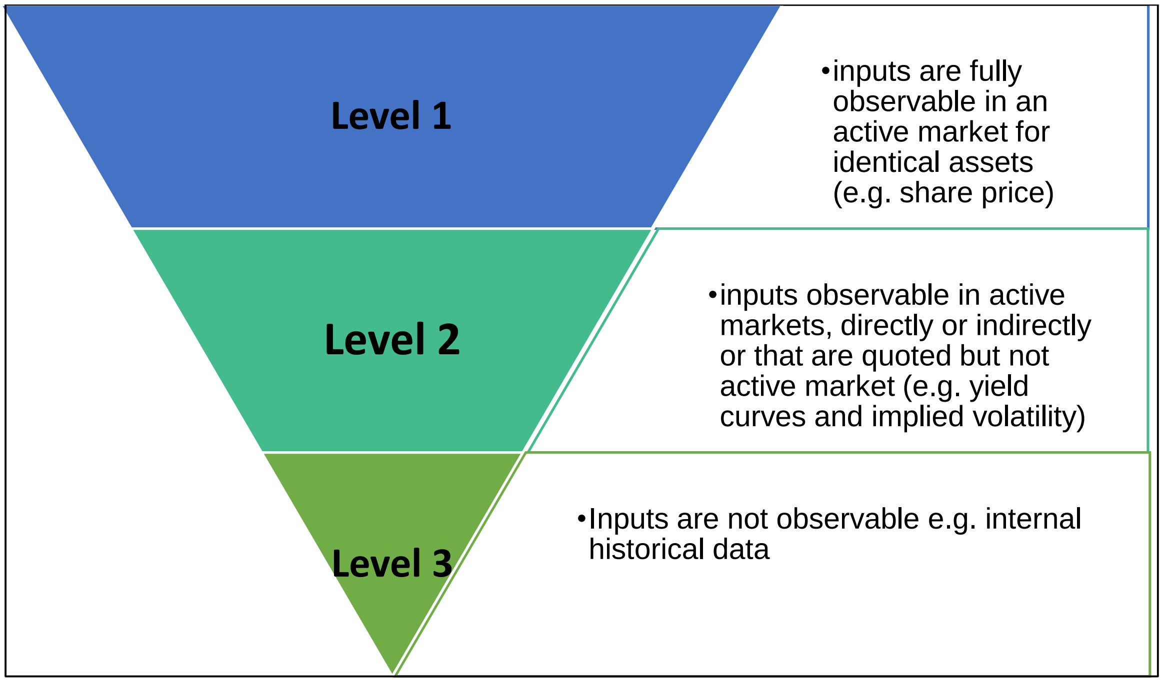

Figure 4: The IFRS fair value inputs hierarchy

Level 1 inputs are not allowed to be adjusted, except under very specific circumstances which are described in *A Guide through IFRS's* section on IFRS 13 paragraph 79 (International Accounting Standards Board, 2011b:A515-A516). These adjustments are sometimes necessary as Pugachevsky *et al*. (2014a:2) explains that for level 1 instruments that are traded in an active market where the quoted price represents the exit price, IFRS 13 requires instruments to be stated at the market price without any further adjustments, but unfortunately quoted prices do not always represent fair value.

The second level of inputs are those that are observable but not in active markets or inputs other than the quoted price in an active market. This includes yield curves, implied volatilities and credit spreads. Adjustments may be made to level 2 inputs but if the adjustment is very significant, the input might have to be categorised as a level 3 input which are unobservable inputs. These inputs are only allowed to be used to measure fair value in the instance where the observable inputs are not available such as calibrated inputs or inputs from historical data that is internally available. Level 3 inputs often reflect a view on risk which is a necessity in the measure of fair value since if risk was not included in the value, it would not be fair value (International Accounting Standards Board, 2011b:A517).

In the case where more than one level of input is used to determine the fair value of an asset or liability, the fair value measurement must be classified according to the lowest level of input (assuming that it is significant) in the fair value calculation (IASB, 2011b:A550). This discourages the use of especially level 3 inputs which in turn leads to greater transparency in fair value measurement. The classification of inputs in the measurement of fair value increases consistency and comparability of fair value measurement in different financial reports (PwC, 2015a:3).

3.3.1 Non-Performance Risk

According to the IASB (2011b:B994) the fair value of a liability will reflect the influence of non-performance risk when fair value measurement is done under IFRS 13. Even though other standards such as IFRS 9 and IAS 39 did mention making adjustments for credit risk, it did not specifically emphasise that adjustments should be included for the reporting entity's own credit risk. This led to inconsistencies in practice where some entities included own credit risk in fair value measurement while others failed to. Therefore, the IASB redefined fair value in IFRS 13 and makes it clear that non-performance risk, which includes DVA, should be included in fair value measurement.

3.3.2 Applying netting under IFRS 13

There is an exception to calculating CVA on an instrument-by-instrument basis that can be made when specific criteria are met. In this case a group of assets and liabilities could be considered as a net set and the adjustment would be calculated when the price is determined at which a net asset position could be sold or paid to transfer a net liability. Hence, the fair value of the group of financial assets and liabilities consistently would be measured as the price of the net risk exposure at the measurement date (European Banking Authority, 2015:17).

3.4 CONCLUSION

It is clear that the two bodies, BCBS and the IASB have different objectives. Regulation regarding CVA has been implemented in both IFRS and Basel since the financial crises, but for different purposes. While Basel's focus is on regulating capital and ensuring that banks do not take excessive amounts of risk given their capital at hand, IFRS ensures transparency and convergence in the approaches of fair value measurement.

The one major difference between Basel and IFRS is the interpretation of DVA. The BCBS does not allow the inclusion of DVA since a decrease in a bank's credit quality will by DVA lead to an increase in equity although the bank's solvency position has not changed. The conclusion of the BCBS is that DVA should therefore not be included for risk management purposes. However, in IFRS 13 the definition of non-performance risk clearly states that an entity's own risk should be included in the measurement of fair value. DVA therefore is a critical part of fair value measurement for financial statement purposes. The effect of this difference in view on DVA is that companies include DVA for accounting purposes but not for risk management. In the next chapter some details regarding calculation of CVA will be discussed and the approaches of the big four South African auditing companies will be considered. The final chapter is a summary of the findings of this research and open questions for further research will be stated.

CHAPTER 4

METHODS

4.1 INTRODUCTION

The different methods of calculation of CVA will be discussed in the three subsectors of this chapter. Firstly, the Basel methodologies will be discussed in which the focus will be on the standardised approach of calculation. In the second subsection different approaches that are applied in accounting is considered. The approaches according to published guidance of the big four auditing companies in South Africa will be discussed. Finally, a short summary will be given on the findings of a study on CVA practices by the EBA and a standard approach to CVA calculation.

4.2 BASEL

Basel III contains major additions and modifications made to Basel regulations especially in the section on Risk Coverage, which the BCBS (2011:29) justifies by stating:

> *"Failure to capture on- and off-balance sheet risks, as well as derivative related exposures, was a key factor that amplified the crisis."*

In this section on risk, a new subsection which consists of nine new paragraphs that involves CVA was added. These paragraphs are added in Annex 4 and numbered 97 to 105. There are two types of transactions that can be excluded when calculating CVA regardless of the bank's method of calculation. These transactions are those with a CCP or SFT transactions except when the bank's supervisor considers the exposure arising from the SFT significant (Basel Committee on Banking Supervision, 2011:31).

Basel III paragraph 98 states that, irrespective of which valuation technique is used for accounting purposes, CVA calculation must be done by the formula:

$$CVA = LGD \sum_{i=1}^{T} \max\{0; k\} \cdot \left(\frac{EE_{i-1} \cdot D_{i-1} + EE_i \cdot D_i}{2}\right), \tag{4.1}$$

where:

- $k = e^{-s_{i-1} \cdot t_{i-1}/LGD} - e^{-s_i \cdot t_i/LGD}$
- t_i is the time of the i^th^ revaluation starting from $t_0 = 0$
- t_T is the time of maturity of the longest contract with the counterparty
- D_i is the default risk-free discount factor at time t_i; $D_0 = 1$

- LGD is a market assessment based on the spread of a market instrument of the counterparty, and
- s_i is the credit spread at t_i where a CDS spread must be used if available else the entity must use an appropriate proxy.

Noh (2013:347) states that since a formula for CVA capital is given in Basel III, banks should rather focus on modelling exposure which is then used in the CVA formula instead of modelling CVA directly.

There are three methods of calculating Exposure at Default (EAD): the standardised method, the Current Exposure Method (CEM) and the Internal Model Method (IMM). The first two approaches provide simple algorithms for banks that cannot internally model exposure. Netting is allowed when calculating EAD.

4.2.1 The Standardised Approach

This Standardised Approach for counterparty credit risk (SA-CCR) is used by banks that have not been approved to use the IMM for applicable OTC transactions and want to use a more risk-sensitive approach than the CEM. SA-CCR can only be used for OTC and exchange-traded derivatives, and long settlement transactions.

Exposure at Default (EAD) is determined by $EAD = \alpha \times (RC + PFE)$, which consists of the three components:

1. α=1.4, a value set by the BCBS for the IMM
2. RC: replacement cost
3. PFE: Potential future exposure

Separate EADs has to be calculated for every netting set (Bank for International Settlements, 2014b:1-3).

4.2.2 Current Exposure Method

The CEM uses the EAD to determine the required capital. According to Kotze (2012:4), the exposure according to CEM is the replacement cost of MtM contracts that are currently in the money plus the potential future exposure risk of changes in the price or volatility of the underlying asset. The EAD is then defined as:

$$EAD = CE + z, \tag{4.2}$$

where z is the add-on as described in paragraph 707 of Basel II and is included as an excerpt in Appendix B (Gregory, 2012:376).

4.2.3 Internal Ratings Based or Internal Model Method

There are certain minimum requirements that must be met by a bank to be eligible to apply the IRB method. These requirements confirm that the inputs provided and the quality of the banks' risk management process is acceptable (Bank for International Settlements, 2001:7).

4.2.4 Summary

Basel is very specific about the CVA calculation for capital requirement purposes. There is a standardised approach that is generally accepted. Banks are allowed to use an internal model but banks need to be approved to apply such model. There are generally strict guidance in the calculation which banks have to follow.

4.3 IFRS

IFRS 13 regards fair value as a market-based instrument but in some cases market information might not be available and other valuation methods can be used. There is no IFRS hierarchy when it comes to valuation techniques but IFRS 13 does specify that some techniques might be more appropriate than others in which case the most appropriate technique should be used.

According to the IFRS Foundation (2012:8), factors that influence the choice in valuation technique include:

- The information available, i.e. market or internal information
- Current market conditions
- The industry of the counterparty which also includes factors such as the business cycle of the counterparty.

The components of CVA should be determined, if possible, by market observable inputs, In determining the PD, market implied PDs are preferred above estimates based on historical data. This can be extracted from CDSs or when CDSs are not available, proxy spreads. LGD is simple to calculate when the RR is available. The preferred method to determine the RR would be to use market implied RRs since market observable inputs are preferred. The exposure profile will usually be created by starting with current market data after which different scenarios will be simulated to consider possible future market conditions (European Banking Authority, 2015:18-19).

There are three types of valuation techniques specified in IFRS: the cost approach, income approach and market approach. Since IFRS is not direct in specifying valuation methods, the guidance published by South African big four accounting companies, which are PwC, EY, KPMG and Deloitte, will be considered.

4.3.1 PwC

In an attempt to simplify CVA calculation, PwC has established a Credit Risk adjustment framework which is quite easy to apply. Before using the framework, one must first determine whether or not non-performance risk has already been incorporated in the value of the asset or liability. If it has not, PwC (2015b:8.10) describes the four-step framework that must be used to determine the necessary adjustment:

1. Determine the unit of measurement for credit risk
2. Apply a market participant perspective to available credit information
3. Calculate the credit risk adjustment
4. Allocate the credit risk adjustment to individual units of the account

As the focus of this chapter, more attention will be given on the details of step three.

PwC (2015b:8.27) argues that even though IFRS allows for flexibility in valuation technique, once a technique is selected the same method should be applied consistently when doing similar calculations. The valuation techniques mentioned are the cost approach, market approach and the income approach, but only the income and market approaches are explained in particular since the cost approach is mainly applicable to property and equipment and not financial assets and liabilities.

4.3.1.1 The Market Approach

When the inputs of valuation are observable in the market or when comparable inputs are available the market approach is the valuation technique that is used primarily. According to PwC (2015b:8.28), if prices of financial instruments requires a credit risk adjustment, it can be calculated with information available in the market such as CDS rates and credit spreads. It can also be used to support outcomes of other valuation techniques such as the income approach (PwC, 2015b:4.20). This approach is the typical ‘Marked to Market’ approach.

4.3.1.2 The Income Approach

The income approach applies the Discounted Cash Flow (DCF) method. In the DCF method future cash flows, including a terminal value if applicable, are calculated and discounted at a rate which includes the appropriate risk. This method is described as a ‘Marked to Model’ method (PwC, 2015b:4.21).

The income approach consists of techniques that include credit risk by means of an adjustment to the discount rate. This can be done by directly incorporating the credit spread in the discount rate or by CDS rate. The CDS rate can be included in a few ways including the *Discount rate adjustment technique* and the *Exponential CDS default method*. In the prior, the entity adds CDS rates as inputs directly to the risk-free rate while the latter method is more complex. In the Exponential CDS default method, the implied risk of default is extracted from the CDS rate and applied to the market value of the unit of measurement. Risk of default can be extracted and converted to CVA by:

$$CVA = PD \times FV \times (1 - RR), \tag{4.3.1}$$

with $PD = 1 - e^{-CDS\,spread/(1-RR)\times T}$,

where RR is the recovery rate, T the time until maturity and FV is the fair value of the instrument (PwC, 2015b:8.28).

The discount rate adjustment technique has two variations. In the first, the discount rate is changed by adding the credit spread to the rate applied before the adjustment (PwC, 2015b:30). The second variation uses the CDS rate instead of the credit spread to adjust the discount rate. Either the credit spread or the CDS or a combination of the two can be applied and according to PwC (2015b:32) the decision must be based on which rate best represents the market participant's view on credit risk.

Considering all of the above information, PwC (2015b, 8.28-2.29) concludes that in the process of reporting at fair value, one must always consider market information that is available such as the prices of similar financial instruments, the credit risk already reflected in the valuation before CVA calculation as well as the entity's own credit rating.

4.3.1.3 Cost Approach

In this approach the assumption is made that fair value would not be in excess of the cost of acquiring or constructing a substitute of the instrument that is being measured. Hence, the method can be described as a 'Mark to Cost' method. The cost approach can be used in valuation of assets that can easily be replaced and is generally not appropriate for financial assets (PwC, 2015b:4.21).

4.3.1.4 Summary

For derivatives such as IRSs, the Cost Approach would not be an appropriate method. Then if the information of the given counterparty is available in the market, the Market Approach would be used; otherwise the Income Approach can be applied. PwC is not specific in the published guidance on CVA about preference in methods implemented, but clearly states that when a method is chosen, it should subsequently be used for similar calculations.

4.3.2 EY

Since IFRS does not specify a valuation technique, there are a quite a few that are applied in practice. EY (2014:5) considers the Expected Future Exposure (EFE) approach, even though very complex, the most fundamentally sound method of calculating CVA, but other methods are also used.

The different methods EY uses to calculate CVA are described below:

4.3.2.1 EFE approach

In the EFE method, simulation is used to generate market variables that influence fair value. The fair value of the derivative is then calculated for each set of simulated market variables which results in an exposure path of the derivative. This is repeated many times after which EPE and ENE can be calculated. This is used in the calculation of CVA as in the formula:

$$CVA = LGD \sum_{t=1}^{T} d_t \cdot EPE_t \cdot PD_t. \qquad (4.3.2.1)$$

The discount factor at time t is denoted d_t. When appropriate collateral can be incorporated in the simulation of exposure and netting can be considered in the EPE or ENE calculation for a set of derivatives with the same counterparty. EPE can be replaced by ENE in the calculation of DVA. EY (2014:5) states that even though the EFE method is theoretically the best method to use, it quantitatively extremely demanding (EY, 2014:13).

4.3.2.2 Swaption approach

This approach models the exposure with regards to options but is limited to interest rate swaps. The Swapation approach calculates CVA as follows:

$$CVA = LGD \sum_{t=1}^{T} PD(t-1,t) S_t, \qquad (4.3.2.2)$$

where S_t is the fair value of the option on the swap with expiry t opposite to the derivative with maturity $T - t$. The PD between time $t - 1$ and time t is denoted $PD(t-1,t)$.

EPE is modelled as a series of swaps. It is calculated as an option of the reverse of the swap with the counterparty defaulting before the first cash flow plus a reverse option on the swap not including the first cash flow with the counterparty defaulting between the first and the second cash flow and so on with the number of options included in the calculation determined by the term and the frequency of payments of the swap.

4.3.2.3 Variable exposure approach

When the premium leg of the CDS is denoted $PV_{prem.leg}$ and CDS_t is a par CDS with a principal equal to the discounted value of the cash flows of the derivative remaining at time t, CVA can be calculated as follows:

$$CVA = \sum_{t=1}^{T} PV_{prem.leg}(CDS_t). \qquad (4.3.2.3)$$

In the calculation of DVA $PV_{prem.leg}$ is replaced by $PV_{default.leg}$.

In the Variable exposure approach, CVA is a supposed credit protection cost which is influenced by the forecasted exposure. The forecasting of exposure is not done by simulation but rather determined by the underlying assumption that markets evolve according to current future or forward prices. The fair value of the derivative is calculated at each cash flow date. The sum of CDS protection costs for future exposure between cash flow dates are determined. If CDS_t is a liability, the entity's own credit spread is used in the valuation of the default leg of the CDS. If CDS_t is an asset, the credit spreads of the counterparty is used in calculation. This case it is referred to as the premium leg (EY, 2014:14).

4.3.2.4 Constant exposure approach

The constant exposure approach is similar to the variable exposure approach since the notional value of the CDSs are based on the current fair value of the derivative except for an add-on profile that is added (EY, 2014:14). Therefore,

$$CVA = \sum_{t=1}^{T} PV_{prem.leg}({CDS_t}^{+}), \qquad (4.3.2.4)$$

where the add-on profile is a proxy for potential exposure and is calculated in advance based on a set of hypothetical trades of standard maturities. ${CDS_t}^{+}$ is equal to CDS_t in equation 4.3.2.4 plus the applicable add-on profile.

4.3.2.5 Discounted cash flow approach

This approach adjusts discount rates to include the credit spread in the discount rate of future cash flows (FV_{ca}), this allows CVA to be calculated as

$$CVA = FV_{rf} - FV_{ca}, \qquad (4.3.2.5)$$

where abbreviations ca and rf refers to credit adjusted and risk-free respectively.

A distinction must be made between when the entity's own credit spread is used and when the counterparty's credit spread is used. This is determined by whether the position or cash flow is an asset or liability (EY, 2014:15).

4.3.2.6 Duration approach

This approach uses duration, as a change in interest rate sensitivity measure, to determine how the fair value of the derivative will change when then credit spread is applied to the risk-free rate. According to EY (2014:15) CVA can therefore be calculated as

$$CVA = MtM \times Credit\ Spread \times duration, \tag{4.3.2.6}$$

where MtM is the current market value of the derivative when assuming none of the parties has credit risk.

4.3.2.7 Summary

EY considers six different approaches to CVA calculation that are all acceptable in certain scenarios, some simpler in calculation than others. They do however consider the EFE method to theoretically be the best method of calculation. Therefore, the EFE method is EY's preferred method, even though it is quantitatively very demanding.

4.3.3 Deloitte

Deloitte (2013:2) states that it is important to consider MNAs as credit risk is calculated at counterparty level and net exposure between the counterparties is settled at the event of default of either of the parties. CVA is then calculated for each counterparty with net exposure as an input since, according to Deloitte (2013:3), IFRS 13 allows portfolio level CVA and DVA if specific criteria are met. When there are collateral agreements, CVA is calculated for the instance where the collateral is short of the exposure.

The general approach of calculating CVA is:

$$CVA = PFE \times PD \times LGD. \tag{4.3.3.1}$$

PFE is Potential Future Exposure which is described in Deloitte (2013:3) as the maximum expected exposure calculated at a (1-α) confidence level for some particular period of time. PFE is determined by aggregating EPE and ENE for every counterparty to determine complete exposure. This is done while considering any MNAs. PFE calculation can be very complex and is usually done by means of Monte Carlo simulation.

LGD is usually not available unless the counterparty is close to default but can be estimated based on internal information. PD calculation has different approaches which varies from being estimated from historical information internally available to using implied PDs that is calculated based on the CDS market. Since these methods can lead to considerably different outcomes, Deloitte (2013:3) highlights that one must remember when choosing a valuation technique that IFRS 13 gives precedence to market observable inputs over unobservable inputs.

Deloitte and Quantifi's collective White Paper on IFRS 13 (Pugachevsky *et al.*, 2014a:2) describes the Quasi approach to calculate CVA or DVA. This is like EY's discounted cash flow approach since the credit spread is included in discounting. In the Quasi CVA approach, the credit spread is added to the discount curve which is then applied when discounting future cash flows. This valuation that included counterparty risk is then deducted from the original risk-free valuation to obtain the CVA or DVA.

There are some criticism regarding the Quasi method. Pugachevsky *et al.* (2014a:2) explains that for CVA calculation, the Quasi method only approximates CVA for instruments with positive cash flows or that are deep in-the-money and for DVA calculation it approximates DVA only for instruments with a negative cash flow or for instruments that are deep out-of-the-money.

Exposure for simple stand-alone instruments such as swaps and forwards can be calculated by using Black's formula. When taking netting and collateral into account, simulation can be used to do calculation under various scenarios. The simulation of the different scenarios can either be valued under risk neutral measure or real probability measure but in either case volatilities should match market implied volatilities when available (Pugachevsky *et al.*, 2014a:2).

CVA is described as the market price of a default option sold to a counterparty by Pugachevsky *et al.* (2014b). The a simple form of CVA can be calculated as

$$\begin{aligned} CVA &= E[Loss] \\ &= (1 - RR) \times EPE \times PD, \end{aligned}$$

where EPE is the average positive expected exposure. DVA, on the other hand, is calculated with PD the entity's own probability of default and EPE replaced with ENE which is the average negative expected exposure.

A bond's CVA can be calculated as

$$CVA = PV_{rf} - PV_{risky}\,, \tag{4.3.3.2}$$

where the risk-free value is calculated by discounting the future cash flows or receivables at the relevant risk-free rates while the risky value is calculated by discounting the same cash flows at the relevant risk-free rate plus some spread. But this only works for receivables e.g. bonds that have a set future cash flow. For other instruments, you need to use a to use Monte Carlo valuation where at each point in time you have to simulate market factors and for those market factors you evaluate exposures and potential future exposure. For an at-the-money interest rate swap for example, the exposure can differ greatly from zero due to volatility even though the swap is currently at-the-money so the discounted value will not be zero.

Requirements for CCR calculation according to Pugachevsky *et al.* (2014b) are the following:

- The Monte Carlo model should be in agreement with best market practices
- It should easily adapt to market or historical data
- It should capture the full effects of netting agreements and collateral
- The calculation of wrong way risk should be included in the model
- The model used should be consistent with front office pricing

4.3.3.1 Summary

Deloitte does not elaborate on their methods used to calculate CVA and just specifies the basic CVA calculation. They do however emphasise that Monte Carlo simulation should be used if exposure of other instruments except bonds are determined.

4.3.4 KPMG

Valuing an interest rate swap:

The KPMG International Standards Group (2012:12) states that the most common approach to value plain vanilla OTC interest rate swap to be discounted cash flow models. In these models the net value of future fixed cash flow and the estimates of variable cash flows are discounted to calculate the present value of the swap. The variable cash flows are estimated by using the forward rate curve while the discounting is done at spot rates.

The problem with the above method is that all factors that influence the value of a derivative is not included. One of these factors is the credit risk of the counterparty. On the simple discounting model, the cash flows are discounted at risk free rates and therefore does not reflect CCR. The valuation can be justified by adding the credit spread to the risk free rates in the calculation of fair value (KPMG International Standards Group, 2012:15).

Even though it is generally accepted to calculate fair value on an instrument-by-instrument basis, the KPMG International Standards Group (2012:16) argues that from time to time valuation on a portfolio basis may be suitable. Portfolio valuation can be applied in more than one way, but the most general technique is a full portfolio valuation approach. In this approach all the cash flows of the portfolio of the derivative instrument are discounted at risk free rate after which the value is adjusted to include factors such as credit risk. This method sidesteps the possibility of having to apply countless forward rate and discount curves, which simplifies calculations significantly however the need to consider each instrument individually remains.

The common CVA calculation for IRSs according to KPMG International Standards Group (2012:19) is based on Figure 5, which indicates the MtM value of an IRS at different points in time. The MtM value of the swap is considered the EAD, which together with the appropriate PD and LGD is calculated as

$$CVA = \sum_{t=1}^{n} EAD_t \times LGD \times PD, \tag{4.3.4}$$

where n in the case of Figure 5 is equal to five.

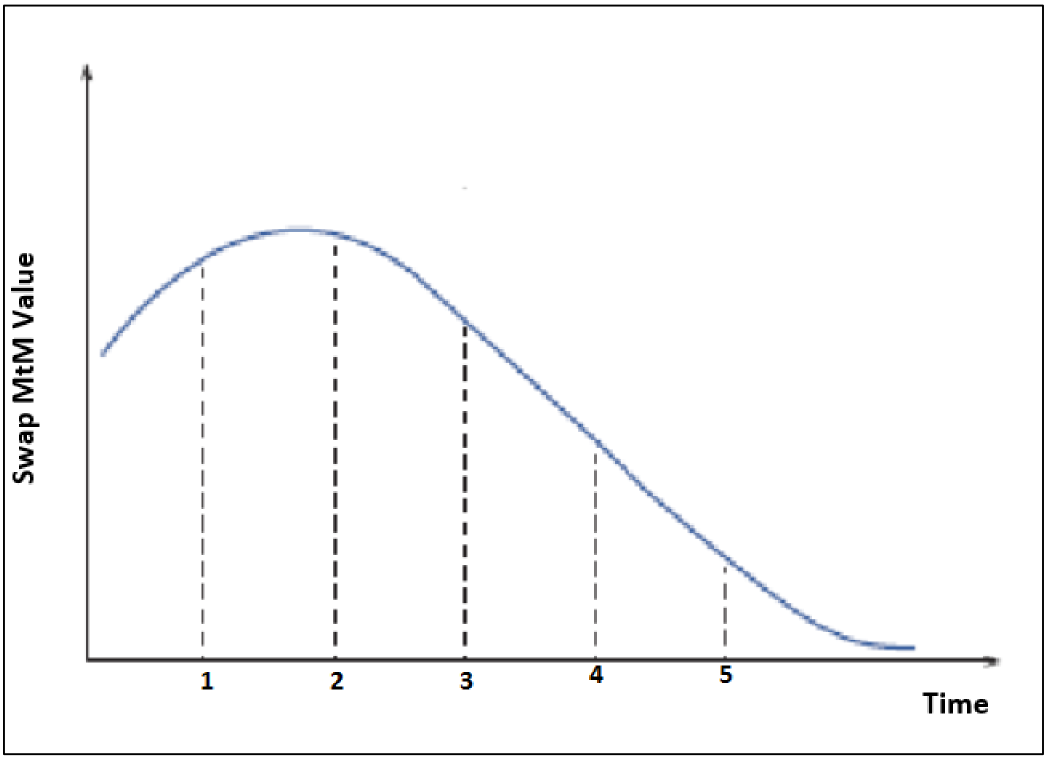

Figure 5: MtM Values of an IRS

Here EAD_t is the exposure at default (at time t) and is calculated by Monte Carlo simulation. PD can be obtained from historic data or implied current default rates that are derived from CDSs. The PD at time t is the incremental PD which assumes that the counterparty did not default in any of the previous $t-1$ periods. The use of incremental PDs determines the CVA while preventing it to exceed the maximum potential loss for any given swap. LGD calculation is determined by the RR which can be estimated from historical data or from rating agencies (KPMG International Standards Group, 2012:19).

4.3.4.1 Summary

KPMG emphasises the importance of valuation on a portfolio level. They do not elaborate much on the details of calculation but two methods are described in a simplified manner. The first is the discounting method is which the credit spread is simply added to the discount rate. The second method is the generally accepted simulation in which CVA is the product of PD, LGD and exposure, summed for every point in time.

4.4 THE STANDARD CVA FORMULA

Gregory (2012:243) considers the standard CVA formula, when netting sets and collateral are considered, to be

$$CVA(t,T) = E^Q\left[I(\tau \leq T) \times (1-RR) \times V(\tau,T)^+ \times \frac{\beta(t)}{\beta(\tau)}\right], \tag{4.4.1}$$

which is derived in Appendix A.2. In Equation 4.4.1, the time of default is denoted τ, with T the maximum time of maturity in the position. $\beta(s)$ denotes the value of a money market account at time s. Let $V(\tau,T)$ be the risk-free value of the derivatives position, while $E^Q(x)$ is the value of x under risk neutral measure.

4.5 THE EUROPEAN BANKING AUTHORTY

The EBA did a data collection exercise in which data regarding the calculation of CVA was collected from 32 banks in eleven jurisdictions. The European Banking Authority (2015:9) found that there has been a convergence to some degree in banks' CVA practices. They also state that this convergence has taken place in using market implied data obtained from CDS spreads or proxy spreads. The EBA considers the implementation of IFRS 13 and Basel III some of the main reasons for this convergence in industry practice.

4.5 CONCLUSION

There are various different approaches to CVA calculation. This is partly due to the different approaches that are prescribed by Basel, but mostly due to IFRS that does not specify or even propose a method of calculation. Basel’s approaches are clearly defined and banks need to pass a rigorous approval process to use an internal model.

Even though IFRS does not specify a formula for CVA calculation, it does state that market observable inputs are preferred above unobservable ones which serves as guidance in the choice of an appropriate CVA method. The four companies’ methods described in this chapter confirms that there are various different approaches with EY clearly stating that different approaches may be suitable for specific types of calculations. There is however a generally accepted method that all the companies agree on and this is confirmed Gregory in section 4.4 and is referred to as the standard CVA formula. The study done by the EBA verifies that the regulation of IFRS and guidance of Basel has led to convergence in the methods of CVA calculation in banks. The following final chapter will summarise the results of this study and state some open questions for further research.

CHAPTER 5

CONCLUSION

5.1 INTRODUCTION

CVA is the adjustment made to the risk free value of a transaction to include the credit quality of the counterparty in the price of the derivative while DVA is just the opposite, considering the credit quality of the entity itself in the valuation of a derivative. Even though CVA has been used for many years, the financial crisis of 2007 shifted much of the attention in the banking industry towards the calculation of CVA.

5.2 SUMMARY OF MAIN FINDINGS

The aim of this research was to verify whether when Basel III's requirements regarding CVA are met, compliance to IFRS would be implied. In the second chapter, all the concepts necessary to understand CVA or are components of the calculation of CVA were explained. The greatest of these were CCR and the difference between unilateral CVA, bilateral CVA and DVA. In chapter three the regulations that concern CVA were discussed. Chapter 3 is a literature review on the regulation of IFRS and Basel. Major differences were found between CVA in IFRS and in Basel. The greatest reason for this is the different objectives regarding the change in regulation with the focus of Basel on enhanced risk management practises while IFRS emphasises transparency in fair value calculations.

It is logical that when the different objectives of the IASB and the BCBS in the change of regulation is considered, it would follow that the regulations differ. With the object of convergence and transparency in valuation, the IASB's focus is on valuation techniques that maximises the use of market observable inputs. This naturally leads to great variation of techniques to a large extent, but with the advantage that any entity would by using the same technique be able to replicate the results. The BCBS' concern on the other hand is that banks either contain their risk appetite given the amount of capital they have, or hold more capital for the same amount of risk. This is done by adding a CVA charge to capital requirement to account for CCR since the financial crisis verified that no company could be regarded risk free.

The most apparent area of conflict between accounting and risk management disciplines regarding CVA is that of DVA. The IASB regard bilateral CVA, which includes the effect of DVA, the most appropriate since accounting is based on the principle of double entry. For risk management purposes however, DVA would only decrease the amount of capital a bank is required to hold without an increase in the company's ability to take risk. The result is that firms include DVA when calculating fair value for accounting purposes but do not include it in CVA calculation for capital requirement.

The fourth chapter confirms that there is great variation in approaches towards CVA but the change in regulation has led to a convergence in the approaches. Even though different approaches are followed, companies generally agree that the best approach is the Standardised Approach as discussed in section 4.4.

The research question asked in the first chapter can finally be answered and is the assumption that when Basel III's requirements regarding CVA are met, compliance to IFRS 13 cannot implied. This is mainly due to diverse objectives which leads to different methods of calculations.

5.3 FURTHER RESEARCH

The topic of CVA has expanded immensely after the financial crisis and has continued to grow as researchers try to understand the concept of CCR. New developments in this field include that of Funding Value Adjustment (FVA) which is a whole new idea on its own. CVA, DVA and FVA are now as a group referred to as XVA and there is much room for further research in this regard. While this study focused on the relationship between CVA and DVA, there can further be considered whether there is a connection between DVA and FVA and if so, what is the connection and does it influence CVA calculation and fair value?

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APPENDIX A: MATHEMATICAL DERIVATIONS

A.1 EFFECT OF NETTING ON EXPOSURE

When the EE of a variable that is distributed normally can be assumed to be:

$$EE_i = \mu_i \Phi\left(\frac{\mu_i}{\sigma_i}\right) + \sigma_i \varphi\left(\frac{\mu_i}{\sigma_i}\right),$$

where $\Phi(x)$ denotes the cumulative standard normal distribution of x and $\varphi(x)$ denotes the probability density function of the standard normal distribution of x.

Now a series of transactions within a netting set (NS) will be considered. Assume each transaction in the netting set is an independent normal variable.

Then the series of transactions will have mean and standard deviation:

$$\mu_{NS} = \frac{1}{n}\sum_{i=1}^{n}\mu_i \text{ and } \sigma_{NS} = \left(\sum_{i=1}^{n}\sigma_i^2 + 2\sum_{i=1;j>i}^{n}\rho_{ij}\sigma_i\sigma_j\right)^{1/2} \quad ,$$

where ρ_{ij} is the correlation between the future values of the transactions.

When a mean of zero and equal standard deviation of $\bar{\sigma}$ for all transactions in the series are assumed, the mean and standard deviation can be simplified to

$$\mu_{NS} = \frac{1}{n}\sum_{i=1}^{n}\mu_i = \frac{1}{n}\sum_{i=1}^{n}0 = 0 \ ,$$

$$\sigma_{NS} = \left(\sum_{i=1}^{n}\sigma_i^2 + 2\sum_{i=1;j>i}^{n}\rho_{ij}\sigma_i\sigma_j\right)^{1/2}$$

$$= \left(\sum_{i=1}^{n}\bar{\sigma}^2 + 2\sum_{i=1;j>i}^{n}\rho_{ij}\bar{\sigma}\,\bar{\sigma}\right)^{1/2}$$

$$= \left(n\bar{\sigma}^2 + n(n-1)\bar{\rho}\bar{\sigma}^2\right)^{1/2},$$

where $\bar{\rho}$ is the average correlation between the transactions.

Hence, since $\varphi(0) = \frac{1}{(2\pi)^{1/2}}$

$$EE_{NS} = \frac{\bar{\sigma}(n+n(n-1)\bar{\rho})^{1/2}}{(2\pi)^{1/2}},$$

where NS is the netting set. In the case of no netting (NN), the EE would be

$$EE_{NN} = \frac{\bar{\sigma}n}{(2\pi)^{1/2}}$$

Therefore, when the netting factor(NF) is the benefit of netting is expressed as the ratio of EEs, then:

$$NF = \frac{EE_{NS}}{EE_{NN}} = \frac{\frac{\bar{\sigma}(n+n(n-1)\bar{\rho})^{1/2}}{(2\pi)^{1/2}}}{\frac{\bar{\sigma}n}{(2\pi)^{1/2}}} = \frac{(n+n(n-1)\bar{\rho})^{1/2}}{n},$$

which then leads to the result:

$$\%\mathrm{R} = 1 - \mathrm{NF} = 1 - \frac{(n+n(n-1)\bar{\rho})^{1/2}}{\mathrm{n}},$$

where %R is the percentage reduction in exposure (Gregory, 2012b:6).

A.2 THE STANDARD CVA FORMULA

Gregory (2012c:1-2) derives the standard CVA formula in the following way:

Let $V(t,T)$ be the risk-free value of a netted set of derivatives positions with a maximum maturity date T. Then denote $\tilde{V}(t,T)$ the risky value of $V(t,T)$. To find the value of $\tilde{V}(t,T)$, one needs to consider the time of default, denoted τ. The assumption can be made that $V(s,T)$, where $t < s \leq T$, includes the effects of discounting. There are two possibilities:

1. $T < \tau$:

   In this case the risky value will be equal to the risk-free value and we can write the payoff as $(\tau > T)V(t,T)$, where $I(\tau > T)$ is the indicator function and is equal to 1 if $\tau > T$ and 0 otherwise. Hence, the payoff is $V(t,T)$.

2. $T > \tau$:

   The payoff will consist of two terms, the cash flows paid before default and the payoff at default. The value of cash flows paid before default equals $I(\tau \leq T)V(t,\tau)$.

Payoff at default will depend on the MtM value of the trade. If the MtM value, i.e. $V(\tau,T)$, is positive, the entity will receive a percentage of the risk-free value of the derivatives which is the recovery rate. Otherwise, if the MtM value is negative, the entity will have to settle the amount. The payoff will be

$$I(\tau \leq T)[RR \times V(\tau,T)^{+} + V(\tau,T)^{-}],$$

where $V(\tau,T)^{+} = \max(0, V(\tau,T))$ and $V(\tau,T)^{-} = \min(0, V(\tau,T))$.

Therefore,

$$\tilde{V}(t,T) = E^{Q}\begin{bmatrix} I(\tau > T)V(t,T) + \\ I(\tau \leq T)V(t,\tau) + \\ I(\tau \leq T)[RR \times V(\tau,T)^{+} + V(\tau,T)^{-}] \end{bmatrix}$$

Now applying $V(\tau,T)^{-} = V(\tau,T) - V(\tau,T)^{+}$, we can write:

$$\tilde{V}(t,T) = E^{Q}\begin{bmatrix} I(\tau > T)V(t,T) + \\ I(\tau \leq T)V(t,\tau) + \\ I(\tau \leq T)[RR \times V(\tau,T)^{+} + V(\tau,T) - V(\tau,T)^{+}] \end{bmatrix}$$

$$= E^{Q}\begin{bmatrix} I(\tau > T)V(t,T) + \\ I(\tau \leq T)V(t,\tau) + \\ I(\tau \leq T)[(RR - 1) \times V(\tau,T)^{+} + V(\tau,T)] \end{bmatrix}$$

$$= E^{Q}\begin{bmatrix} I(\tau > T)V(t,T) + \\ I(\tau \leq T)V(t,T) + \\ I(\tau \leq T)[(RR - 1) \times V(\tau,T)^{+}] \end{bmatrix},$$

since $V(t,\tau)$+ $V(\tau,T)$= $V(t,T)$.

$$I(\tau > T)V(t,T) + I(\tau \leq T)V(t,T) = V(t,T)(I(\tau > T) + I(\tau \leq T)) = V(t,T)$$

$$\tilde{V}(t,T) = E^{Q}[V(t,T) + I(\tau \leq T)[(RR - 1) \times V(\tau,T)^{+}]]$$

$$= V(t,T) + E^{Q}[I(\tau \leq T)[(RR - 1) \times V(\tau,T)^{+}]]$$

$$= V(t,T) - E^{Q}[I(\tau \leq T)[(1 - RR) \times V(\tau,T)^{+}]]$$

The above equation adjusts the risk-free value of the derivatives position to determine the risky value.

This adjustment is the CVA, hence

$$CVA(t,T) = E^Q[I(\tau \leq T)[(1 - RR) \times V(\tau,T)^+]],$$

and $\tilde{V}(t,T) = V(t,T) - CVA(t,T)$, so $CVA(t,T) = V(t,T) - \tilde{V}(t,T)$.

When the assumption that $V(s,T)$ includes discounting is dropped and $\beta(s)$ denotes the value of a money market account at time s, then:

$$CVA(t,T) = E^Q\left[I(\tau \leq T) \times (1 - RR) \times V(\tau,T)^+ \times \frac{\beta(t)}{\beta(\tau)}\right].$$

APPENDIX B: EXCERPTS FROM BASEL

B.1 Basel II:

707. The counterparty credit risk charge for single name credit derivative transactions in the trading book will be calculated using the following potential future exposure add-on factors:

Table 1: Add-on factors

	Protection Buyer	**Protection Seller**
Total Return Swap “qualifying” reference obligation “Non-qualifying” reference obligation	5% 10%	5% 10%
Credit Default Swap “qualifying” reference obligation “Non-qualifying” reference obligation	5% 10%	5%** 10%**

There will be no difference depending on residual maturity. The definition of “qualifying” is the same as for the “qualifying” category for the treatment of specific risk under the standardised measurement method in paragraph 711(i) and 711(ii).

** The protection seller of a credit default swap shall only be subject to the add-on factor where it is subject to closeout upon the insolvency of the protection buyer while the underlying is still solvent. Add-on should then be capped to the amount of unpaid premiums (Basel Committee on Banking Supervision, 2006:164-165).

B.2 Basel III:

Cumulative gains and losses due to changes in own credit risk on fair valued financial liabilities

75. Derecognise in the calculation of Common Equity Tier 1, all unrealised gains and losses that have resulted from changes in the fair value of liabilities that are due to changes in the bank’s own credit risk the (Basel Committee on Banking Supervision, 2011:23).