JMF> Vol.7 No.2, May 2017

The Economics of XVA Trading

Full-Text HTML XML Download as PDF (Size:3743KB) PP. 239-274

DOI: 10.4236/jmf.2017.72013

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ABSTRACT

The theory of trading with value adjustments, or XVA, is well established. However, the mar
significantly in pricing practice with houses applying varying numbers of adjustments to the same
at all. Here the aim is to outline the basic trading strategies used by XVA desks and to explore the
terms of the risk transfer involved and the resulting profit and loss. This is achieved through case s
traded structures including details of the positions themselves and the motivation for executing th
to-market impact is also quantified. Following one case study, a methodology to calculate the
Initial Margin, or MVA, for linear products will be developed.

KEYWORDS

XVA Trading, Credit Value Adjustment, Funding Value Adjustment, Margin Value Adjustment, CVA, I

1. Introduction

XVA is the term now used to encompass the value adjustments, i.e. "VA", that are applied to the r
(m2m) of derivatives to correct the pricing of classic risk-free models. The literature on the th
increasingly comprehensive [1] [2] [3] . However, the understanding of XVA within capital m
variable. For trading, there is no market standard. As of mid- 2015, only 29 banks have announce
XVA to their books by formally adjusting their profit and loss (P & L) to reflect these risks [4] . In
losses were incurred [5] - [13] . The consequence of these divergent pricing views is that there is a
forming: those who price XVA and those that don't.

The "X" in XVA refers to the number of value adjustments that are now applicable. Credit Value
CVA, is the credit risk that an arranger will price into a trade to face a given uncollateralized counter
Debt Value Adjustment, or DVA, is the credit risk that the client should take into account when fa
There are funding considerations, which are quantified using a Funding Value Adjustment, or FVA.
either a cost, when collateral is posted, or a benefit, when collateral is received. An originator wil
track their LVA, or Liquidity Value Adjustment. This is the slippage that a bank will incur by fundi
only receiving an overnight swap rate (OIS) in return, on posted collateral. Margin Value Adjustm
cost of funding Initial Margin when trades are cleared. KVA, or Capital Value Adjustment, is the
regulatory capital against derivative portfolios. CollVA quantifies the value of the optionality, e
Collateral Support Agreement (CSA), to post collateral in different currencies.

The Basel Committee on Banking Supervision (BCBS) has formally recognized CVA by inc
management as part of the Fundamental Review of the Trading Book [14] . Accounting standards n
CVA to be recorded in the general ledger [15] . This has led to an increase in awareness of XVA in
but there has not been a consistent response from sovereign regulators, nor banks [17] [18] [19] [20]
announced a review of FVA [21] , but the other adjustments remain unaddressed. This is all indica
tier market that now exists.

Increasing transaction costs will naturally encourage clients to seek out arrangers who don't price
may change their trading patterns. They will shop trades with high costs around the street. Deal
price XVA are motivated to trade in different ways from those that don't consider it. The value they
very different from the old-school view of P & L. Houses that don't price these costs will generally
other banks and clients out their door wanting to execute certain trades with them.

Very little has been written about the effect of XVA on capital markets. Several short articles have a
general press [22] [23] [24] [25] [26] , but nothing has been published that either outlines the trade
quantifies the impact. This article seeks to address that. The aim here is to summarize the basic tr
used by XVA desks and to explore the risk transfer involved, as well as the P & L implications. I
overview of the theory is presented. Then case studies of actual transactions will be given in sect
include details of the positions themselves, the incentives for executing those trades and the resulti
all scenarios, the XVA P & L will be shown to have similar magnitude to the profitability of the u
trading desk. In some cases, the XVA P & L is an order of magnitude greater. Motivated by on
methodology to calculate MVA for linear products will be developed in section 4. The findings will
is of equivalent importance to FVA when trades are cleared. Section 5 concludes the study.

2. The Model

When banks include XVA as part of the m2m of derivatives, they will typically have dedicated fron
manage the risk as shown in Figure 1. They

Figure 1. XVA trading desk.

look to transfer price the XVA to clients. These desks are typically run as any other derivative busi
m2m and P & L that is reported as part of the bottom line of Capital Markets. At their most advan
hedge the exposures into the market like any other derivative book; what is known as risk-neutral p
Perhaps the most important function of an XVA desk is to write protection against losses to the flo
for the various VA components. Take CVA. At trade inception, the CVA costs are transfer priced t
upfront payment is then exchanged between the flow desk and the XVA desk. The XVA desk h
protection against any loss from the counterparty defaulting. If the client does default, the flow de
affected trades to the XVA desk for the default workout process. The XVA desk then makes a paym
desk equal to

$\text{Payment} = \text{LGD} \ \max(m2m, 0)$, (1)

where LGD is the loss Given Default. This is also known as a Contingent CDS (CCDS).

Quantifying XVA risk requires modelling the evolution of the product in question to maturity. Typ
Carlo approach is used. The advantage of such a technique is that portfolios can be considered i
Netting from various positions can be calculated, likewise any effects from collateralization. The ca
will focus on interest rate (IR) and foreign exchange (FX) derivatives.

2.1. Monte Carlo Simulation

Calculating XVA risk consists of:

- Choosing simulation dates where the last date is the longest maturity in the portfolio.
- Generating market scenarios.
- Pricing individual trades and collateral for each scenario and simulation date.
- Calculating the portfolio exposure, considering netting and collateral.
- Calculating XVA at the counterparty level.

Scenario generation involves simulating Monte Carlo paths for the IR and FX market factors requ
the trades. Credit spreads are also used to infer default probabilities, but they are not simulated.

To generate the Monte Carlo simulations, a shifted Libor Market Model (LMM) [27] [28] [29] is used
of tenor dates $t = T_0 < T_1 < \ < T_N$, with associated simple forward Libor rates $f_i(t)$ and tenors i
so that

$1 + \ i f_i(t) = P(t, T_i) \ P(t, T_{i+1})$, (2)

where $P(t, T_i)$ is the value of a zero-coupon bond maturing at T_i. In the spirit of the original Bla
forward rate for a given currency evolves per a displaced stochastic differential equation

$$d(f_i(t)+s_i)(f_i(t)+s_i) = \mu_i(t)\,dt + \ i(t)\,dW(t) \quad (3)$$

and s_i is the shift associated with the appropriate forward rate. The drift term, $\mu_i(t)$, is a functior
rates and their volatilities which is determined by no-arbitrage arguments as

$$\mu_i(t) = \{ \ k= \ (t)\,i \ \ k[f_k(t)+s_k]\,1+ \ k f_k(t) \ \ i(t) \ \ k(t) \ \ i,k(t) \ , \text{ base } \ k= \ (t)\,i \ \ k[f_k(t)$$
$$(t) \ \ i(t) \ \ k(t) \ \ i,k(t) - \ k(t) \ \ \ (t)\,X(t) \ , \text{ foreign} \quad (4)$$

where ‘base’ represents the domestic currency and ‘foreign’ adjusts the drift for the volatility of t
market standard is to report XVA in the base currency in which the bank reports P & L. Here the b
USD. (t) is the index of the closest forward rate that has not reset yet. The volatility of each forwar
specified using the parametrization due to Rebonato [30]

$$i(t) = [a + b(T_i - t)]\,e^{-c(T_i - t)} + d \quad (5)$$

and a, b, c, d are constants calibrated to user-selected swaptions. $i X(t)$ is the FX volatility where,
$| \ \ t < T_k)$ is the next tenor date. The forward FX rate between a given currency and the base currenc
normal process

$$dX_i(t)\,X_i(t) = \mu_i X(t) + \ i X(t)\,dW_t. \quad (6)$$

The instantaneous correlation between two forward LIBOR rates is determined by the reset time dis

$$i,j(t) = e^{- \ (T_i - T_j)}, \quad (7)$$

with being a user input that is typically calibrated to historic data.

It is well known that when LIBOR rates are log-normal, only one forward FX rate can be log-norn
commonly used technique where we specify the volatility of the forward FX rate maturing at the nex
(t), deterministically. This means that [redacted] $t)\,X(t)$ is also deterministic and can be calibrated to
market. Knowing the forward FX rate, X[redacted]$(t)\,(t)$, maturing at the next tenor date, [redacted](t), other fo
obtained from interest rate parity.

Calibrating (2) - (5) requires specifying a swaption implied volatility surface. The model solves
parameters in (5) that replicate the swaption prices. Calibrating the 4 parameters requires the u
minimum of 4 points on the surface. Here the diagonal of the swaption surface from 1 to 10 y
Likewise, calibrating (6) requires the specification of an FX implied volatility surface. The shift, s i
2%. See the appendix for the market data.

2.2. XVA Formulation

For a given portfolio of trades, the LMM is used to generate Monte Carlo simulations of the underly
for a given time horizon, T, with pre-specified time increments. At each time step, the portfolio of tra
each simulation. All scenarios that result in a positive m2m are then aggregated. Likewise, all
outcomes are also summed. For a given number of time steps, i and a number of simulation
expected positive exposure, or EPE, as

$$EPE_i = \ j\, m2m_{i,j} \times I_{m2m_{i,j} > 0}\, j \quad (8)$$

and the expected negative exposure, or ENE, as

$$ENE_i = \ j\, m2m_{i,j} \times I_{m2m_{i,j} < 0}\, j, \quad (9)$$

where I is the indicator function. From the definitions of (8) and (9), it also follows that m 2 m i = E
the presence of a CSA agreement, the m2m is modified to

m2m i,j ' = { [m 2 m i , j − C i , j] + [m 2 m i , j − C i , j] − (10)

where x + = max (0 , x) , x − = max (0 , − x) and C i , j is the collateral amount. The definitions of E as given by (8) and (9), will hold for all calculations in the remainder of this article.

Following [1] [2] [3] , when a dealer trades with an uncollateralized client, the exposures are typical into the street, with professional counterparties, under two-way zero threshold Credit Support An the trades mature, if there are m2m gains on the client side, the dealer then has a credit exposu Likewise, if the m2m is negative, the counterparty has credit risk facing the arranger. Hence,

CVA = LGD C   i = 1 N DF i EPE i P (t t i B) P (t = t i C)   t , (11)

DVA = LGD B   i = 1 N DF i ENE i P (t = t i B) P (t t i C)   t (12)

and LGD B , C is the Loss Given Default of the bank and counterparty, respectively. DF i is the ris factor for time step i . P (t = t i B , C) are default probabilities for the bank and counterparty respe the size of the time step. Equations (11) and (12) are known as the bilateral representation of the r formulation can also be used which omits the survival probability P (t t i B , C) . Here Equations be used with LGD = 60% and a 5-year CDS equal to 100 basis points (bp). See the appendix fo details.

The survival probabilities are risk neutrally derived from the CDS curve of the counterparty [31] . R spread is the ratio of the premiums paid by the protection buyer divided by any pay outs from seller, or,

CDS i = LGD   i = 1 n P (t = t i C) DF i i = 1 n DF i [1 − P (t = t i C)] . (13)

Without loss of generality, (11) - (13) imply that the CVA, as well as the other VA, vary approxi versus the credit spread. All default probability calculations in the remainder of this article are c (13).

BCBS recently released guidelines for marking non-traded credits [14] . It requires mapping those to traded CDS based on rating, industry and geography. An alternative, that has been used on the st is to use historic default probabilities. It is well documented [32] that the implied default rates fro spreads have a much greater magnitude than historic default rates. CVA varies linearly with the def Consequently, moving from historic to implied default rates will have a large P & L impact as show

FVA is gaining increasing acceptance by the market. It is the cost over and above the risk-free rate institution to fund derivative positions. FVA arises primarily due to the asymmetry in t uncollateralized client trades versus the hedges that are executed in the professional market under the m2m of a client portfolio is positive, then the m2m of the hedges will be negative. Ignoring p minimum transfer amounts, the book runner will be required to post collateral to the counterparty Typically, a bank will fund this collateral by borrowing the required cash at its funding rate of LIBO the bank’s forward term funding cost. Likewise, if the client portfolio shows a loss, there will be an gain on the hedges. In this case, under the CSA, the bank will receive collateral which can then be i rehypothecation terms. Applying a bid-offer to S allows the investor to earn a net return.

Analogously to CVA, define the FVA as the expected funding cost over the life of the portfolio. This into a cost, where collateral is posted, and a benefit, where collateral is received. Or

FVA = FVA cost + FVA benefit , (14)

where

FVA cost = i = 1 N s i , i – 1 , offer EPE i P (t ti B) P (t ti C) t , (15)

FVA benefit = i = 1 N s i , i – 1 , bid ENE i P (t ti B) P (t ti C) t (16)

and s i , i – 1 is the forward funding spread given by

s i , i – 1 = s i ti – s i – 1 ti – 1 t i – t i – 1 , (17)

which holds for small t . The bid and offer applied to S reflect the spreads paid or earned by the de the CDS, here a funding curve with a 5-year spread equal to 100 bp is employed to facilitate comp (14) and (11). See the appendix for further details of the funding curve.

An argument exists that FVA should not be included in the valuation of a derivative [33] [34] [35] [36 school of thought says that including $FVA_{benefit}$ as well as DVA in a calculation is "double countin

For a trader, the argument is irrelevant. If DVA is to be included and transfer priced to a client, possible to monetize that price through hedging. That would require the ability for a bank to enter and sell protection on itself which is not possible. Alternatively, a trader might seek to sell protectio institution that is trading at a similar spread to the bank and that is highly correlated. Again, flow C generally not buy that protection. Consequently, DVA cannot readily be monetized. On the other will have funding costs charged back to the book, typically from Treasury. $FVA_{benefit}$ can rehypothecating the posted collateral. Hence, transfer pricing FVA to clients is essential profitability.

Another consideration under a CSA is the interest accrued. Typically, a bank will fund at LIBO receive OIS in return on posted collateral. The value of a trade needs to be adjusted for this slippa known as Liquidity Value Adjustment, or LVA. Define LOIS as

LOIS = 3 M LIBOR – OIS . (18)

Where collateral has been posted, an LVA_{cost} will apply which is equal to the interest shortfall attrib Likewise, when collateral is received, the desk can retain the LOIS differential as an $LVA_{benefit}$. L analogously to FVA

LVA cost = i = 1 N LOIS offer EPE i P (t ti B) P (t ti C) t , (19)

LVA benefit = i = 1 N LOIS bid ENE i P (t ti B) P (t ti C) t . (20)

Houses may in fact choose to incorporate LVA into the FVA calculation. This will be influenc structure in the trading room. If different desks manage different components of the risk, then a b split the risk based on those lines. Here we shall assume that LOIS is negligible thereby minimizing

In terms of the other value adjustments, CollVA arises from multi-currency CSAs. Due to interest ra at any one time, a given currency will be cheapest to deliver, as the calculations given in (2) discounting in only one currency. Banks are increasingly reluctant to sign such CSAs, due to optionality. Here we shall assume that any CSA agreement is single currency.

The use of KVA remains limited. It is computationally difficult as it is a simulation intensive c magnitude of the KVA can be much greater than the other value adjustments combined [38] [39 banks use KVA as a hurdle rate, that the P & L on a potential trade must meet, in order to be deal

may call this “Return on Equity”. Transfer pricing such a cost to clients in isolation on the street
Bank uncompetitive hence the use only as a profitability measure. However, given the capital t
now hold and the pressure to be profitable, it is unclear whether this position is tenable in the lo
also a computationally intensive calculation, but with the introduction of central and now OTC cle
drawn significant attention [40] - [46] .

When a trade is cleared, there are two margin requirements. One is the Initial Margin (IM), which
and recalculated at least daily. The second is the Variation Margin (VM). The VM is equal to the m2
the trade itself. If the m2m moves against the clearing member, then VM equal to that m2m loss
Similarly, if there is a m2m gain, the clearing member will receive VM in the form of cash or securit
also calculated at least daily. Hence, funding the VM is directly analogous to FVA. IM is intend
potential losses from further m2m movement from the time of a counterparty’s default to the actual
position. The calculation of the IM varies depending on the clearing house. Generically, it is a Va
calculation, corresponding to an assumed closeout period of risk, using historic simulation based
of market data. As such, it is a portfolio level calculation, where the incremental effect of a new trad
The specific tail loss statistic defining the IM will vary depending on the exchange. The IM is recal
margined at least daily. In contrast to FVA, there is no benefit to IM. The IM is always posted t
Following [2] ,

$$MVA = \sum_{i=1}^{n} s_{i,i-1,offer} \, IM_i \, DF_i \, P(t < t_i^B) \, P(t < t_i^C) \, \Delta t, \quad (21)$$

where IM_i is the forward initial margin for time step i. Here $P(t < t_i^C)$ is the survival probability
house in the case of central clearing, or the counterparty, if a trade is OTC cleared. The calculatio
IM is highly non-trivial. In section 4, an approach to calculate forward IM for linear products will be
Given the previous definitions, we now have that XVA is a subset of, or equal to,

$$XVA = CVA + FVA_{cost} + FVA_{benefit} + MVA. \quad (22)$$

The exact combination of the adjustments depends on the trade in question. For example, if a trade
CVA can be ignored but the MVA should be included. Similarly, if a counterparty has not signed a
no clearing component, CVA should be included with FVA but not MVA. Houses in North America m
DVA as it is an accounting requirement. Here it was excluded due to the hedging argument mentio
The fair value m2m of any derivative is then the classical risk-free valuation adjusted for the XVA.
Unless explicitly specified, we shall assume the date for pricing all exposures is September 29th 2
data used for calibrating (1) - (22) is given in the appendix.

3. Case Studies

In this section, the aim is to understand the economics of the risk transfer involved in XVA trading
the P & L impact.

3.1. Incremental XVA

3.1.1. Client Reverse Enquiry

The most important concept in XVA trading is that of an incremental price. No XVA risk shoul without understanding the portfolio effect of any proposed trade at the level of the counterparty. Ar can certainly increase the riskiness of the portfolio to the bank, but it can also offset existing po reducing XVA exposures. Generally, corporate clients have floating receivables and they look interest rate risk by swapping those exposures into a fixed rate. Hence a client book will typicall receive floating as shown in Table 1. For the given

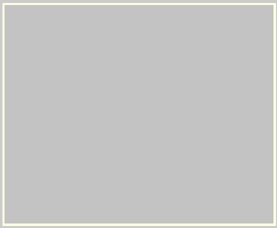

Table 1. Corporate client IR portfolio without CSA[a].

[a]XCY denotes cross currency. P: Pay. R: Receive.

counterparty, there is a mix of swaps and cross currency swaps for 3 currencies. Maturities vary fro Assume there is no CSA in place with the bank. This is common as the cash requirements to post c non-trivial for smaller corporate accounts.

Running the Monte Carlo calculations summarized by Equation (22) produces the exposure pr Figure 2. The m2m of the portfolio, which is calculated as the sum of the EPE and the ENE, equals U (MN). The portfolio then evolves through time to a peak exposure of USD 100 MN. The reductions ENE in late 2019 and 2021 are due to the cross-currency swaps maturing. The principal exchange those positions represents a large exposure. The EPE and ENE then pull to par as the remaining c off from the swaps. Note also that the magnitude of the EPE has a much larger peak exposure tha reason is that the portfolio is paying fixed in a low rate environment. The ability for IR to move ag is reduced (rates can only go to zero). However, the arranger does have the upside from receivi increase in IR will translate to m2m gains for the book runner. The 'saw tooth' pattern of the profi the semi-annual versus quarterly coupon risk of the portfolio.

Applying (11) - (17), the calculation shows that

$\text{CVA} = \text{USD} \quad 6.8 \quad \text{MN}, \text{FVA} = \text{USD} \quad 3.8 \quad \text{MN}.$

The FVA is lower than the CVA due to the $\text{FVA}_{\text{benefit}}$ partially offsetting the FVA_{cost} whereas DV included in the calculation. In terms of the m2m of the book, the valuation should be adjusted do embedded credit risk and term funding costs. This yields the fair value m2m as

$m2m = \text{USD} \quad 16.6 \quad \text{MN} - \text{USD} \quad 10.6 \quad \text{MN} = \text{USD} \quad 6 \quad \text{MN}.$

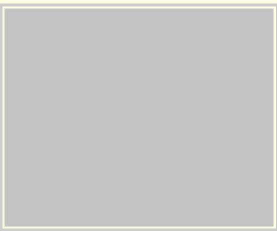

Figure 2. EPE and ENE profiles for an IR swap portfolio.

The large P & L write down is indicative of what has occurred on the street. Any bank which has in
revaluation, in whatever form that has taken, has incurred significant losses [5] - [13] . At first glan
argued that instituting an XVA desk will render capital market operations uncompetitive. However
case. What will occur is that a bank will change the way it looks at risk and the way it trades. To ill
shall consider the impact of two new trades to the exposures in the portfolio.

Using the portfolio from Table 1, assume now that there is a new reverse enquiry from the client:

1) Bank to pay fixed semi-annually, receive 3-month LIBOR + 100 bp on USD 100 MN for 5 years.

Recall from Table 1 that the existing portfolio pays fixed. Hence, the new trade is purely additive to
profile. The XVA risk must be calculated incrementally against that portfolio. Let the trade k be the n
denote the existing portfolio to which trade k is to be added. The incremental XVA correspondi
defined as

$XVA_k^{incr} = XVA_{E+k} - XVA_E$. (23)

Incremental XVA depends on the order in which new trades are executed. Calculating XVA_k^{incr} for

$CVA_1^{incr} = \text{USD } 80,000$, or 1.7 bp running,

$FVA_1^{incr} = \text{USD } 50,000$, or 1.1 bp running,

where bp represents a basis point adjustment to the fixed leg. The upfront XVA charge equals USD
translated to a running spread adjustment to the fixed leg of the swap. Assume that the par rate is 2
market maker on the swap will typically take 2 bp in day-1 P & L on trade 1. For a bank with an XVA
adjustment of 2.8 bp, or 3 bp say, must be applied. The price to the client is then 2.51% per annum
XVA P & L itself has a greater magnitude than the flow P & L. This is a common finding for any ba
desk. For houses without such desks, the immediate response is that charging XVA will mak
uncompetitive. However, consider the next reverse enquiry from the client:

2) Bank to receive fix, pay floating quarterly. USD 100 MN, 5-year maturity.

Such a trade might simply be a position clean up by the client or a more general risk reduction. In t
will offset the existing portfolio and there will be an XVA release. Again, running the incremen
produces

$XVA_2^{incr} = -\text{USD } 130,000$,

which is a running spread of –2.8 bp. The flow desk will offer to receive fixed at 2.58%. The XVA
priced to the client. Adjusting for the XVA release, the bank is now in a position to improve the price
even pay through the mid to win the trade, if desired. Alternatively, Sales can keep the XVA release
mark up.

In conclusion, with an XVA desk, the way banks approach trading changes. Without an XVA desk,
trades they should lose and lose trades they should win.

3.1.2. Pricing Grid

Continuing the incremental argument, counterparties in London and New York now routinely ex
factored into quoted prices at least where they know that the dealer has an XVA desk. Assume
undertaking a new bond issue which will be denominated in a single currency. The client may ne
capital requirements in several currencies. This is achieved by swapping the cash flows into the des

as needed. As the issuance date approaches, clients will approach XVA desks from dealers that cove following generic request:

Please provide indicative XVA costs for the following:

1) Pay fixed EUR: 3 Y, 5 Y, 7 Y, 10 Y

2) Pay Fixed GBP: 5 Y, 7 Y, 10 Y, 15 Y

3) Pay Fixed USD: 3 Y, 5 Y, 7 Y, 10 Y

All trades are versus receiving floating on USD 100 MN.

The first two scenarios represent cross-currency swaps for different tenors. The third option deno swaps. Not all options are necessarily desired by the counterparty. Clients expect to receive the res as an upfront dollar amount, within a prescribed time horizon, usually days. There will often l refresh the quotes depending on moves in the underlying interest rates or even the clients own cr entire process can take several months.

What clients seek is the best portfolio offset versus any given position i.e. the lowest incremen against their existing portfolio with the dealer. When the bond is issued, tickets for the required print over the course of the ensuing days. Counterparties will shop these trades across the street l execution. Achieving this is straight forward. The client will start with the houses that quo incremental XVA charge, fill them, then move on to the next highest charge. The range of quoted vary dramatically. At the tight-end will be those houses that do not price XVA. Their appetite wi immediately. Then those houses with low XVA costs will be hit. If a dealer is seeing business fro especially for longer dated trades, or if the client seeks to increase the size of trades, then these a XVA is underpriced.

3.2. Strip of FX Forwards

An XVA desk will often focus on longer dated portfolios as that is where the risk is concentrated. F this will be the IR desk but other desks such as commodities, can also fall into that category. As mat survival probabilities decrease rapidly, thereby making those positions the riskiest. FX derivative b to be much shorter dated. Liquidity for FX volatility trading does not extend much beyond 1 y trades, such as a strip of FX forwards can extend out 2 - 3 years but not often more than that. Never still XVA risk in those trades. FX derivative desks operate on a high volume, low margin, business m erosion from XVA would therefore have a significant effect on the bottom line of such desks. There that such short-dated trading carries limited credit risk. Certainly, the CVA is reduced, but it is non- the need to fund positions remains constant. To illustrate this, consider Table 2. It shows a qu forwards, buying euros and selling dollars out to 2 years.

Running the Monte Carlo generates the EPE and ENE profile shown in Figure 3. The profile is sy captures the ability of the FX forward rate to move in either direction in the market. The p constrained the way the IR portfolio was in Figure 2. Applying (11) - (17) produces

$\text{CVA} = \text{USD} \quad 150,000, \text{FVA} = \text{USD} \quad 26,000.$

It is immediately apparent that the reduced maturity has also reduced the magnitude of the symmetry in the profile has reduced the FVA as the benefit largely offsets the cost. However derivative desks survive on a high volume, low margin, flow model. For the structure shown in

Table 2. Strip of FX forwards out to 2-years.

[a]"Fwd Pts" denotes the forward points of each trade from a Euro spot rate of 1.245.

Figure 3. EPE and ENE profiles for a strip of FX forwards.

Table 2, the P & L would typically be approximately "4 pips" of the total notional which gives

$$\text{P \& L} = \text{USD } 800 \text{ MN} \times 0.0004 = \text{USD } 320{,}000.$$

Hence, the XVA is half the day-1 P & L. Recall that the counterparty 5-year CDS equals 100 bp. B standards, that is a tight, high quality credit curve. As previously mentioned, the XVA varies approxi with the credit spread. As the credit curve widens to 200 bp, the P & L is entirely eroded. The results not mean that FX derivative trading is unprofitable. Instead there is a need to reassess the curr business model. Either the XVA costs need to be transfer priced to clients, or other risk mitigant need to be introduced.

3.3. The CSA Effect

In general, CSAs hold significant value for an XVA desk. All uncollateralized clients will draw attention. Even with a CSA in place, there are still strategies that the desk will exploit.

3.3.1. Signing a CSA

Take a client who is receiving fixed on a portfolio of trades and paying floating in a variety of curr there are several deals that printed pre-Lehman at high coupons. As fixed rates collapsed follow these trades showed large m2m losses for the dealer. The remaining trades are all much longer d little P & L, as they were dealt at rates which have remained quite stable since 2010. The risk is Table 3.

Running the Monte Carlo simulation and calculating (11) - (17) produces the EPE and ENE pro Figure 4. The portfolio XVA equals

$$\text{CVA} = \text{USD } 4.3 \text{ MN}, \text{FVA} = \text{USD } 2.5 \text{ MN}.$$

Table 3. Deep out-of-the-money IR portfolio without CSA.

Figure 4. EPE and ENE profiles for a swap portfolio with negative m2m.

The Expected Exposure, or EE, is the average path the XVA desk sees the portfolio taking through that is the current m2m. For the client in question, there is a large negative m2m of the order o However, under simulation this rolls off quickly as the pre-Lehman legacy trades mature. At the simulation suggests that the remaining longer dated trades will move substantially in the deal increase.

The opportunity for the XVA desk is straight forward. To start, the XVA desk will speak to Sales. Th will be very simple. It will revolve around calling the client and asking them to sign a 2-way zero- The client is told that when the CSA is signed the bank will "post them USD 110 MN". Unle sophisticated and understands XVA costs, what they won't be told is that the XVA desk will mark th USD 6.8 MN when the CSA is inked (remember the XVA desk is fully m2m and reports their P & derivatives desks). The reason is that on a net present value basis, the initial collateral posting of US fact small compared to the long- dated credit risk which remains in the book as well as the funding maintain the hedges on the street. The net present value of all XVA exposures swamps the initial co Any client approached to sign a CSA by a dealer should look to negotiate a payment of at least part release that results from signing the agreement.

The idea behind risk reduction and XVA release is an important one. Whenever a client unwinds ris trades that offset existing exposures, an active XVA dealer will see a P & L release from the XVA des will be held by either the XVA desk itself or by Sales as a hard dollar mark up. Knowing that produce different incremental costs can be important to achieving best execution. If a client is addin look to shop that to non-XVA dealers. Wherever they can achieve a risk reduction, they will look to XVA desk and they will apply pressure for that release to be incorporated into the traded price. Wh a client, or a professional counterparty, the more sophisticated the analytics, the better the ability to

3.3.2. Cross-Currency Swap Intermediation

Take a 7-year cross currency swap, paying fixed in EUR and receiving USD floating, printed in late 2 the Lehman default, liquidity was highly stressed well into 2010. Banks globally were struggling f position receiving US dollars traded at a premium. The default also led to large FX moves, a signif rates and the collapse of the euro cross-currency basis. The net result was that such swaps now impacts of approximately 10% of the trade notional. If there was no CSA in place with the client, the the associated US dollar cash flows were at risk.

A common dealer strategy for such positions is to ask another bank to intermediate the trade. This i desk approaching another bank where they have a two-way zero-threshold CSA already in place. T shown in Figure 5.

The intermediating bank steps in between the client and the dealer. The intermediating bank now and the dealer faces the bank via the CSA. On day 1, the intermediating bank must post collatera under the terms of the CSA, to offset the positive m2m. The question is: what is the fair value to cha intermediation?

Without an XVA desk, a bank might charge the LIBOR-OIS risk free price of 2 - 3 bp thereby giving th m2m gain on the XVA reduction. In principal, this applies to any trade where the m2m may move the arranger's favor and there is no CSA in place with the client. The EPE and ENE profiles for the s in Figure 6. The remaining tenor is 4 years. Given the moves in the underlying rates, the simulation trade has a large positive m2m with very little chance of further movement. Calculating (11) - (17) g

$\text{CVA} = \text{USD}\quad 390,000, \text{FVA} = \text{USD}\quad 300,000,$

or 19 bp running. By stepping in, the intermediating bank's CSA will collapse these risks as co immediately posted to the dealer. This is an order of magnitude greater than the typical flow P & L.

Figure 5. Cross-currency swap intermediation.

Figure 6. EPE and ENE profile for a deep in-the-money cross-currency swap.

Recall that all calculations are undertaken with a 5-year CDS and funding rate equal to 100 bp. spreads were substantially wider. Dealer credit spreads were routinely more than 300 bp. Wide spreads and funding rates in these calculations to those post-Lehman levels can elevate the XVA to of the trade notional. The magnitude of the risk only heightens the dealer's desire to novat Consequently, not calculating XVA can leave significant economic value on the table for the interme

In conclusion, trade novation is not a recent development. Prior to the Lehman default, the sa Figure 5 was used to intermediate Collateralized Debt Obligations (CDOs). Inevitably the CDOs we typically A to AAA. The rating may make the intermediation appear less risky. However, w delinquencies increased in the United States in 2007 and clients were bankrupted by losses on t intermediating banks incurred substantial losses [47] . The arranger was protected by the CSA.

3.3.3. One-Way CSA

A common request from highly rated counterparties, usually A to AAA, is to ask their arrangers t CSAs. Such a request may typically originate from Debt Capital Markets (DCM) where a new bon negotiated with the client. As part of the debt issuance, underlying swaps will also be traded to m capital needs across a variety of currencies. Assume the client requires a 5-year cross currency sw in GBP semi-annually, receiving USD 3-month LIBOR floating, as part of the new issue. The EPE a for such a trade are shown in Figure 7. Note that the profile does not pull to par as there is substa principal exchange at maturity. Should the bank sign the CSA to win the DCM business?

As an uncollateralized trade, the XVA produces

$\text{CVA} = \text{USD} \quad 460,000, \text{FVA} = \text{USD} \quad 240,000,$

or a running spread of 15.5 bp. The proposed one-way CSA would see the bank post collateral a USD 20 MN and the client would not post collateral. The effect of signing the CSA would be the im any $\text{FVA}_{\text{benefit}}$. Hence, the XVA costs would increase to USD 800,000, or 18 bp running.

Now assume that the client trades a second cross-currency swap with the same terms under the pro CSA will come into effect as the EPE breaches the collateral threshold. The incremental XVA is now:

$\text{CVA} = \text{USD} \quad 270,000, \text{FVA} = \text{USD} \quad 150,000,$

or a running spread of 9 bp. The argument from DCM will be that the client will issue more than time and the relationship should be developed. The total P & L for DCM from a new debt issue is a bp. The question is then: How many trades are needed for the bank to be profitable? As shown in Ta will not see profitability until the 4th trade or USD 400 MN in notional equivalent has been dealt.

The portfolio effect is crucial under a one-way CSA. The incremental risk can be negligible if the have been breached. But to reach those levels, the bank may need to incur short term losses wh proposition for any capital markets business. Consequently, the costs need to be priced into the ne the arranger should not trade the swaps. Another obvious question is whether the Credit Risk c have the appetite to in fact trade adequate notional with the client to make the business viable. Alte

Figure 7. 5-year cross-currency swap, paying fixed in GBP versus receing U USD 100 MN equivalent.

Table 4. XVA costs under a one-way CSA[a].

[a]XVA as a running bp adjustment to the fixed rate of the swaps.

the bank could approach the client and ask to trade the required swap notional as part of the bond profitability.

3.3.4. Counterparty CSA Arbitrage

Once trading desks actively manage XVA, the way they approach risk will change. The simple fact t automatically generates trading opportunities with counterparties that do not price it. Genericall reduce the XVA exposure to a given counterparty. This will result in an upfront P & L release from the affected flow book.

Take Figure 8. Here a swaption dealer identifies that selling volatility to a regional counterparty, wh CSA in place, will reduce the overall exposure to that counterparty. The trader then execu Consequently, the XVA desk pays the incremental XVA release to the swaption desk. The swap executes an offsetting hedge, or buys back the volatility from a street counterparty, under a threshold CSA. The hedge effectively negates the market risk. The trader is then free to pass the c Treasury and earn the funding on the released P & L.

The offsetting hedge with the regional bank does not introduce new XVA due to the CSA. There is n the positions offset and crucially there will be no capital charge as there is no increase in VaR. Neith bank, nor the client, will understand the motivation for the trades by the dealer as they only see structure. The regional client has generated the XVA exposure by trading without a CSA. The dea CSA with the regional bank to offset the risk. As previously discussed, XVA Trading does not s trading businesses but it does alter the way a bank views and trades risk.

3.4. Long Dated Swap Trading

Trading long-dated swaps generates risks that are easily overlooked. Here two risk mitigants are ex of their effect on such trades.

3.4.1. The Collateralization Effect

Large international dealers will commonly trade IR swaps with maturities out to

Figure 8. Counterparty CSA arbitrage.

30 years. They will seek banks that do not price XVA, as counterparties to hedge those transac possible. The reason is that under a CSA agreement a Bank might assume that the XVA is trivial and fact, that is not the case. The mechanism for posting collateral was given in (10). Beyond that, wit

are three key terms:

- Collateral threshold.
- Minimum transfer amount.
- Posting lag.

The threshold specifies the m2m above which counterparties will post collateral. The minimum t quantifies the minimum size of the exposure before a collateral call can be made. The posting la number of days between the margin call and when the actual collateral must be delivered. Eve threshold, the remaining two terms carry risk; especially for long- dated trades. In Figure 9, the u and collateralized exposures for a zero threshold CSA, with a USD 500,000 minimum transfer amou posting lag, are shown for a USD 100 MN swap paying fixed at-the- money. Despite the CSA, the col routinely exceeds USD 1 MN and can approach USD 2 MN. The reason is that between making the r receiving the collateral, the exposure continues to increase; in this case, more than doubling. collateralized position, (11) - (17) yield

$$\text{CVA} = \text{USD} \quad 386,000, \text{FVA} = \text{USD} \quad 177,000,$$

which equates to a total of USD 563,000 or 3 bp running. Certainly, this is lower than for the uncolla The same calculation on the uncollateralized exposures produces a total XVA equal to USD 5.3 under no circumstances does the CSA eliminate the risk. In fact, the residual XVA from collateraliza equals the day-1 P & L for the trade. The magnitude of the residual XVA is magnified by the surviv in (11) - (16). Recall that the CDS spread used in these calculations was 100 bp. After 15 yea probabilities drop below 70%. After 25 years, this decreases further to

Figure 9. Collateralized and uncollateralized EPE and ENE profiles for a 30-ye

50% (see the appendix for the details). Hence the residual XVA is greater the longer the maturity of t

3.4.2. Mandatory Breaks

The United Kingdom market for long-dated interest rate and inflation swaps has grown significant approximately GBP200 billion (BN) in outstanding notional [48] . Funds trying to manage the risk paying inflation-linked pensions to members drive the market. Tenors commonly extend to 30 yea out as far as 50 years. Pension funds may opt to have tight two-way zero threshold CSAs in p arrangers. As just seen, even under such a CSA, the XVA on a 30-year interest rate swap will still imp approximately 3 bp which amounts to non-trivial P & L. The fund will also be forced to post colla CSA a fact which will further impact the funds ability to invest. Pension funds can look at other op risk, such as increasing the collateral quality further, or allowing bigger haircuts (i.e. a perce collateralization) on the assets used. Another option is for pension funds to post an initial margin, assets; all of which will drag on the performance of the fund. Instead the market has evolved a

reduce the XVA by reducing the length of the trades by adding mandatory breaks to the term shee
break tenor is 5 years.

In Figure 10, the effect of introducing the mandatory break is shown. With the EPE and ENE profile
calculated XVA equals

XVA break = USD 1.1 MN,

under the effect of the break clause. This is certainly higher than the collateralized figure for the ful
there are no collateral calls. Two issues should be addressed with any counterparty looking to exe
break clauses. Firstly, an assessment must be made of whether the counterparty will be able to
From the sum of the EPE and ENE in the simulation of Figure 10, the expected m2m at the brea
Unwinding the trade requires the client to have the requisite liquidity to fund that payment to t
break date. Secondly, the break must be mandatory. As part of the

Figure 10. 30-year swap with a 5-year mandatory break.

relationship with the client, Sales will not want to break the trade. If the break is optional then the X
price the risk to the full maturity of the trade. The only exception is if the XVA desk owns the opti
can trigger it.

Another consideration is how the XVA is quoted. The client may seek to price the XVA to the break
it included in the spread of the swap, which is quoted to term. This is not ideal for the XVA desk
often non-negotiable with the counterparty. In those instances, the term sheet must be modified to
At the break date, the universal question that is asked is, "What is the XVA cost to roll the trade for
An understanding of whether there is residual XVA from the previous break is then important for
costs to roll the position.

3.5. Risk Participation Agreements

Corporate clients can fall into a grey area, where they need to raise large amounts of capital, bu
debt market is not readily open for issuance. In such a case, they may seek a syndicated loan. Assum
USD 1 BN, which will exceed any individual credit line for a single institution. The client will app
bank to orchestrate the loan via multiple other banks, known as participant banks. Assume USD 20
as shown in Figure 11. Fees, interest payments and the repayment schedule will all be govern
Participation Agreement (LPA).

The agent bank will also need to provide underlying swaps to the client to facilitate the movemen
Again, the notional required will exceed the credit lines of the agent bank. To offset this, the agent b
risk participation agreements (RPA) with each of the participant banks in the syndicated loan. Unde
corporate client defaults on the underlying interest rate swap, the participant bank is responsible fo
to the agent bank. Typically, a participant bank's risk participation is pro rata to its participation i

participant bank receives an initial fee and then has no further involvement with the swap unless t defaults. For the structure shown in Figure 11, the agent bank and each participant bank fund 2 facility. Similarly, each participant bank would also take a 20% risk participation in the correspond swap.

Assume the counterparty defaults with a 40% recovery. The agent bank's loss from the default wo MN. Each participant bank would then

Figure 11. Syndicated loan structure.

absorb USD 120 MN in losses under the LPA. Similarly, each participant bank would pay 20% of positive m2m on the underlying swaps from the RPA. This is exactly the cash flow given by Equati words, an RPA is simply a CCDS. The value, or m2m, of the CCDS is the CVA calculated using (11).

A provision in Dodd-Frank [49] has created the possibility that RPAs could be interpreted as sw Lobbying against treating RPAs as swaps has been undertaken [50] [51] . The case has been made t transfer the risk of IR movements. In fact, from Equation (11), the RPA derives its value d movements. There is also a claim that RPAs are banking products. Certainly, the LPA is a bank identified under Dodd-Frank. However, the RPA is clearly a non-trivial credit derivative. Hence, an be characterized as a "simplified CDS" [51] .

To quantify the economic value of an RPA, there are two further considerations. Firstly, the ter shorter than the swaps that have been considered here so far; typically, 2 - 4 years. Also, a syndicated loan is often traded with a counterparty that can't access the wholesale debt mark counterparties are less credit-worthy or even sub-investment grade. This will translate to a Equation (11) that is much wider than the curve used in these case studies. In Table 5, the CVA for swap paying fixed, at-the-money, is given for short-dated tenors against several high yield credit c take-away is that the upfront fee for the RPA is non-negligible and the marking of the credit curve i the tenor extends much beyond 3 years, the CVA increases markedly. Finally, comparing to the re 3.3.3, if the underlying swaps are cross-currency, the CVA in Table 5 will increase by a factor of 3.

Another consideration is funding. The RPA only insures against credit risk. The agent bank will st costs for the entire notional of the swap. In Table 6 the equivalent funding risk for the same swap For the

Table 5. CVAby swap tenor and CDS spread per USD 200 MN in notional[a].

[a]CVA as an upfront amount in USD and as a running bp spread in brackets.

Table 6. FVA by swap tenor for USD 1 BN in notional[a].

[a]FVA versus the 5-year funding spread of 100 bp as given in the appendix.

full USD 1 BN in notional, the FVA equals USD 525,000 for the 5-year swap. Again, note that exter quickly increases the FVA. The agent bank should transfer price this to the corporate client. Like needs an understanding of XVA costs to ensure best execution.

3.6. Asymmetric CSA and Clearing

Beyond the immediate portfolio offset from netting, the structure of individual deals and their inhe can materially alter the relative magnitude of the XVA. Consider the scenario given in Figure 12. asked to intermediate a trade between a dealer and a triple-A rated client. In this case, the client intermediating bank, not the dealer. The motivation to novate the swap is to free up lines for between the client and the dealer. There is a CSA in place between the intermediating bank and th the CSA, the intermediating bank will post collateral when exposures reach USD 10MN. The leveraging their rating, will not post collateral until the m2m exceeds USD 30 MN. The interme cleared through a central counterparty (CCP) to the dealer.

Assume there is an existing portfolio of trades as shown in Table 7. The effect of the existing significantly reduce the perceived risk of the intermediated trade as the incremental exposures quickly move through the CSA thresholds. Nevertheless, there is still risk up to those thresholds. intermediated is a 4-year, USD 2 BN swap, paying fixed at-the-money semi-annually versus rec LIBOR floating. On the leg facing the client there is incremental XVA risk on the new trade up to the That is shown in Figure 13. There will be incremental CVA, but also FVA, as the clearing house will c margin to offset any m2m movement in the cleared position. Calculating the incremental XVA produ

Figure 12. Asymmetric CSA and clearing.

Table 7. IR portfolio facing the triple-A client[a].

[a]With a two-way asymmetric CSA. Arranger posts at USD 10 MN, client posts at USD 30 MN.

Figure 13. EPE and ENE profiles for the portfolio in Table 7.

$\text{CVA} = \text{USD} \quad 300,000, \text{FVA} = \text{USD} \quad 150,000,$

or a running spread of 0.6 bp. As a comparison, the XVA for the new trade on a stand-alone basis e
MN. Hence the existing portfolio and the CSA thresholds reduce the risk significantly.

Once the leg with the clearing house settles, there will be a margin call for IM. In section 4, we wi
margin call will equal USD 36 MN. The posted initial margin will continue to vary for the life of t
trade matures, the initial margin requirement will progressively roll off. In the interim, the initial r
must be funded analogously to FVA. Funding initial margin was defined in Equation (21). Again,
will show that

$\text{MVA} = \text{USD}\ 450,000. \quad (24)$

In summary, MVA has become the primary risk in the trade. This also adds another 0.6 bp to the
XVA charge. The total running spread of 1.2 bp for the XVA will be comparable to the IR desk P & L o
to transfer price the XVA to the client essentially leaves the intermediating bank with little to n
transaction.

4. Margin Value Adjustment

The main difficulty in applying (21), to calculate (24), lies in defining the forward initial margin, IM
IM is calculated using full revaluation historical VaR calibrated from 5 to 10 years of data. A p
essentially the Lehman default, is also included. At its most fundamental, Equation (21) requires r
inside the Monte Carlo simulation, i.e. at each simulated market scenario defined by (2) - (7), t
should be calculated. If the CCP uses 5 years of data, that will equate to a further 1250 revaluation
and simulation. Essentially, this is a nested Monte Carlo problem. If brute force is used, the calc
becomes computationally intractable. In [45] , this was overcome by calculating the MVA u
Processing Units and Longstaff-Schwartz regression [52] .

Ideally, the MVA would run on existing bank infrastructure. To achieve this, a simplifying argum
For IR swaps, the simplification exploits the inherent linearity of the product. As an asset class
minimal convexity. In Figure 14, a series of perturbations are applied to the USD yield curve used

to price swaps (see the appendix for details). Figure 15 shows the corresponding m2m across shocks and through time for a 10-year swap paying fixed at-the-money and receiving floating. At a step, the m2m varies essentially linearly versus the underlying simulation. In Figure 16, this can clearly as the m2m impact is plotted across all perturbations at the 5 and 10-year points. Some limi present; but in the tails of the simulation. Hence, the impact of the convexity will be negligibl calculated as the mean across all simulations at each time step. What this implies is that for IR swap effects can be ignored. The IM_i can be approximated by purely calculating the VaR from the yiel value the swap. The nested Monte Carlo problem is then avoided with minimal loss of accura reduces the computational burden.

Figure 14. Yield curve purtabations (in black) versus the closing yield cur valuation (in red).

Figure 15. 10-Year IR swap m2m through time for the yield curve scenarios in

Figure 16. m2m slice at 10 years and 5 years from Figure 15.

What does need to be addressed is the portfolio effect. The existing trade set can materially red incremental IM of a new trade. Furthermore, the portfolio composition will change through time; a and the netting effect rolls off. Capturing the portfolio aging can be done by rolling the valuation maturity. To model the portfolio effect, define the effective date as t_0 and the maturity date as T. The be margined can be written as

$F_0 = F(t_0, T, \ )$, (25)

where F represents the pricing of the derivative in question. Rolling the valuation date forward to obtain

$F_i = F(t, T, \ ) \mid t = t_0 + i$ (26)

and F_i is the future valued trade. There are several ways to roll the valuation date forward. For t illustration, the methodology will be kept relatively simple. Consider the yield curve instance at t

valuation at $t_i = t_0 + i$. The forward rates are left unchanged between the two dates. In particular, w
i, the discount factors for pricing cash flows are the same as the discount factors at t_0 which were
the t_0 curve. The initial margin is then the incremental VaR charge of the future valued trade agai
portfolio, $\tilde{F}$:

$$IM_i = VaR[\tilde{F}(t, T, \ ) \mid t = t_0 + i]. \quad (27)$$

In (27), the vector of historic shocks is held constant against the forward trades for $i = 1, \ , n$. In effe
is aged through time and the VaR calculation is run by holding the historic time series of perturbatio

It is now possible to quantify the MVA. To illustrate the application of (21), take a 5-year, USD 1(
interest rate swap, paying fixed semi- annually at-the-money versus receiving LIBOR floating qu
historical simulation, yield curve data from 1250 days spanning 2007 to 2012 were employed. Cho
period generically replicates the CCP methodology of including a stressed period represented
default. For the historical simulation, absolute basis point shifts were calculated and applied to clo
from September 29th 2014. The IM is calculated as a 1-day, 99th percentile, one tailed VaR. Applyin
the MVA is then calculated. For illustrative purposes, yearly time increments are used and the CCI
be riskless. The MVA is then broken down by time step for clarity in Table 8. For the trade i
calculated MVA is of the order of USD 18,000.

Is this significant? A simple way to assess the importance is to quantify the MVA against the FV
define a series of USD 100 MN notional swaps, paying fixed at-the-money, with maturities from 3 ye
Calculating both FVA and MVA, the results are summarized in Table 9. What the results show is tha
comparable magnitude to the FVA.

In practice, calculating a 1-day VaR is only a starting point. Generally, a clearing house will apply
period. This will lead to a substantially more conservative IM calculation. For non-cleared trades,
proposed a 10-day standard margin period of risk [53] [54] . Recall that

$$VaR_{n-day} \ \ VaR_{1-day} \times n. \quad (28)$$

Scaling the results from Table 9 by 5 indicates that the MVA is equivalent to the FVA.

In [45] , the calculated MVA was approximately 50% of the magnitude of the FVA, using a 10-day m
risk and the same data set to generate the perturbations. However, there were two differences. Fi
yield curve shocks were applied relatively i.e. as a percentage change to the yield curve, whereas
calculated absolutely, or as an absolute basis point shift

Table 8. MVA for a 5-year USD swap paying fixed[a].

[a]USD 100 MN, paying fixed at-the-money semi-annually, receiving 3 month Libor floating quarterly

Table 9. MVA versus FVA[a].

[a]USD 100 MN per swap, all at-the-money, paying fixed and receiving floating.

to the yield curve. In a low yield environment, relative perturbations, will produce a lower VaR shocks, thereby partly explaining the difference. Secondly, and most importantly, the MVA in [45] against the FVA for a portfolio where the m2m was deeply in favor of the dealer. This minimizes $FVA_{benefit}$ and also increases the FVA_{cost} substantially. Here the magnitude of the FVA is much lowe of the types of costs that new trades would generate.

Clearing was introduced following the Lehman default to reduce counterparty credit risk. Based on of the numbers from Table 9, what clearing has effectively done is to transform credit risk, i.e. CVA risk in the form of MVA. The net result for banks is that the overall magnitude of the risk predominantly unchanged.

Clearing houses also apply multiplicative factors to the VaR to capture either perceived lower cou quality, or concentration risk in that counterparty's portfolio. Generically such a factor varies be Hence for a lowly rated, highly concentrated name, the MVA could be substantially higher again. employ expected shortfall, which averages across the tail risk, instead of VaR which is a specific these extra adjustments, the MVA could easily exceed the FVA. Given the size of the FVA write-d been reported [5] [6] [7] [9] [10] [13] , quantifying MVA and transfer pricing it to clients becomes concern. Given that IR swaps are the main cleared asset class, developing an MVA calculation, simplifying assumptions made here, will allow banks to correct for these costs. From Table 8, it is calculate (24). Firstly, using a 5-day margin period of risk, the VaR for the 4-year swap equals U calculated MVA is then

$$\text{MVA} = \text{USD} \;\; 450,000 .$$

As indicated previously, there are also portfolio considerations. The numbers in Table 8 will ho calculated on a gross basis. If netting is employed there may be portfolio offsets. Consider the origi paying fixed, from Table 8, with an offsetting 3-year trade, receiving fixed, with the same USD 100 the presence of netting, the resulting MVA is calculated in Table 10. For the first 3 years, there is a IM but once the 3-year trade matures, the portfolio effect is lost. Crucially the total MVA is r Maximizing portfolio offset and netting across exchanges, while controlling concentration penaltie substantial benefit.

Another requirement of clearing house membership is the participation in Fire Drills. This is the pr portfolio of a defaulted counterparty is reassigned to another member via auction. Bidding on s requires quantifying the cost of facing the CCP for that portfolio. The FVA generated from the vari well understood. Considering the results here, failing to include MVA in the calculations can un costs by as much as 50%.

Table 10. MVA for an offsetting portfolio[a].

[a]USD 100 MN, 5-year swap paying fixed versus a 3-year swap receiving fixed.

5. Conclusion

Going forward, there is no agreed model. Many houses still ignore XVA. Others only look at CVA or a regulatory or accounting requirement. The function itself might sit within capital markets, but within the remit of a portfolio management function, or even treasury. Historically, trading owns and sales owns the credit risk. But with XVA, that paradigm is changing. Credit risk is now incre trading, under the XVA umbrella. Every time sales originate a trade, XVA risk enters the bank. Som now considering centralized business models where the XVA desk also handles the collatera function for capital markets. This may or may not include treasury. For large organizations wi networks, the XVA desk might also be tasked with internally transfer pricing XVA back to the desk th A global bank will find it hard to keep track of every sales representative and the prices they a thereby making this centralized function valuable.

Taking this a step further, one structure that is being implemented at certain banks in Europe consolidating the client facing role. The trade flow is shown in Figure 17. Under this business mode facing clients is the XVA desk. All trades are entered with the XVA desk, which then mirrors the risk t flow desks, after stripping the XVA from the trades. The fact that this new structure for capital m proposed at all reflects the changing nature of the market itself. The centralized model is considere when complex trades or unwinds are considered. Rather than trying to assess risk across multiple XVA desk has a consolidated position view. It is also an indication of the magnitude and changing the trading functions. Flow trading is relatively transparent. The client knows their price is 1 - whereas the XVA costs can be an order of magnitude higher and depend on a variety of variables su counterparty's credit curve is marked, to the legal documents in place with the client, to whether o have a clearing component. That's without even considering the complexity of the simulation itself of the centralized model is that it may run significant human risk. Existing sales relationships betw the flow desks will be affected. There may also be other legacy issues within a dealing room su systems that prevent the transition.

Figure 17. Centralized booking model.

Acknowledgements

The case studies presented here were all traded by the author while employed at National Australi
2010 and 2013. All exposure profiles and XVA calculations were produced using version 15 of
software designed and built by Calypso Technology Inc. An abbreviated version of this researc
distributed to Calypso clients in 2014 and 2015. However, the views and opinions expressed in thi
those of the author and do not necessarily reflect the official policy, or position, of Calypso Tech
market data was sourced from Bloomberg.

Appendix: Market Data

To calibrate (1) - (22), market data was sourced for September 29th, 2014. Yield curves are shown i
CDS and funding curve used in (11) is given in Figure A2. The corresponding survival probabilitie
curve are plotted in Figure A3.

The swaption volatility surfaces used to calibrate Equations (2) - (5) are given in Figures A4-A6.

The FX volatilities employed to calibrate (6) are shown in Table A1, Table A2. Risk reversals and
converted to 25 and 10-delta put and call volatilities applied to a 5-point volatility surface.

Figure A1. Yield curves for USD, EUR and GBP.

Figure A2. Funding and counterparty CDS curve by tenor (in bp).

Figure A3. CDS survival probabilities.

Figure A4. USD Log-Normal swaption volatilities, SA 30/360 vs. 3 M L Act/360).

Figure A5. EUR Log-Normal swaption volatilities, PA 30/360 vs. 6 M EU Act/360).

Figure A6. GBP Log-Normal swaption volatilities, SA Act/365 vs. 6 M LIBOR (S

Table A1. EUR FX implied volatilities[a].

[a]ATM: at-the-money; RR: risk-reversal; BF: butterfly.

Table A2. GBP FX implied volatilities[a].

[a]ATM: at-the-money; RR: risk-reversal; BF: butterfly.

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Zeitsch, P. (2017) The Economics of XVA Trading. *Journal of Mathematical Finance*, **7**,
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