WHITE PAPER:

BEST PRACTICE ANALYSIS OF CREDIT VALUATION ADJUSTMENT CALCULATION – A COMPARISON OF POTENTIAL FUTURE EXPOSURE AND CURRENT EXPOSURE APPROACHES

September 2010

I. OBJECTIVE AND BACKGROUND

Objective

This white paper compares various approaches to calculating the fair value and the attendant credit valuation adjustment (CVA) for interest rate and foreign exchange derivatives in accordance with the provisions of Accounting Standards Codification Topic 820, *Fair Value Measurements and Disclosures*, (formerly Statement of Financial Accounting Standards No. 157, *Fair Value Measurements*).

The guidelines of Topic 820 require that valuations incorporate the assumptions that market participants would use in performing valuations of financial instruments measured at fair value. In practice, two broad methods for determining CVAs have emerged. One approach uses simplified current exposure methods which focus on the current values of derivative positions to estimate the effect of credit risk on these values. The other approach uses more complex models to calculate the total expected exposure of the derivative positions, based on both current and potential future exposure. This paper will outline these different approaches and compare the results of current and potential future exposure models using specific examples of each.

Background

Topic 820 is an accounting standard issued in September 2006 as FAS 157 whose adoption is mandatory and which became effective for fiscal years beginning after November 15, 2007 (January 1, 2008 for calendar year entities). The guidance defines fair value, establishes a framework for measuring fair value under generally accepted accounting principles (GAAP), and expands disclosures about fair value measurements.

Under Topic 820, fair value is defined as, “the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date” (TOPIC 820-10-20). The fair value measures the price of a “hypothetical transaction… considered from the perspective of a market participant that holds the asset or owns the liability” and attempts to determine the “exit price” rather than the “entry price” (TOPIC 820-35-3). The fair value must be “determined based on the assumptions that market participants would use in pricing the asset or liability” in the “principal (or most advantageous) market” (TOPIC 820-35-9). Specifically with regard to liabilities, “a fair value measurement assumes… the liability is transferred to a market participant at the measurement date (the liability to the counterparty continues; it is not settled)” and that “the nonperformance risk relating to that liability is the same before and after its transfer” (TOPIC 820-35-16). In evaluating current and potential future exposure models, it will be important to examine how each approach conforms to these key considerations in the standard.

II. APPROACHES TO CALCULATING CVAs

A. General Principals

Before exploring the different approaches to calculating the exposure faced by the counterparties in a derivative contract, it is useful to first outline two key commonalities between all valid approaches to calculating CVAs.

First of all, every correct approach to calculating CVAs for derivative contracts must take into account the entire set of transactions between two counterparties and not simply look at an individual position. The unit of valuation for derivatives is generally at the counterparty portfolio level because master netting arrangements (the ISDA) and collateral terms, if any, exist to reduce the aggregate credit risk related to all derivatives between those parties. Accordingly, market participants appropriately consider credit risk for derivatives at the counterparty portfolio level whenever an ISDA document governs the counterparty relationship. Therefore a valid method for determining CVAs would by necessity calculate these adjustments at the counterparty level. For example, if a company has three interest rate swaps and an interest rate cap with a single bank counterparty, an accurate CVA would look at the net exposure represented by this set of positions rather than looking at each transaction separately.

Second, all methodologies for determining appropriate CVAs on derivatives apply some measure to account for the probability of default and expected loss given default on the transaction in question. Some approaches apply these factors directly and others use credit spreads or credit default swap spreads as an indicator of these factors. Chatham's earlier whitepaper provides a detailed explanation of how these factors are used to calculate the CVA. Simplifying approaches use flat spread assumptions across time while more complex methodologies utilize a term structure of credit adjusted for the probability of survival, but all approaches require some factor that captures the implied nonperformance risk of the two counterparties to the transaction to determine the CVA. With these two fundamental components in place, it is possible to examine the divergent approaches to calculating the exposure involved in a derivative.

B. Potential Future Exposure Models

One approach to calculating credit valuation adjustments on derivative positions considers the potential future exposure (or PFE) between the two counterparties of the contract. This methodology begins with the current exposure of the derivative, which reflects the estimated termination value of the transaction. For example, an at-market five-year interest rate swap executed at the five-year swap rate would have a current exposure of zero at inception, since the net present value of the expected future cash flows on the swap discounted using the unadjusted LIBOR forward curve would be zero.

While the underlying economics of such a swap might not represent any current exposure at inception, dealer banks who make a market in interest rate swaps would also evaluate the potential future exposure they might face toward their counterparty in the contract. Credit exposure is increased (or reduced) by the derivative's PFE. For an interest rate swap, the PFE is a function of movements in interest rates over time and the resulting, probability-weighted termination values. Calculating potential future exposure involves:

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a) shocking the current term structure of interest rates by the market-implied volatility of these rates;

b) determining the fair values of the derivative based on the dispersion of those interest rates after volatility is applied; and

c) probability-weighting and discounting those potential future values.

Added together, the current exposure and potential future exposure represent the total expected exposure. (For additional information about the calculation methodology using total expected exposure, please see Chatham's earlier whitepaper which contains a detailed discussion of this topic.)

Forward-based derivatives (such as interest rate swaps) can "flip" from being assets to being liabilities (and vice versa) based on movements, for example, in underlying interest rates or foreign exchange rates. Accordingly, there is both a positive and a negative aspect to the PFE for those types of derivatives – i.e., when volatilities are applied to forward-based derivatives, a portion of the exposure is an asset and a portion is a liability. Once the PFE is calculated, the positive portion (potential future scenarios in which the derivative is an asset) is multiplied by the counterparty's credit spread and the negative portion (potential future scenarios in which the derivative is a liability) is multiplied by the entity's own credit spread to arrive at two credit charges – one that arises from the entity's exposure to the counterparty and the other that arises from the counterparty's exposure to the entity.

Chart No. 1 below provides an illustration of PFE. This graph captures the exposure between two counterparties for a series of 10 foreign exchange forward contracts. These contracts, half of which are buy USD / sell EUR and half of which are sell USD / buy EUR, all begin on December 31, 2008, and mature one each quarter beginning at the end of September 2010, with the final contract maturing on March 31, 2013.

The net position is a liability of roughly $4 mm on the measurement date of March 31, 2009, but, as the graph depicts, there is potential over time for the set of trades to become a larger liability or an asset depending upon the future EUR-USD exchange rate. Once the relevant credit spreads have been applied against the exposure at each point in time, the overall CVA for the portfolio is $1,440,500, which is made up of a credit charge reducing the potential liability value by $1,564,400 and a corresponding counterparty credit charge reducing the potential asset value by ($123,900).

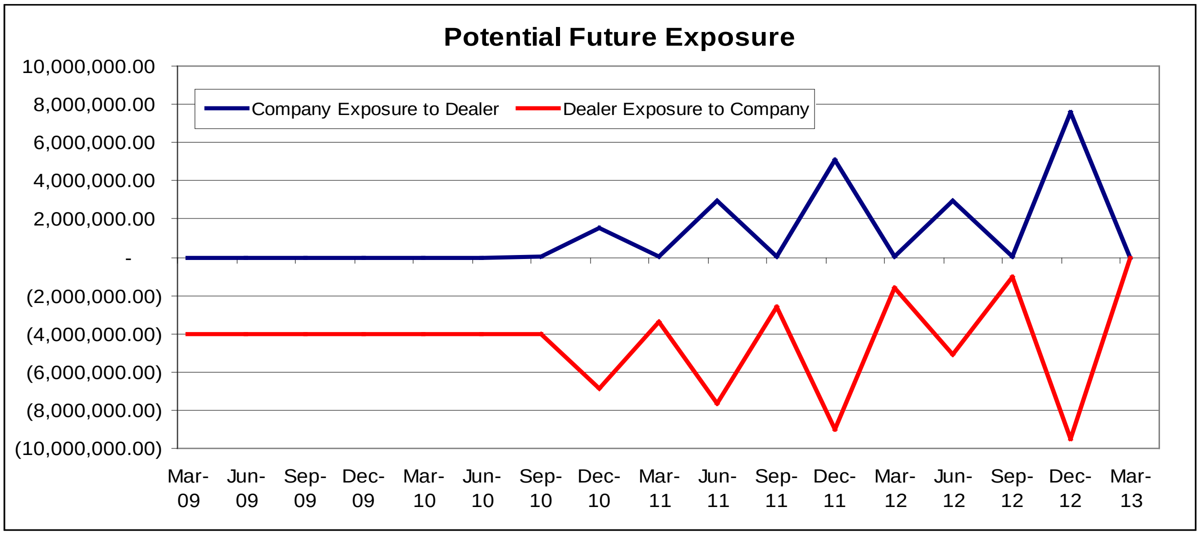

Chart 1. Aggregate PFE for FX Forward portfolio

TOPIC 820 requires that valuations incorporate the assumptions market participants would use in pricing the derivative contract. Market participants with the largest volume of transactions generally calculate CVAs based on both the current exposure and the potential future exposure of a derivative contract as of a particular point in time. Such a methodology represents a robust approach that is consistent with how dealer banks and other market makers calculate credit charges and routinely price credit risk in the marketplace. In addition, Ernst & Young's *Financial Reporting Developments: FASB Statement No. 157, Fair Value Measurements*, refers to a study published in July 1993 by the Group of Thirty (G30 Study) entitled *Derivatives: Practices and Principles* (and its related Working Papers), which recommends that both dealers and end users measure credit exposure on their derivatives by considering both current exposure and potential exposure.[1] Such an approach, while certainly complex, represents the most technically accurate methodology for calculating the fair value of a derivative contract.

C. Current Exposure Approaches

While market expectations and auditor requirements continue to evolve, and as more valuations providers attempt to develop their own potential future exposure models to follow the robust approach highlighted above, currently many firms use current exposure models to determine the CVAs on their derivative portfolios, especially when the CVAs calculated by these simplified approaches are not judged to be material.

The simplicity of the current exposure approach makes it attractive to entities performing their own CVA calculations. There are four essential approaches to calculating current exposure, although each one makes the same basic assumption in order to approximate the exposure between two counterparties in a derivative contract. All current exposure models assume that market volatility for interest rates or

[1] In-depth discussion of how to accurately measure credit risk in derivative instruments, including the modeling of a derivative's total expected exposure, is available in various professional and financial publications, such as *Counterparty Credit Risk Modelling: Risk Management, Pricing and Regulation*, edited by Michael Pykhtin, published by RiskBooks.

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foreign exchange rates can be ignored and that the current forward curve offers enough information from which to estimate the CVA. From that initial assumption four approaches with varying complexity have been developed to determine current exposure.

1. Discounted Cash Flows Using a Single Spread

This first approach adjusts the discount factors used to calculate the present value of expected future cash flows of a derivative by the credit spread of the party holding the liability position on the contract. While the estimated termination value of an interest swap, for example, would be calculated by using discount factors derived from a mid-market LIBOR forward curve, this method for determining the CVA would adjust these discount factors by the credit spread of the party in the liability position on the measurement date.

The credit risk-adjusted fair value of the derivative then is the sum of the projected future cash flows discounted by this adjusted discount factor, and the CVA is the difference between the adjusted and the unadjusted value of the contract.

$$\text{Estimated Termination Value} = \sum_{k=1}^{T} \frac{CF_k}{(1+r_{0,k})^k}$$

$$\text{Credit-Risk Adjusted Value} = \sum_{k=1}^{T} \frac{CF_k}{(1+r_{0,k}+creditspread)^k}$$

CVA = Estimated Termination Value – Credit Risk-Adjusted Value

For the portfolio of foreign exchange forward contracts introduced above, the projected future cash flows on these derivatives would equal the calculated settlement values at the measurement date. Because the net position is a liability to the company of roughly $4 mm, the company's credit spread (in this case 1,000 basis points) would be applied to the discount factors for each of these projected cash flows, regardless of whether an individual cash flow is expected to be an asset (receivable) for the company or a liability (payable).

This approach results in a CVA of $1,142,300 which is $298,200 lower than the CVA from the potential future exposure approach.

2. Discounted Cash Flows Using Multiple Spreads

The second current exposure approach also adjusts the discount factors used to calculate the present value the projected future cash flows; however, in this approach the discount factor is adjusted by the company's credit spread when the projected cash flow is a payable and by the dealer counterparty's credit spread when the projected future cash flow is a receivable. For the portfolio of foreign exchange forward contracts examined so far, half of the transactions are in an asset position at the measurement date of March 31, 2009, while the other half are in a liability position. This means that the contracts in an asset position have the counterparty credit spread (540 basis points in this example) applied to adjust

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the discount factors. The net result is a CVA for the portfolio of $1,678,200 which is $237,700 higher than the CVA calculated using the PFE model.

$$\text{Estimated Termination Value} = \sum_{k=1}^{T} \frac{CF_k}{(1+r_{0,k})^k}$$

$$\text{Credit-Risk Adjusted Value} = \sum_{k=1}^{T} \frac{CF_k}{(1+r_{0,k}+relevant\ creditspread)^k}$$

CVA = Estimated Termination Value – Credit Risk Adjusted Value

3. Variable Exposure Using Multiple Spreads

A third approach to estimating CVAs using current exposure involves the use of the unadjusted termination value rather than the individual cash flows to determine the appropriate adjustment. The total settlement value of the portfolio is calculated over the life of the contracts and then this exposure is multiplied by the relevant credit spread to determine the CVA for the set of trades. Under this approach, whenever the total value is an asset the dealer credit spreads are used and whenever the value is a liability the company spreads are used.

$$\text{CVA} = \sum_{k=1}^{T} \textit{termination value}_k * \textit{relevant credit spread} * \textit{time to maturity}_k$$

For the portfolio of foreign exchange forward contracts used in the preceding examples, this approach looks at the settlement value of the portfolio out to the maturity of the longest dated transaction. The termination value remains constant until the first of the ten contracts matures, and is then adjusted every quarter as another contract matures. The net value of the portfolio is always a liability under this approach and so the company credit spread of 1,000 basis points is used throughout to calculate the credit adjustment. Using this approach, the net CVA for the portfolio is $1,410,000, which is only $30,000 less than the CVA calculated under the potential future exposure model.

4. Constant Exposure Using a Single Spread

The final method for determining CVAs using current exposure is the most simplified approach. It looks only at the current termination value of the portfolio and multiplies this by the relevant credit spread and the time to final maturity for the transactions to determine the CVA. Given the current settlement value for the portfolio of ($4,065,000) this method would use the company credit spread of 1,000 basis points and the four year time to maturity, resulting in a CVA under this approach of $1,650,000, which is $210,000 higher than the CVA calculated using the PFE methodology.

CVA = *termination value * credit spread * time to maturity*

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Each of these four current exposure approaches results in a different estimate of the CVA. Some of these approaches produce results closer to the potential future exposure method than others do, with half of them under-stating the CVA and the other half over-stating it.

SUMMARY TABLE OF CVA RESULTS

Method	Type	Resulting CVA
PFE	Total Expected Exposure	$1,440,500
Method 1. Cash Flow Single Spread	Current Exposure	$1,142,300
Method 2. Cash Flow Multiple Spreads	Current Exposure	$1,678,200
Method 3. Variable Exposure Multiple Spreads	Current Exposure	$1,410,000
Method 4. Constant Exposure Single Spread	Current Exposure	$1,650,000

Table 1. CVA Results Under Various Methodologies

While different examples would result in different discrepancies between the results, the general weakness of current exposure approaches comes from the fact that they do not consider the bilateral nature of the exposure between the two counterparties. This can result in an over-stated CVA because any potential offsetting charge from the truly bilateral exposure of the derivative transaction is ignored. A further problem with simplified current exposure approaches is that they ignore the volatile nature of potential future exposure, often resulting in an under-stated credit adjustment. CVAs calculated for transactions on their inception date – when their current exposure is close to zero – often display this issue, but it can occur during the life of derivative transactions as well. Finally, the various results from different current exposure approaches show a wide dispersion of possible CVAs, varying by over 20% from the average CVA calculated using these methodologies. For situations in which the CVA can have a material impact on reported earnings, the value of using a robust and technically accurate approach consistent with the principles-based standards of ASC Topic 820 becomes apparent.

III. IN DEPTH COMPARISON OF POTENTIAL FUTURE AND CURRENT EXPOSURE

While the above discussion gives an overview of the differences between current and potential future exposure for derivatives, a more thorough example will be useful in elaborating on the different CVAs resulting from these varying approaches. For this purpose, we examine a portfolio of interest rate hedging transactions and the associated CVAs, calculated at inception and for five subsequent quarters.

For the purpose of this examination, a portfolio containing two interest rate swaps, one interest rate cap, and one interest rate swaption will be used. All four transactions have initial trade dates of June 30, 2008, and the terms of the trades are summarized in the table below.

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Derivative	Trade Date	Exercise Date	Maturity Date	Notional	Strike Rate	Floating Index
Pay-fixed swap	6/30/2008	NA	6/30/2018	$100mm	4.69%	3-month LIBOR
Receive-fixed swap	6/30/2008	NA	6/30/2013	$50mm	4.21%	3-month LIBOR
Purchased cap	6/30/2008	NA	6/30/2011	$50mm	4.50%	3-month LIBOR
European receive-fixed swaption	6/30/2008	6/30/2010	6/30/2018	$100mm	4.25%	3-month LIBOR

Table 2. Derivative Terms Summary for Example Portfolio

The first interest rate swap pays a fixed rate of 4.69% semi-annually for 10 years on a notional of $100 mm and receives quarterly payments based on 3-month USD LIBOR. The second swap pays quarterly interest payments for 5 years based on 3-month USD LIBOR and receives a fixed semi-annual payment of 4.21% on a notional of $50 mm. The purchased interest rate cap has a notional of $50 mm and strike rate of 4.5%, meaning the company will receive a quarterly payment if 3-month USD LIBOR exceeds 4.5% during the three year term of the cap. Finally, the purchased interest rate swaption gives the company the right to enter an 8-year swap 2 years from the trade date (on June 30, 2010) in which they would receive a fixed rate of 4.25% semi-annually and pay 3-month USD LIBOR quarterly on a notional of $100 mm. Although the two swaps had small liability values at inception, the two purchased options (the cap and the swaption) both had positive values due to the market expectation that they may become assets over the course of their terms, giving the total portfolio an initial asset value of approximately $3.2 mm. For the six quarters examined, the following values display the unadjusted settlement or termination values (in dollars) of the portfolio at each date.

Date	Settlement Value
6/30/2008	3,215,261.30
9/30/2008	2,221,445.14
12/31/2008	(1,029,436.69)
3/31/2009	(1,036,482.38)
6/30/2009	1,670,414.25
9/30/2009	512,312.87

Table 3. Portfolio Termination Value across Six Quarters

In analyzing the CVAs calculated for this portfolio, the projected future cash flows and the exposures generated for these four transactions will be treated as a net position between the company and their counterparty. We then calculate CVAs for six quarterly periods, beginning with the inception date of June 30, 2008, and including September 30, 2008, December 31, 2008, March 31, 2009, June 30, 2009, and September 30, 2009.

For each date CVAs will be calculated under six different scenarios. We use three different generic companies (Ace Healthcare, Ace Corporate, and Ace Real Estate) representing average credit spreads

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across these three sectors (healthcare companies, low-rated corporate entities, and real estate companies respectively). Each company will face two different counterparty banks – one with lower and more stable credit spreads (Bank 1) and one with higher and more volatile spreads (Bank 2) to illustrate the impact of facing dealers with different credit standings.

At each date, we generate CVAs across all six scenarios using each of the methodologies outlined above. The calculations will be presented in both tables and graphs to demonstrate the different results obtained under each approach. This will allow comparisons of the varying methodologies.

A. Potential Future Exposure

The first approach examined uses the potential future exposure of the portfolio to calculate the CVAs. This methodology begins with the current exposure between the two counterparties (Ace and the Bank) and uses market-implied volatility of interest rates to project the potential exposure represented by the portfolio of transactions. While the cap and the swaption (as purchased options) can never become liabilities, the two interest rate swaps have the potential to be either assets or liabilities over time. Therefore the potential exposure graph below displays bilateral exposure. This data specifically focuses on the portfolio as of 6/30/08, using interest forward curves and market volatility to project the total expected exposure between Ace and the Bank counterparty.

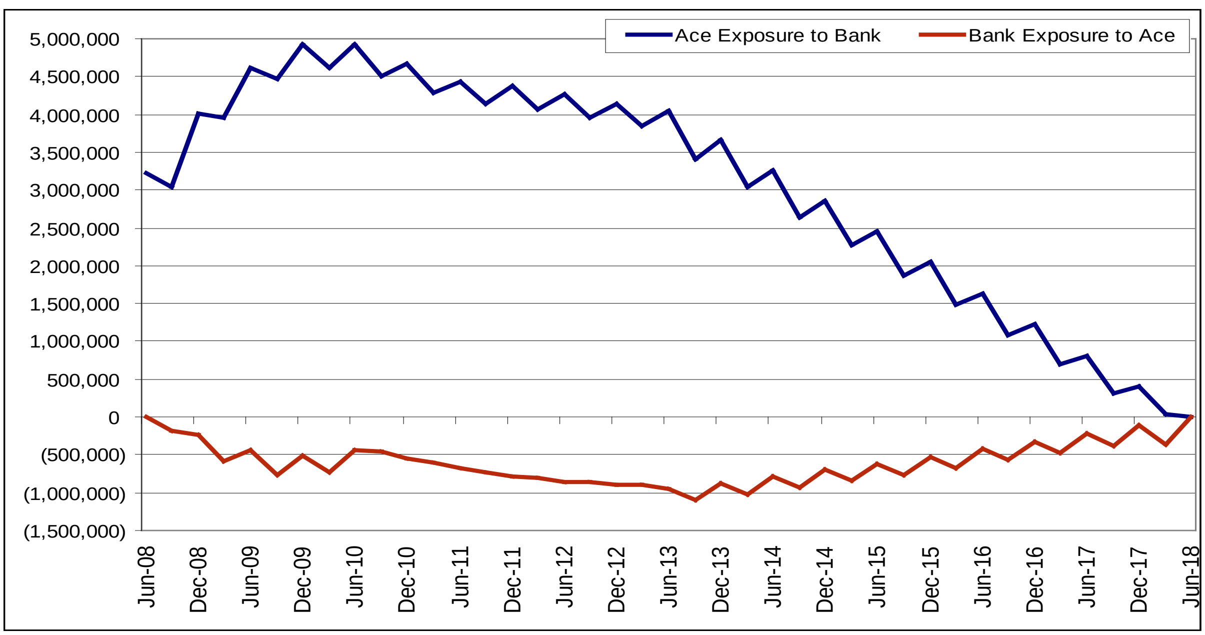

Chart 2. Portfolio Potential Future Exposure as of 6/30/08

Calculating the exposure profile of the portfolio comprises the first step in determining the CVA. The second step involves determining the correct credit spreads to apply to this exposure curve. The period examined in this paper – June 2008 through September 2009 – constituted a period of tremendous volatility in credit spreads for dealer counterparties as well as for companies holding derivative

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contracts. Across all of the methodologies examined in this paper, the starting point for determining credit spreads for the three Ace entities comes from the flat credit spreads below, given in basis points.

Date	Ace Healthcare Spreads	Ace Corporate Spreads	Ace Real Estate Spreads
6/30/2008	247	425	387
9/30/2008	287	950	523
12/31/2008	499	1,700	1,449
3/31/2009	394	1,350	1,139
6/30/2009	270	850	600
9/30/2009	226	700	341

Table 4. Ace Entity Credit Spreads across Six Quarters

However, the potential future exposure approach calculates implied forward credit spreads from these flat spreads. This process requires using information about the loss given default (LGD), i.e. the percentage of the exposure amount that would not be recovered if the party were to go into default, to calculate an implied conditional probability of default for each period. For the three Ace companies used in these examples, a conservative assumption of 100% LGD produced the following credit curves at June 30, 2008. These three curves show a slight impact for the implied conditional probability of default because the initial values started relatively low; for illustrative purposes the graph also depicts the forward credit curve for Ace Corporate as of December 31, 2008, when the flat value started at 1,700 basis points.

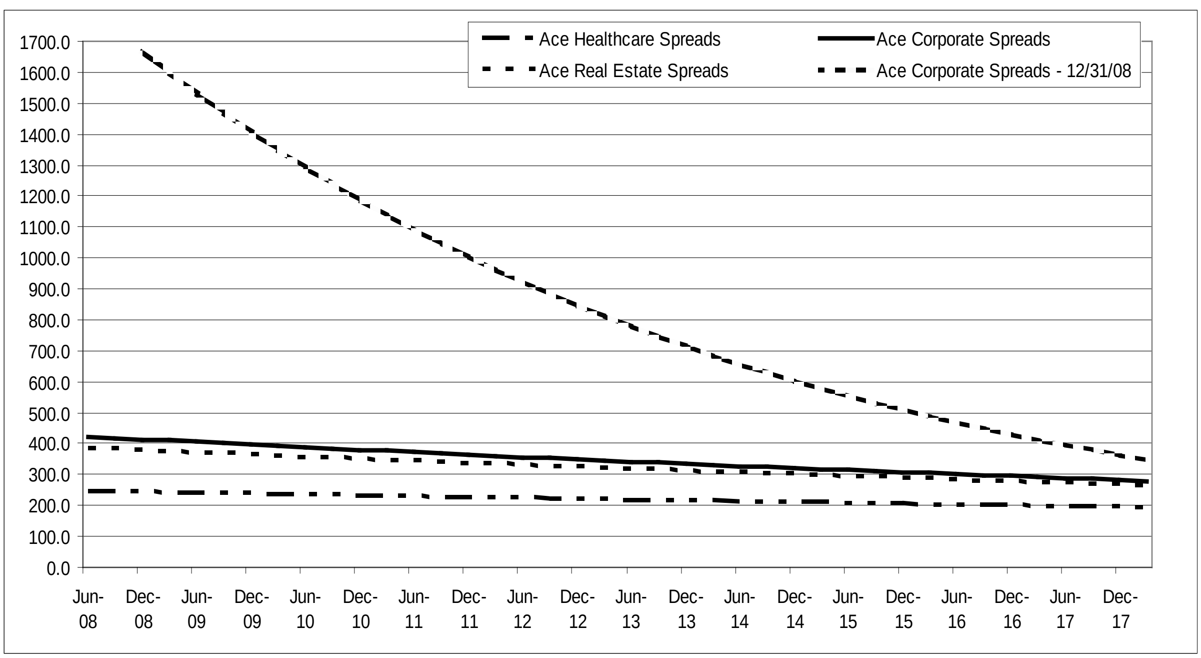

Chart 3. Forward Credit Spreads for Ace Companies

For the two bank counterparties used in these examples, similar issues emerge in the different ways that various current exposure approaches and the potential future exposure approach treat the credit spreads. All four of the current exposure methodologies simply use a flat spread for the bank counterparties where these are required; these flat spreads are listed in the table below.

Date	Bank 1 Spreads	Bank 2 Spreads
6/30/2008	57.71	140.06
9/30/2008	113.55	223.06
12/31/2008	171.51	300.11
3/31/2009	209.39	540.90
6/30/2009	85.16	518.26
9/30/2009	91.88	166.57

Table 5. Five Year Credit Spreads for Two Banks across Six Quarters

Rather than relying on a simple flat credit spread, the potential future exposure approach uses a full ten year term structure of credit and calculates the impact on these spreads of the relevant conditional probability of default to capture the ways that credit spreads differ by the time to maturity for these bank counterparties. The ten year term structure for the credit spreads, along with the LGD assumption used for each date, is given in the tables below for the two bank counterparties.

Bank 1 Spreads	6/30/2008	9/30/2008	12/31/2008	3/31/2009	6/30/2009	9/30/2009
Year 1	10.97	22.08	42.53	39.81	15.76	16.53
Year 2	20.83	42.80	79.54	77.87	28.96	31.37
Year 3	32.62	67.58	116.90	122.42	45.62	49.16
Year 4	46.11	92.90	150.43	170.52	65.10	70.62
Year 5	57.71	113.55	163.88	209.39	85.16	91.88
Year 6	65.56	126.55	171.29	232.99	99.71	107.86
Year 7	70.86	134.36	171.51	246.44	110.59	120.28
Year 8	74.31	138.49	177.35	251.95	118.79	130.10
Year 9	76.36	139.50	179.91	252.82	124.93	137.89
Year 10	77.36	139.96	180.85	254.16	129.46	144.06
LGD:	**1**	**0.195**	**0.1773**	**0.3077**	**0.2976**	**0.3845**

Table 6. Term Structure of Credit Spreads for Bank 1 across Six Quarters

Bank 2 Spreads	6/30/2008	9/30/2008	12/31/2008	3/31/2009	6/30/2009	9/30/2009
Year 1	23.77	34.61	173.94	834.31	459.04	34.42
Year 2	59.70	86.68	314.69	962.26	571.93	63.61
Year 3	93.04	138.32	341.10	799.22	596.95	98.16
Year 4	121.86	186.87	327.58	650.70	564.55	134.74
Year 5	140.06	223.06	300.11	540.90	518.26	166.57
Year 6	150.65	244.87	272.00	460.71	475.74	190.12
Year 7	156.23	257.07	245.78	399.85	436.96	208.09
Year 8	158.38	262.54	222.36	352.36	401.89	221.96
Year 9	158.12	263.23	201.88	314.48	370.41	232.67
Year 10	156.17	260.52	184.14	283.68	342.28	240.85
LGD:	**1**	**0.3176**	**0.1717**	**0.2476**	**0.3075**	**0.5089**

Table 7. Term Structure of Credit Spreads for Bank 2 across Six Quarters

Using the potential future exposure approach and the forward credit spread methodology generates the CVAs depicted on the graph below.

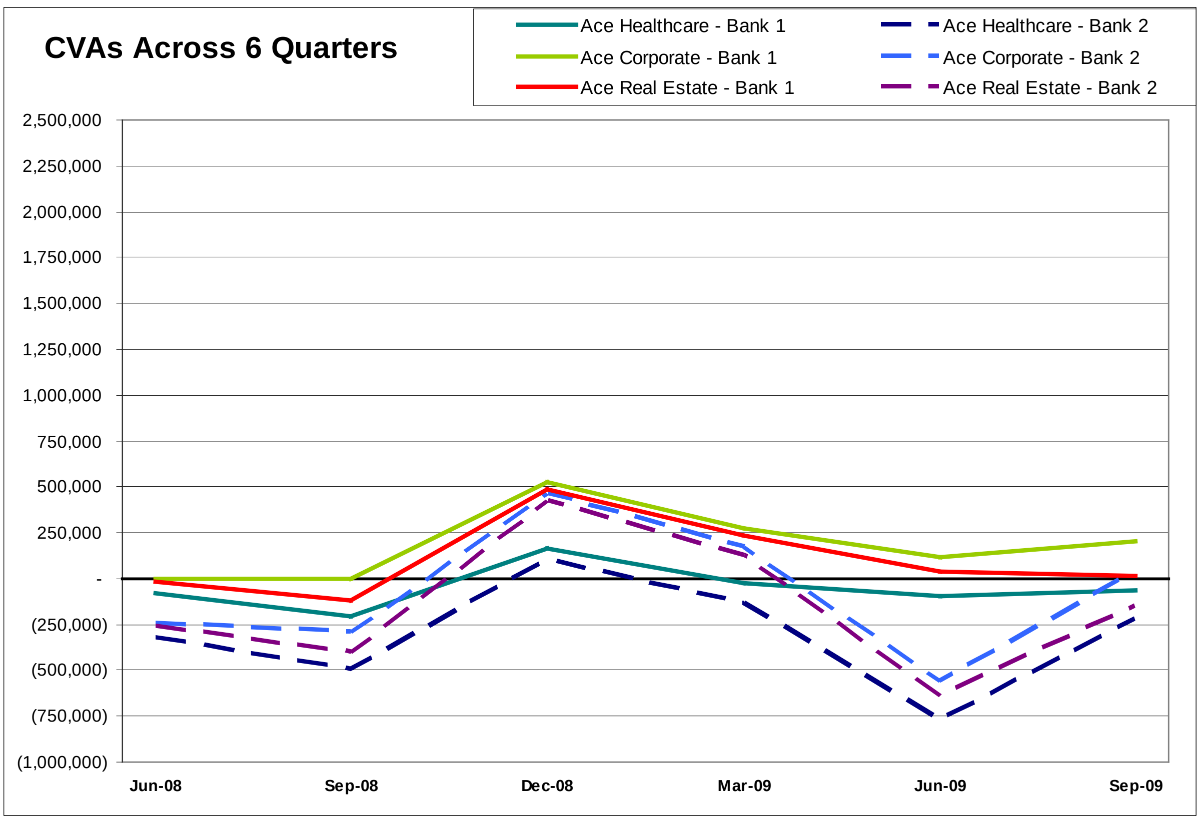

Chart 4. CVAs Using PFE Approach

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The CVAs displayed for this 15-month period demonstrate significant volatility. The CVAs for Ace Healthcare facing Bank 1 stayed within the narrowest band and still moved over $370,000 from the low point to the high point. The most volatile CVAs – for Ace Real Estate facing Bank 2 – moved over $1mm from the low point to the high point.

Of course, during the same period the at-market 10 year swap rate moved from a high point of 4.669%% to a low point of 2.583%, showing a move of over 200 basis points. During the same period the 5 year swap rate moved from a high of 4.257% to a low of 2.156%. Not only did interest rates move dramatically during these six quarter but they also displayed very high volatility, moving frequently and leading to market expectations of continued fluctuations. The table below displays the 5 year and 10 year swap rates and the underlying volatility of interest rates at the 1 year and 5 year time horizon during this period.

Date	10 year swap rate	5 year swap rate	1 year volatility	5 year volatility
6/30/2008	4.669%	4.257%	40.16%	29.52%
9/30/2008	4.483%	4.093%	54.13%	32.28%
12/31/2008	2.583%	2.156%	77.81%	48.07%
3/31/2009	2.865%	2.209%	63.20%	40.01%
6/30/2009	3.785%	2.977%	77.57%	41.57%
9/30/2009	3.459%	2.648%	91.55%	46.32%

Table 8. Swap Rates and Volatility across Six Quarters

This underlying market volatility drove a major change in the termination values for the transactions in this portfolio; the market value fluctuated between a high of over $3.2mm and a low of nearly ($1.04mm). The volatility of underlying interest rates, paired with the wide fluctuations in credit spreads for both the company and the bank counterparty, combined to generate significant volatility in the CVAs during this period.

Fluctuations of CVAs during this period of major market volatility are not a function of the potential future exposure methodology however. This approach to calculating CVAs – because it considers the possibility of bilateral exposure over time – actually serves to diminish the overall volatility of the CVAs on these transactions. This happens because increased market volatility increases both sides of the potential exposure, with each side of this potential exposure partially offsetting the other side.

As described above, four common current exposure approaches are used in the market. Two of the methodologies adjust the discount factors on currently expected cash flows to reflect credit risk, while the other two focus on the exposure (or the current termination value) of the transactions to determine what credit valuation adjustment to apply. Fair values derived by applying a credit spread directly to the exposure are examined first, followed by those that focus on the expected cash flows.

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B. Constant Exposure Using a Single Spread (CESS)

The simplest method for determining CVAs using current exposure looks only at the current termination value of the portfolio and multiplies this by the relevant credit spread and the time to final maturity for the transactions to determine the CVA. On four of the six quarter end dates examined here (June 30, 2008, September 30, 2008, June 30, 2009, and September 30, 2009), the portfolio has an asset value and so the credit spread from the relevant bank counterparty (Bank 1 or Bank 2) was applied to the settlement value of the portfolio to determine the CVA. For the other two dates (December 31, 2008, and March 31, 2009) the portfolio had a liability value, meaning the spread for the relevant Ace entity was applied to the current exposure to determine the CVA. These calculations resulted in CVAs with the widest range of values, displayed on the graph below.

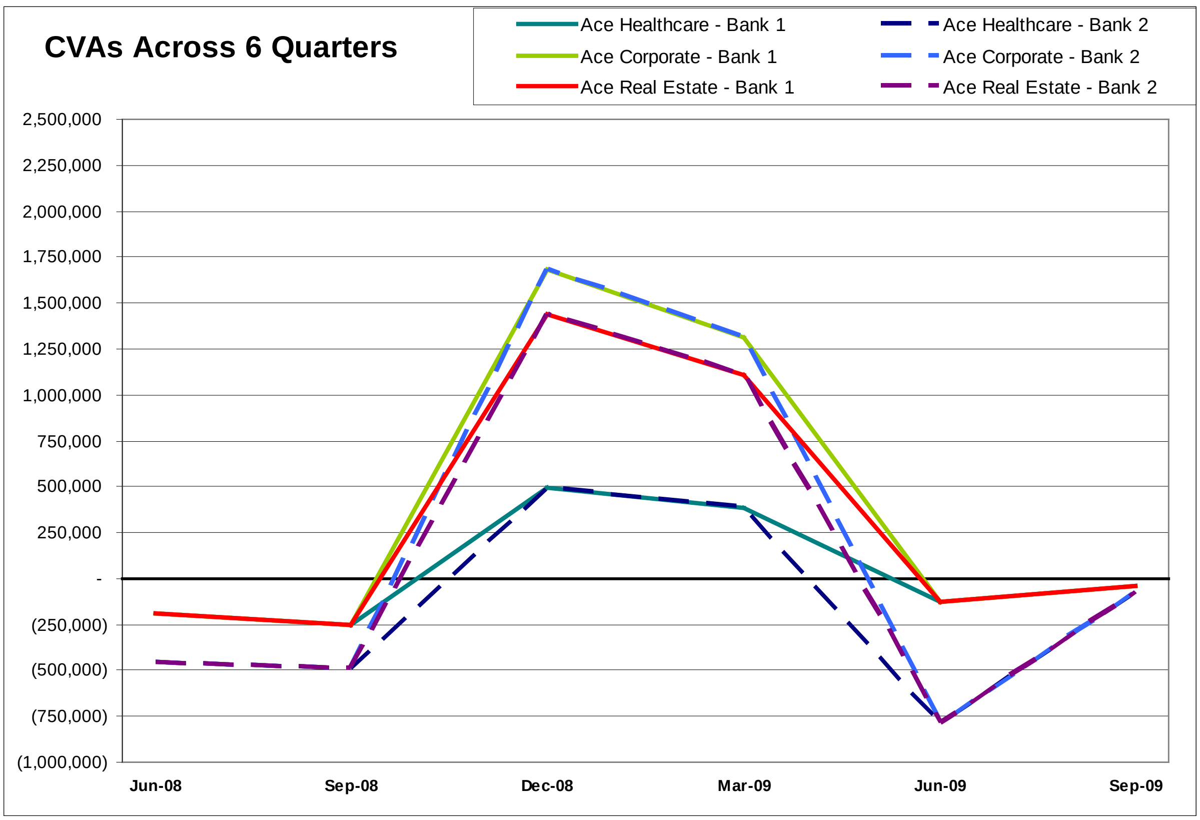

Chart 5. CVAs Using CESS Approach

This approach to calculating fair value relies on the assumption that exposure and the non-performance risk it represents only impact one of the two parties in a transaction at any given point in time. A portfolio with current liability value only places the counterparty at risk regardless of how the value of that portfolio might change over time. In this approach, the current unadjusted termination value of the portfolio totally drives the magnitude and direction of the CVA.

The contrast between this simplified approach and the potential future exposure approach described above can be represented graphically through a comparison of the exposure profiles for each of the two methods. The exposure profile as of 6/30/08 for the methodology utilizing both current and potential future exposure indicates the total expected exposure between the two counterparties and displays a range of both positive (asset) and negative (liability) values for the portfolio out to maturity.

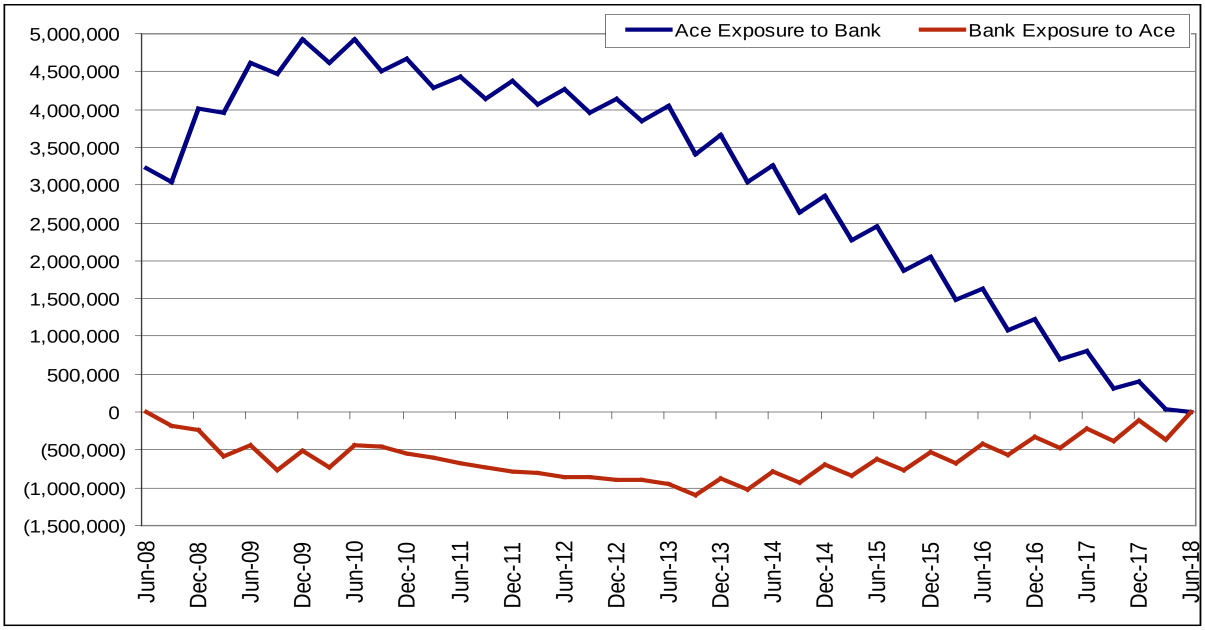

Chart 6. Portfolio Potential Future Exposure as of 6/30/08

By contrast, the exposure used for calculating the CVA under the simple current exposure approach extends the current portfolio value out to maturity, as pictured below.

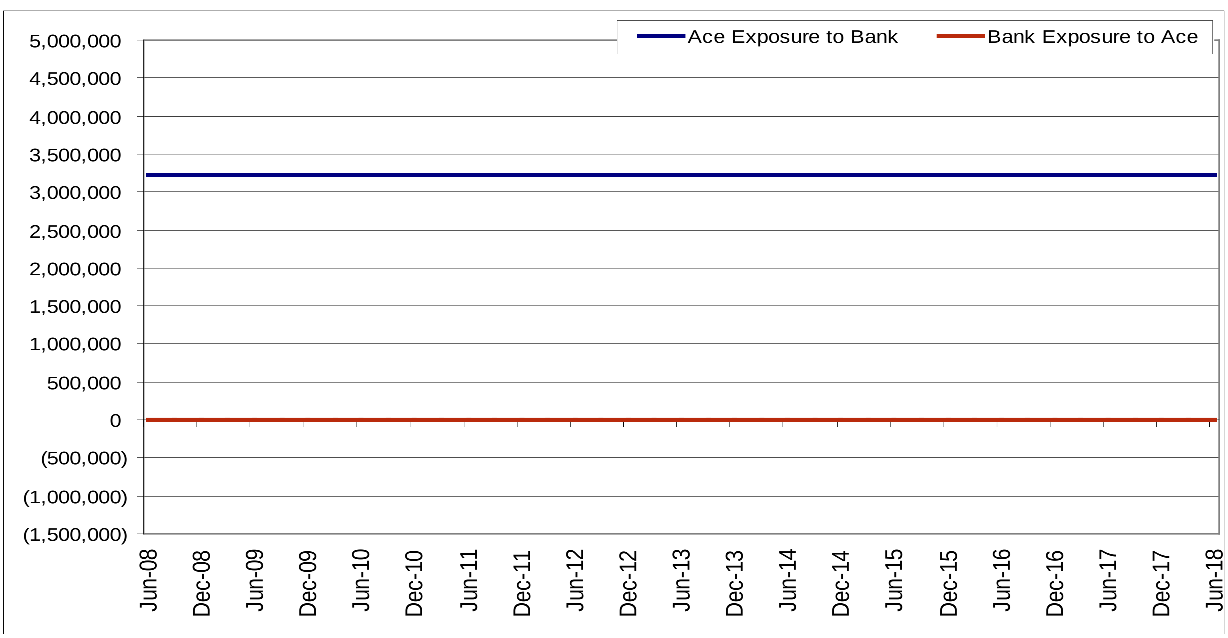

Chart 7. Portfolio Current Exposure as of 6/30/08

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At each point in time the simple current exposure method assumes one-sided exposure, multiplying a flat credit spread by the exposure value and the time to maturity to determine the CVA. Without the mitigating factors of bilateral exposure and exposure that approaches zero as the portfolio matures – factors considered in the potential future exposure methodology – the simple current exposure approach generates more volatile CVAs.

The graph below depicts one example of this difference. The most volatile CVAs under the PFE approach – those between Ace Real Estate and Bank 2 – are compared with those for the same counterparties in the simple current exposure approach (although these do not represent the most volatile CVAs under this simple approach). While the CVAs from the PFE methodology in the solid line below follow the same basic path as those for the current exposure single spread (CESS) approach displayed in the dashed line, the CVA values fluctuate more dramatically between periods for the current exposure CVAs than they do for the potential future exposure CVAs. The difference between the highest and lowest CVA values under the potential future exposure approach below is $1.06 million, while the range for the simple current exposure approach is over $2.2 million – more than twice that of the PFE approach.

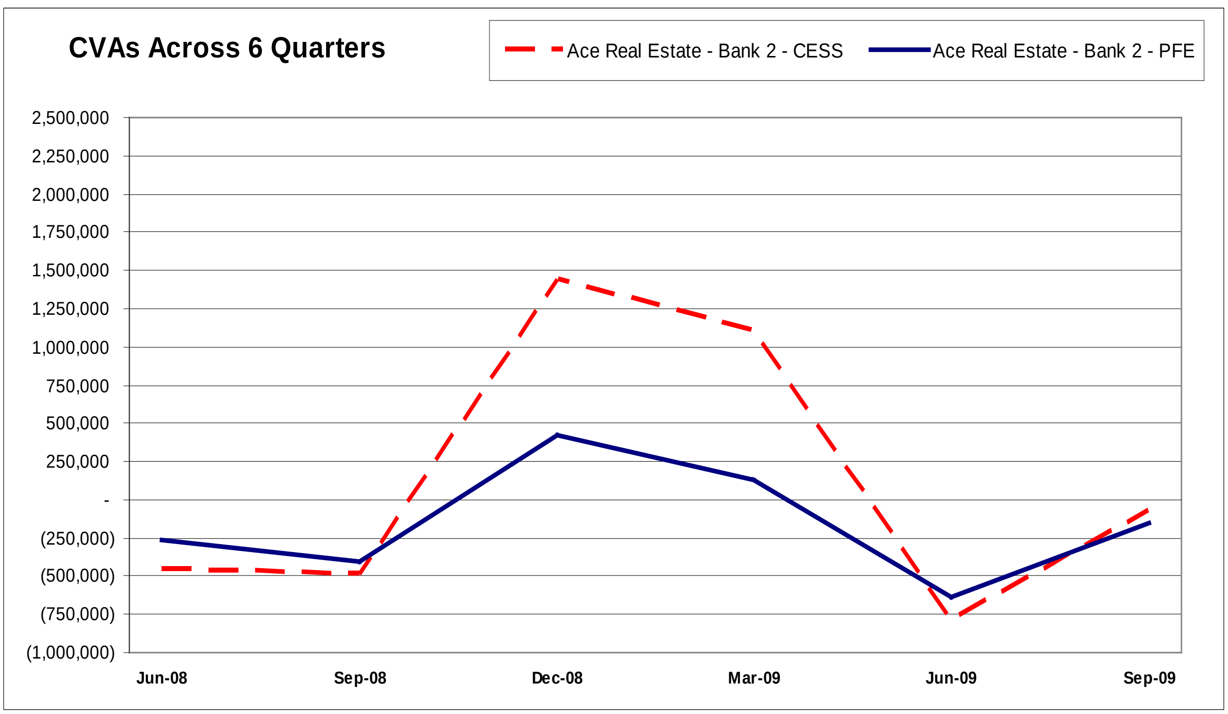

Chart 8. Comparing CESS and PFE Results for Ace Real Estate – Bank 2

While CVAs under the simple CESS approach are the easiest to calculate, they clearly introduce greater volatility than those under the potential future exposure methodology.

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C. Variable Current Exposure Using Multiple Spreads (VCE)

A second method for calculating CVAs based on the current exposure between two counterparties introduces greater refinement in calculating the exposure. Rather than looking only at the current termination value of the portfolio, this approach assumes that rates will follow the forward curve and therefore the termination value of the trades in the portfolio will change over time as contractual payments are made and maturity approaches. For example, the five year receive-fixed swap in the portfolio used here pays quarterly interest payments based on 3-month USD LIBOR and receives a fixed semi-annual payment of 4.21% on a notional of $50 mm. Assuming interest rates follow the forward curve pictured below as of 6/30/08, the present value of the projected future cash flows (the exposure value of the swap) on that date would follow the path also displayed in the graph below.

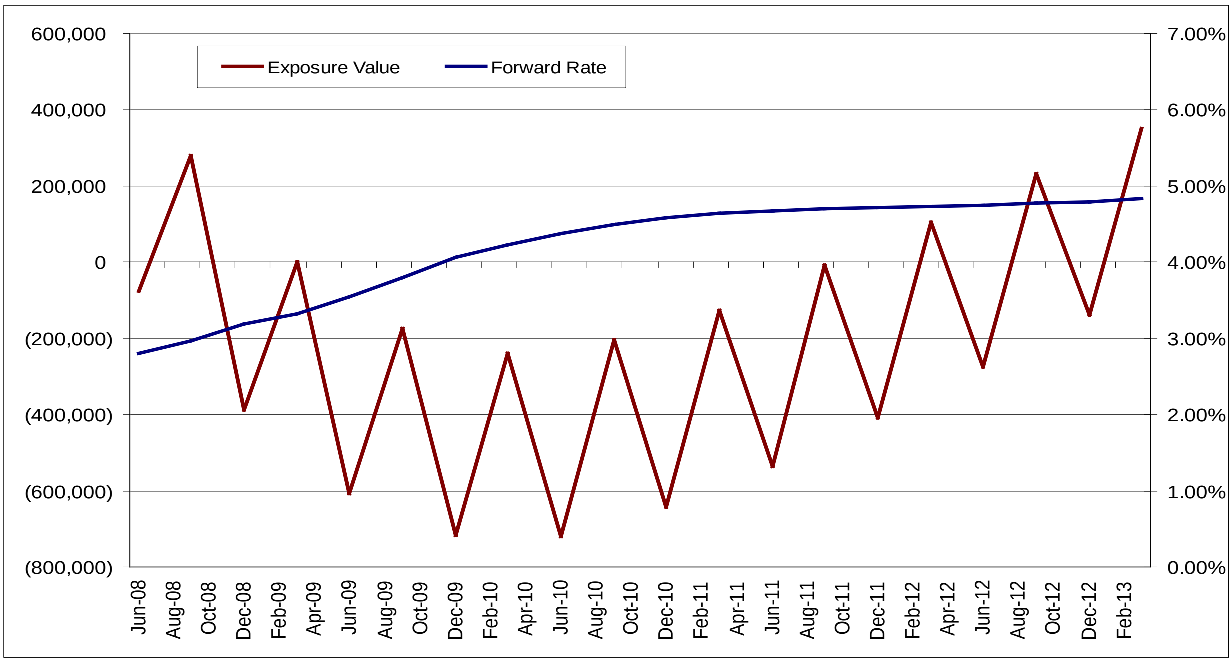

Chart 9. Variable Exposure and Interest Rate Forwards

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Performing the same calculation for the entire portfolio yields the exposure profile below.

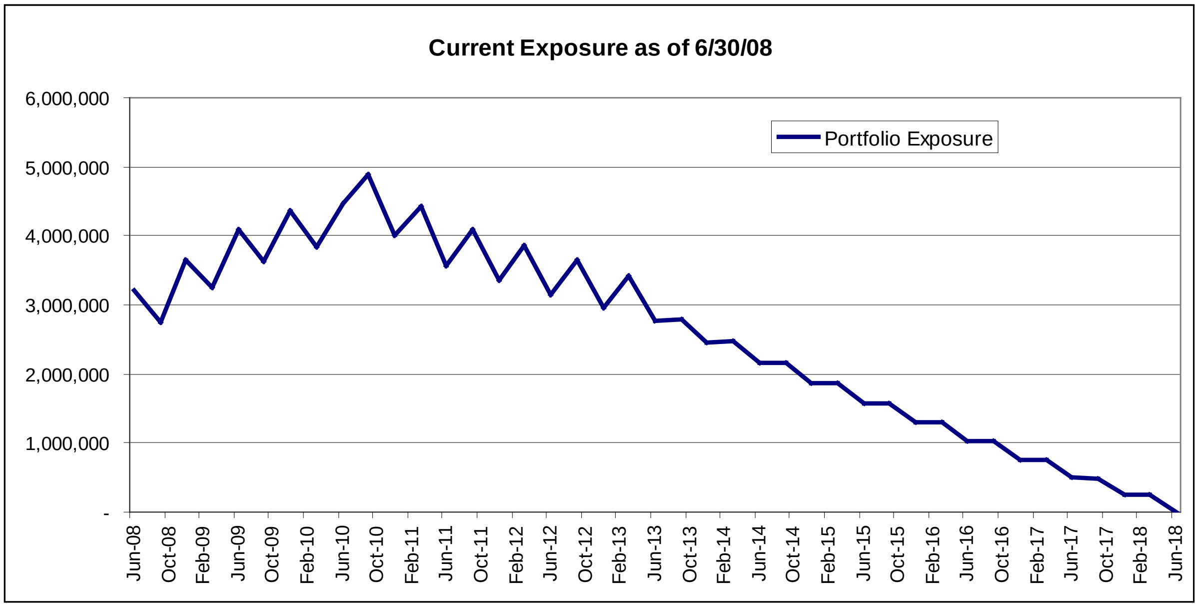

Chart 10. Variable Current Exposure as of 6/30/08

Note that this exposure profile roughly matches the one side of the exposure profile generated by the potential future exposure model and pictured earlier in this document (see Chart 6). Introducing volatility to the projected forward rate as the potential future exposure approach does widens the possible asset values that the portfolio could attain and also introduces the chance that the portfolio could switch from an asset to a liability over time. The variable current exposure approach simply assumes that interest rates will follow the current forward curve.

Once the exposure profile has been generated, the VCE model applies the relevant credit spreads to this exposure to generate the CVA. Determination of the relevant spread depends upon whether the exposure at a given point in time shows an asset value (in which case the dealer counterparty spreads are applied) or a liability value (in which case the company spreads are used). Because this approach has a variable exposure that changes through time with the overall value of the portfolio, the appropriate spread can switch if the projected value of the portfolio switches.

Whether the exposure value is an asset or a liability, this methodology generally applies a flat spread rather than calculating a forward term structure of credit. The following graph displays the CVAs calculated under this methodology for the portfolio in question.

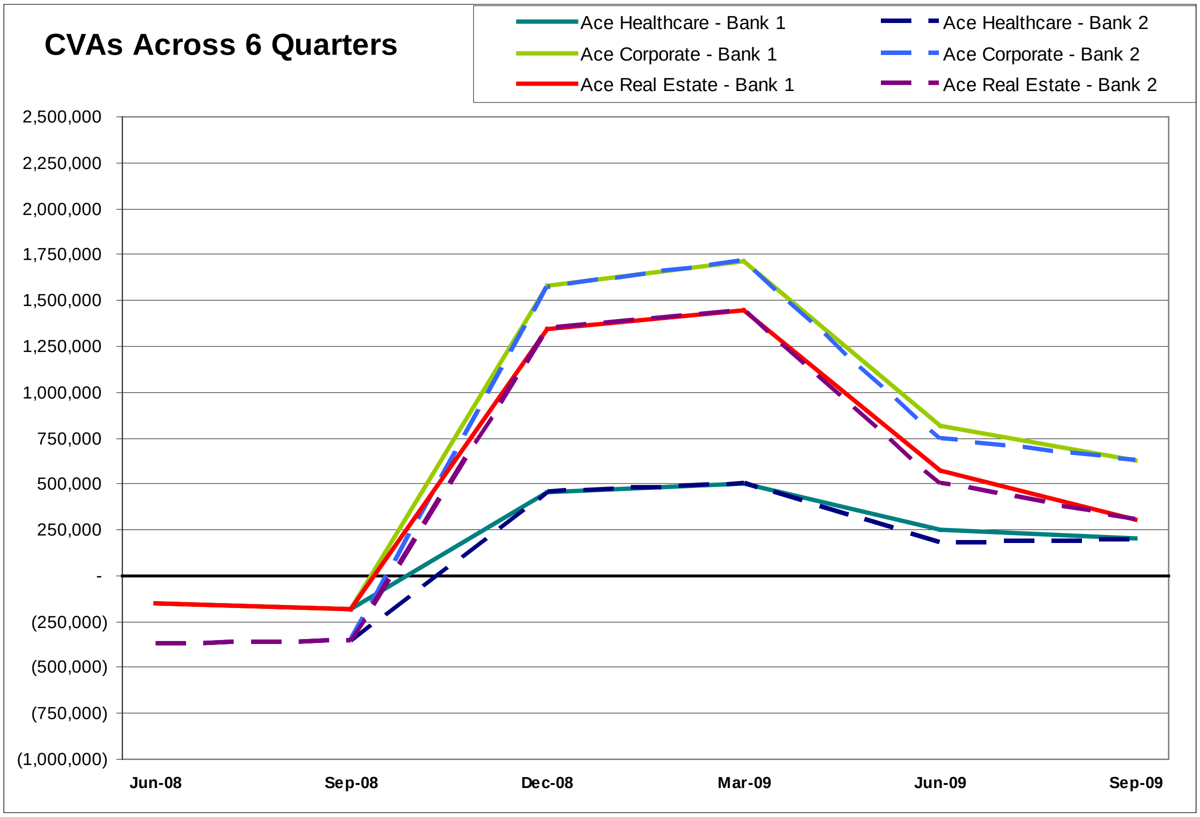

Chart 11. CVAs Using VCE Approach

While these CVAs start with values relatively close to those produced under the PFE methodology, they begin to diverge from these values significantly after the first two quarters. Comparing the CVAs from the most volatile results of the VCE approach – those between Ace Corporate and Bank 2 in the dashed line below – with those for the same set of CVAs under the PFE model in the solid line below shows the different results of these two approaches.

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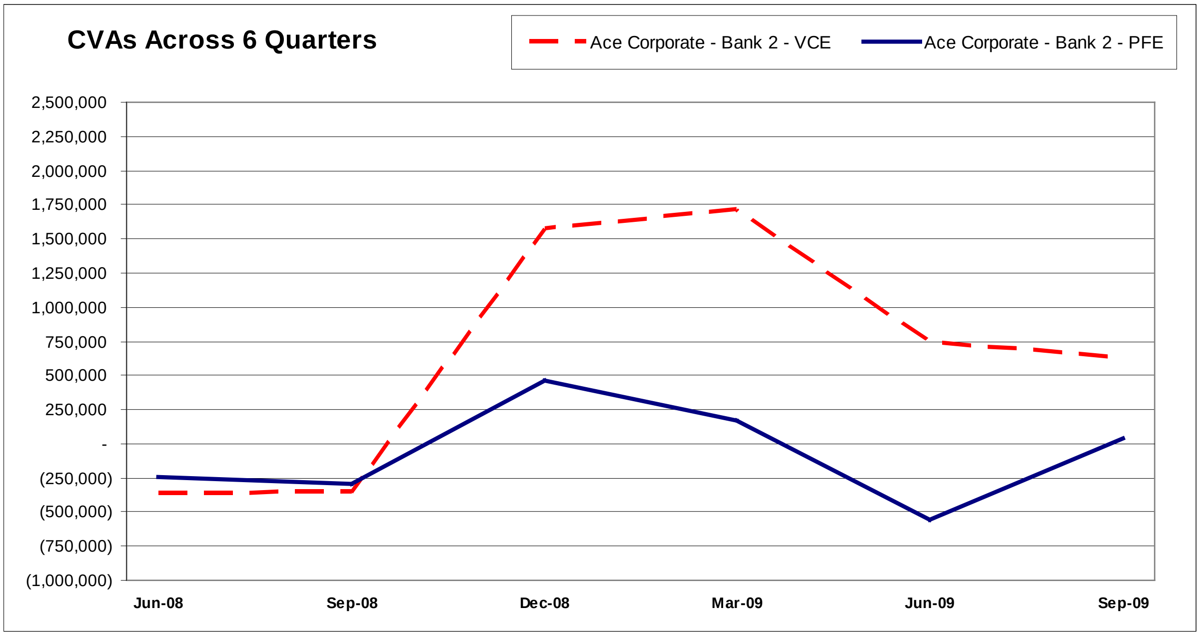

Chart 12. Comparing VCE and PFE Results for Ace Corporate – Bank 2

Because the variable current exposure using multiple spreads methodology still models exposure as only one-sided at any given point in time, and because it does not incorporate volatility when projecting the exposure between counterparties, the CVAs generated under this approach can shift more dramatically than those under the potential future exposure approach. While the CVA values follow the overall trend of those calculated using PFE, these current exposure CVAs demonstrate the same kind of volatile swings evidenced by those determined using the simple current exposure approach.

D. Discounted Cash Flows Using a Single Spread (DCFSS)

In addition to the two methods discussed above that focus on the current exposure (or termination value) of a portfolio, two other methods calculate the CVAs based on applying credit-adjusted discount factors to the projected future cash flows. While the unadjusted termination or settlement value of an interest swap for example would be calculated by using discount factors derived from a mid-market LIBOR forward curve to present value the projected future cash flows, this method for determining the CVA would adjust these discount factors by the credit spread of one of the parties in the transaction. The credit adjusted fair value of the derivative would then be the sum of the projected future cash flows discounted by this adjusted discount factor, and the CVA would be the difference between the adjusted and the unadjusted value of the contract.

As with the two methods that focus on current termination value, there are two different ways that these cash flows can be discounted. The first approach adjusts the discount factors used to calculate the present value of expected future cash flows of a derivative by the credit spread of the party holding the liability position on the contract as of the measurement date. If the derivative or the portfolio of transactions has a liability value for the company, then the company's credit spreads would be used to adjust the discount factors on all of the projected future cash flows. If instead the transactions are in an asset position, the counterparty spreads are used to adjust the discount factors (see the explanation and formula in section II.C.1. above for more information on this methodology).

Applying the method to simple interest rate swaps allows for fairly straight forward calculations. The specific portfolio of transactions considered in this paper – composed of two swaps, a cap, and a swaption – presents a more difficult scenario. While the current termination value of the interest rate swaps – and therefore their current exposure – ties directly to the present value of their expected future cash flows, the current termination value of the two options – the cap and the swaption – comes from both the projected future cash flows (the intrinsic value) and the potential way in which those cash flows could be impacted by the volatility of the underlying interest rate (the time value). This adds a layer of complexity to the process of determining the expected cash flows to which the credit-adjusted discount factors should be applied.

For the interest rate cap, the projected cash flow to use for each period comes from the value of the 'caplet' for that period. For example, the table below displays the value of each period's potential cash flow from the cap as of 6/30/08.

Start Date	Payment Date	Notional	Strike	Forward Rate	Volatility	Caplet Value
6/30/2008	9/30/2008	50,000,000	4.50%	2.80%	0.00%	0
9/30/2008	12/30/2008	50,000,000	4.50%	2.97%	35.00%	193
12/30/2008	3/30/2009	50,000,000	4.50%	3.19%	35.00%	4,035
3/30/2009	6/30/2009	50,000,000	4.50%	3.32%	35.01%	11,689
6/30/2009	9/30/2009	50,000,000	4.50%	3.54%	34.78%	24,244
9/30/2009	12/30/2009	50,000,000	4.50%	3.79%	34.22%	40,309
12/30/2009	3/30/2010	50,000,000	4.50%	4.06%	33.36%	57,590
3/30/2010	6/30/2010	50,000,000	4.50%	4.22%	32.13%	71,427
6/30/2010	9/30/2010	50,000,000	4.50%	4.38%	30.72%	82,958
9/30/2010	12/30/2010	50,000,000	4.50%	4.50%	29.49%	90,646
12/30/2010	3/30/2011	50,000,000	4.50%	4.59%	28.57%	96,250
3/30/2011	6/30/2011	50,000,000	4.50%	4.65%	27.92%	103,773
					Total Cap Value:	583,115

Table 9. Interest Rate Cap Value as of 6/30/08

Values for the cap and each individual 'caplet' come from the Black model for valuing interest rate options. Note that, even though forward interest rates were not expected to rise above the 4.5% strike rate on the cap until the payment due on 12/30/10, the previous periods still had some potential value. These values were used as the projected cash flows on the cap when calculating the portfolio-level cash flows and determining the credit-adjusted values of those cash flows.

Determining the correct cash flows to use for the swaption presented additional complexity. The swaption gives the holder the right but not the obligation to enter into a swap on 6/30/10 in which they would receive a fixed rate of 4.25% on a semi-annual basis and pay 3-month LIBOR quarterly. Therefore

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the swaption has no projected cash flows for the first two years and afterward only has cash flows if the holder of the swaption chooses to exercise the option and enter into the swap. For four of the six quarters (from December 31, 2008 through September 30, 2009) the swap is expected to be an asset at the time that the swaption can be exercised (June 30, 2010) and so the projected future cash flows on the swap can be used to determine the cash flows for the swaption. For the first two quarters – June 30, 2008, and September 30, 2008 – the swap is projected to be a liability and so the swaption has no intrinsic value; however it does have time value because of the possibility that rates might move before the exercise date of the swaption. Therefore an approach similar to the one used for the cap can be used for projecting the cash flows for the swaption. To determine the values of those projected cash flows, the time value of the swaption can be used to derive the implied cash flows on the swap.

Once the projected cash flows from all four transactions have been determined, we can aggregate the cash flows for each period to determine the net projected cash flows for the portfolio. Utilizing the discounted cash flows with a single credit spread methodology, we can calculate the present value of each of these cash flows using a discount factor based upon (1) either the company's credit spread (if the current value of the portfolio is a liability) or (2) the counterparty's credit spread (if the current value is an asset). The difference between the sum of the cash flows discounted without applying the credit spread and the sum of the cash flows discounted by applying the credit spread gives the CVA for the portfolio as of the specific date. This approach yields the set of CVAs displayed below.

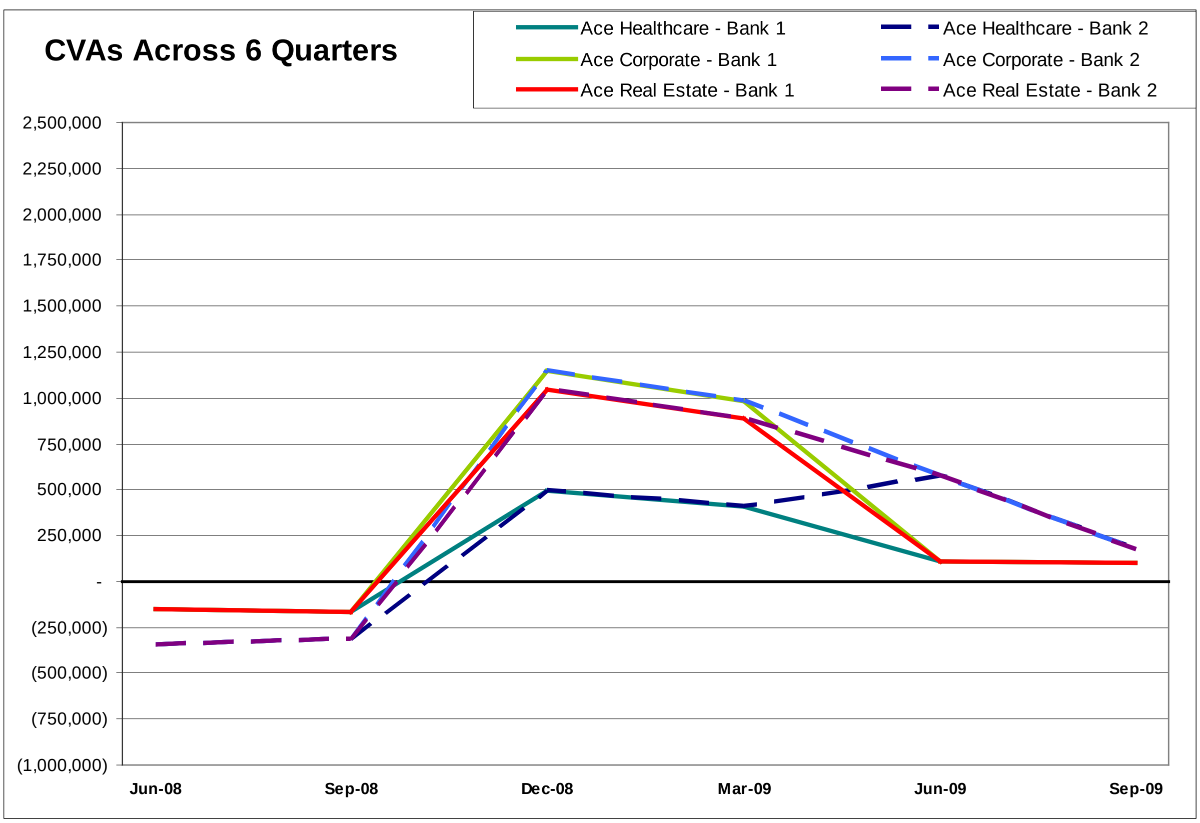

Chart 13. CVAs Using DCFSS Approach

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One of the patterns that emerges from this comparison – a pattern also visible under the current exposure with single credit spread methodology – concerns the impact of using only one credit spread to discount all of the projected cash flows. Because the company's credit spread is used whenever the portfolio has a current settlement value in a liability position, the relative credit spreads for the two banks have no effect on the CVAs for the two dates when the portfolio is a liability (December 2008 and March 2009). Correspondingly, for the other four quarter end dates when the portfolio settlement value was an asset for the company, the fact that the different Ace companies had widely divergent credit spreads had no impact on the CVAs. The graph below demonstrates the difference made by using only one credit spread, comparing the CVAs for the portfolio of transactions between Ace Healthcare and Bank 1 under the DCFSS approach (dotted line) with those under the PFE approach (solid line).

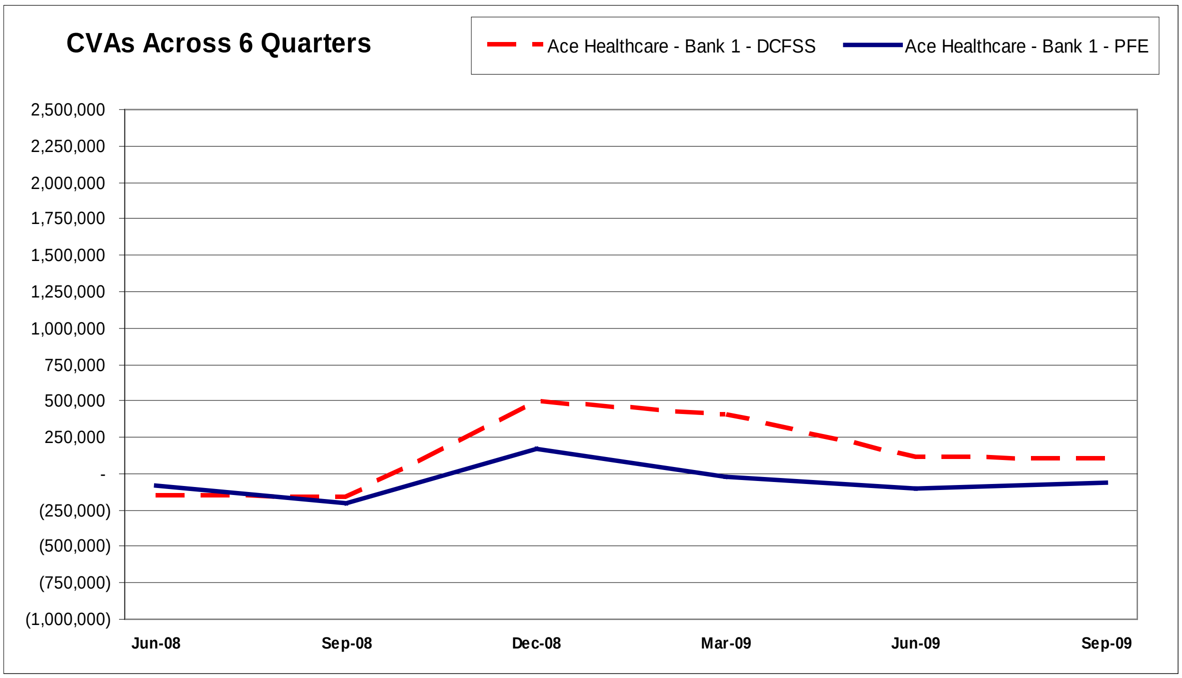

Chart 14. Comparing DCFSS and PFE Results for Ace Health Care – Bank 1

While the overall movement of the CVA in both scenarios follows a similar pattern, the CVAs calculated using a single credit spread to discount the projected cash flows display greater volatility and, at several points, have a positive value while those from the potential future exposure approach have a negative value.

E. Discounted Cash Flows Using Multiple Spreads (DCFMS)

The second approach based on discounting cash flows also adjusts the discount factors used to calculate the present value of projected future cash flows; however, in this approach the discount factor is adjusted by the company's credit spread when the projected cash flow at the portfolio level is a payable and by the dealer counterparty's credit spread when the projected future cash flow is a receivable. Approaching CVA calculation in this way attempts to capture the nonperformance risk of each projected

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cash flow more accurately, applying the credit spread of the party making the net payment to the discount factor rather than using only one spread regardless of which party will be paying.

As in the case where only a single credit spread is used, the credit-adjusted fair value of the derivative portfolio would be the sum of the projected future cash flows present valued using this variably adjusted discount factor, and the CVA would be the difference between the adjusted and the unadjusted value of the portfolio (see the explanation and formula in section II.C.2. above for more information on this methodology). Applying this methodology to the set of transactions we have been examining generates the CVAs depicted in the graph below.

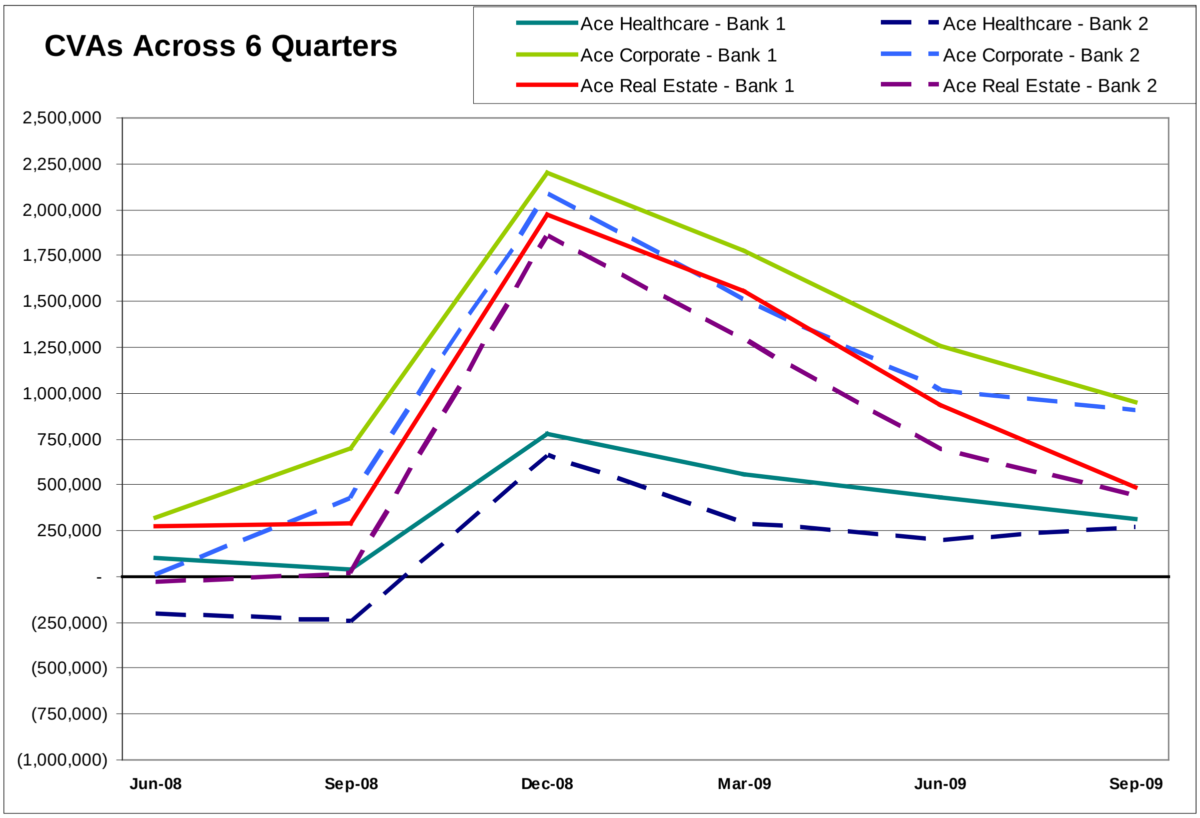

Chart 15. CVAs Using DCFMS Approach

Interestingly, applying different spreads based on whether the projected cash flows are receivables or payables generates larger and more volatile CVAs than those generated by applying a single credit spread regardless of which party makes the payments. For the portfolio in question here, the fact that roughly half of the projected cash flows would be payables for the three Ace companies while the other half would be receivables, coupled with the significant difference between and volatility of the credit spreads for both the Ace companies and the two bank counterparties, produces wider swings in the CVAs under a methodology that applies different spreads to cash flows depending upon whether the companies expects to make or to receive the payment.

Again, comparing specific results from the DCFMS approach with those calculated using the PFE methodology reveals the two basic trends visible for other comparisons: the overall shape of the CVA movement across these six quarters is similar in the two approaches, but the potential future exposure methodology displays less volatility and generally smaller CVAs. The graph below illustrates this using the portfolio of trades between Ace Corporate and Bank 1, showing the CVAs from the discounted cash flow methodology with the dotted line and those from the potential future exposure method with the solid line.

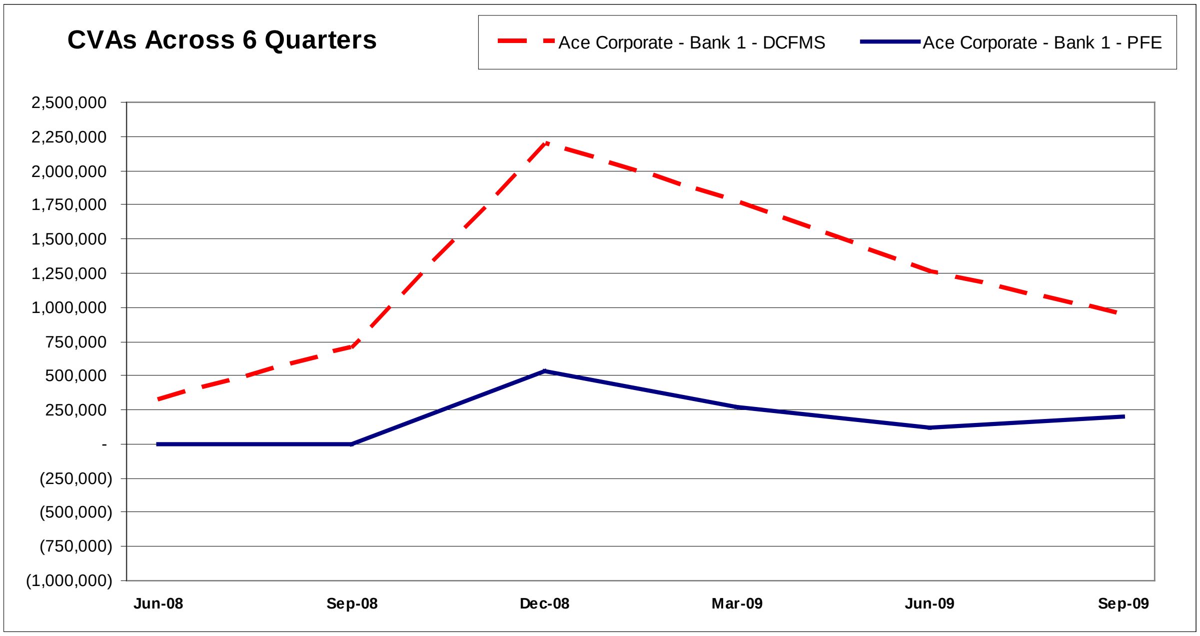

Chart 16. Comparing DCFMS and PFE Results for Ace Corporate – Bank 1

F. Summary

Starting with the same basic data about a portfolio of four derivative transactions and the interest rate and credit spread environments for several companies and banks across six financial quarters, we have examined the CVAs produced under five different methodologies. The specific period examined – June 2008 through September 2009 – evidenced significant volatility of both interest rates and credit spreads, impacting the size and fluctuations of the CVAs generated under each methodology. Each of the five different approaches attempts to quantify the nonperformance risk of the portfolio during this period of significant market volatility. An example in the graph below displays the different CVAs produced by each methodology for the set of transactions between Ace Corporate and Bank 2 – the two entities with the largest and most volatile credit spreads during this period.

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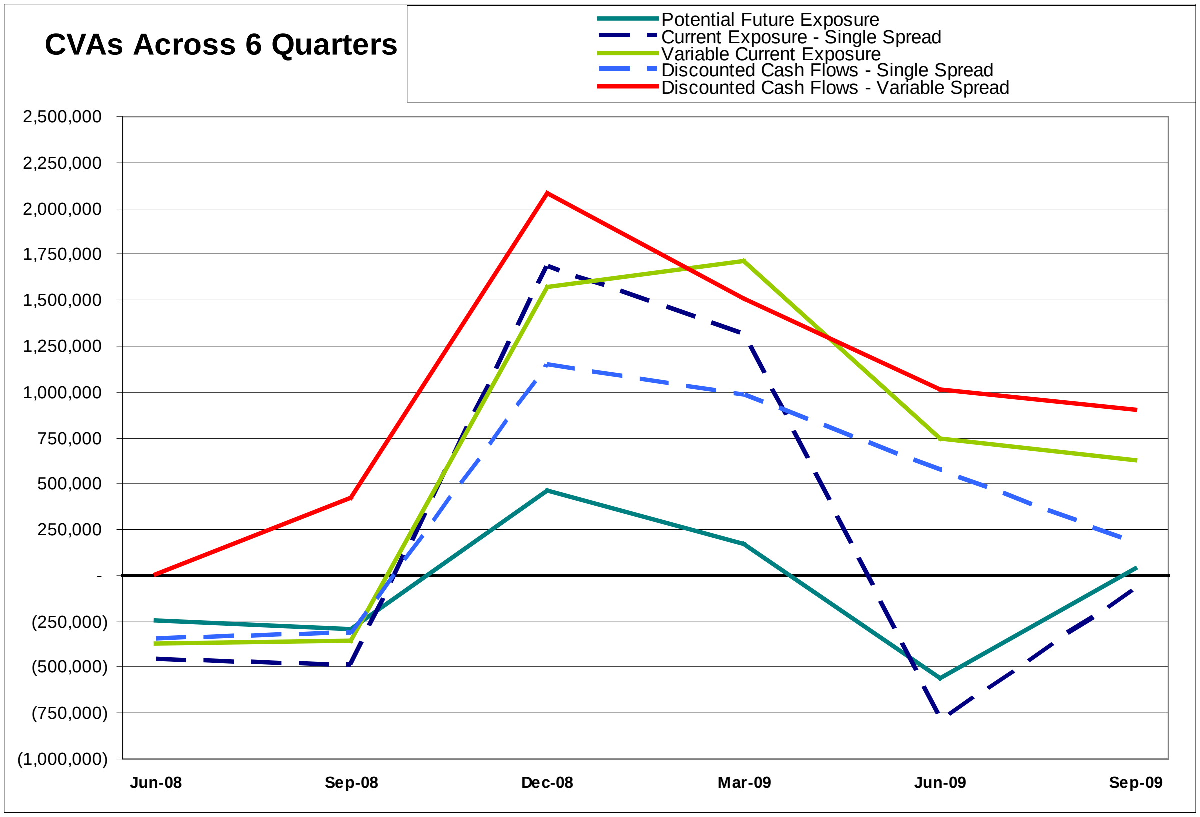

Chart 17. Comparing CVA Results across All Approaches for Ace Corporate – Bank 2

The graph captures the overall trends visible across each of the different scenarios examined above:

- The general direction of movement for the CVA takes a similar shape for each of the different approaches.
- The CVA displays significant volatility reflective of the general market volatility prevailing during the same period.
- The potential future exposure approach generates by far the least volatility of the five methodologies examined.

IV. CONCLUSION

Calculating CVAs on interest rate and foreign currency derivative positions requires a complicated process. ASC Topic 820 outlines a principles-based standard that defines fair value and spells out the factors that should be considered when measuring the fair value of any financial instrument. The added complexity required to calculate the fair value of many derivative transactions stems from the fact that these transactions can flip from being assets to liabilities over the life of the derivative. Because of this, accurately measuring the CVA necessitates an approach that incorporates both current and potential future exposure.

Certainly calculating CVAs based upon the potential future exposure methodology involves greater complexity than the more simplified current exposure approaches. Accurately determining PFE requires more data inputs – specifically about market-implied forward volatility – and greater computational rigor. The complexity of this model discourages many firms from attempting these calculations on their own and most third-party valuations providers also rely on more simplified and limited methodologies for determining CVAs. Many firms took the simplest approach possible to satisfy the accounting standard requirement without considering what impact that decision might have on the level and volatility of the CVAs.

However, these less complex approaches fail to meet one of the central guidelines of the accounting standard because they do not calculate nonperformance risk in the way that major market participants – and specifically dealer banks – price credit. In addition, the various current exposure approaches examined above all generate more volatile CVAs than the potential future exposure methodology calculates. For firms with smaller derivative positions or those with immaterial CVAs, such simplified approaches may be adequate, assuming audit firms continue to accept these limited models. However, when CVAs have a noticeable impact upon earnings results and volatility, firms may prefer to adopt an approach that reduces the fluctuations of CVAs from period to period and follows a more robust calculation methodology.

The period of time examined in this white paper encompassed one of great market volatility, impacting both interest rates and credit spreads. This helped to cause significant fluctuations in both the termination values and the fair values of the portfolio considered. A period with more stability in market conditions would most likely have produced less variability in the CVAs under each of the methodologies examined above. However, the fact that only the PFE model uses bilateral exposure means that under almost all market conditions it will produce CVAs with less volatile fluctuations than those of the various current exposure models.

As market demands for accurate third-party valuations continue to grow, and as the expectations of audit firms for acceptable models continue to evolve, more companies may pursue an approach to CVA calculation that captures the complex variables involved in correctly quantifying nonperformance risk. Volatile financial and credit markets enhance the value of accurately assessing CVAs, both to allow firms to determine and mitigate their counterparty risk and to allow investors to analyze a company's potential risk exposures. All of these factors make accurate CVAs important and enhance the value of using the best available methodology to determine these CVAs.

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