Capital and funding

Banking operations are being rewired around XVA metrics, quantifying market incompleteness. Here Claudio Albanese, Simone Caenazzo and Stéphane Crépey focus on the cost of funding of variation margin and the cost of capital: that is, funding valuation adjustment (FVA) and capital valuation adjustment (KVA). Motivated by Basel Pillar 2, Solvency II and IFRS 4 Phase II, they propose a principled approach to accounting regulatory treatments for FVA and KVA, arguing the two are intertwined since economic capital is itself a source of funding

As explained in Albanese, Andersen & Iabichino (2015), credit valuation adjustment (CVA) and funding valuation adjustment (FVA) are adjustments to entry prices that flow into reserve capital, and they are meant to compensate shareholders for the systematic losses they incur due to counterparty defaults and funding costs. Common Equity Tier 1 Capital (CET1) is the difference between assets and liabilities minus reserve capital, and it plays the role of a further capital cushion aimed at absorbing exceptional losses.

According to Basel Pillar 2, CET1 must exceed economic capital, computed as the 99% value-at-risk over a one-year holding period. Following the *Fundamental review of the trading book* (FRTB), a more conservative definition of economic capital makes reference to an expected shortfall measure with 97.5% confidence. Pillar 1 capital charges are given by regulatory formulas that approximate Pillar 2 economic capital (see Pykhtin 2012).

CET1 receives funds from both shareholders and clients. The portion coming from clients is called risk margin and is usually abbreviated as KVA (from capital valuation adjustment). KVA is loss-absorbing capital that is also earmarked to remunerate shareholder capital over the lifetime of the portfolio at a given hurdle rate. Since the KVA is sourced from clients, it is also an adjustment reflected in entry prices. Although Basel III and accounting standards for trading books do not envisage a role for a KVA-type entry, Solvency II and IFRS 4 Phase II for the insurance industry have a principled framework for this purpose that has been extensively debated for more than a decade.

In our proposed accounting framework, KVA is configured as a retained-earnings account that ensures profits are reported and distributed in a sustainable fashion throughout a portfolio's lifetime. From a regulatory standpoint, Solvency II adopted a principle first stated in the Swiss Solvency Test (SST) according to which economic capital is at all times the maximum of the expected shortfall measure on CET1 mentioned above and the KVA itself. The reason for this is that risk margin is considered as capital that is meant to absorb exceptional losses and therefore represents an integral part of economic capital. However, economic capital must be larger than or equal to KVA in order to ensure that it is sufficient to cover the cost of capital throughout the portfolio's lifetime – a principle first introduced in the SST.

By ignoring capital costs in fair valuation, IFRS 9, Generally Accepted Accounting Principles (Gaap) and tax codes force banks to release fair valuation profits prematurely into the dividend stream. This turns derivatives markets into a gigantic Ponzi scheme whereby dealers are able to pay dividends on capital only when there is exponential growth of assets and escalating leverage ratios. When a 2007-type crisis hits, it then takes decades to restore acceptable returns on equity. By building KVA risk margins into the fabric of banking regulation, accounting standards and executive compensation schemes, derivatives markets will be better positioned to finally overcome this explosive systemic instability.

This paper is organised as follows. The next section contains a high-level discussion of the interrelation between capital and funding. That is followed by a section that sets out a model for economic capital and then a section about the KVA risk adjustment, earnings and transfer pricing policies for capital costs. The last section concludes.

See Albanese, Caenazzo & Crépey (2016) for a more detailed version of the present work.

Capital and funding

Since banks may default, lenders ask for a credit spread on unsecured funding. As explained in Albanese, Andersen & Iabichino (2015), FVA quantifies the cost of paying a spread to carry assets. In accounts, CET1 represents the fair valuation of shareholder capital, and FVA is deducted from that. Since total wealth is preserved (see Modigliani & Miller 1958), FVA is also a benefit for senior creditors and ultimately has no impact on the portfolio fair valuation. The FVA is, however, reflected in entry prices as a compensation to shareholders for the wealth transfer to creditors. This follows from the intrinsic market incompleteness plaguing banks: the only way to prevent wealth transfers to creditors is to fully deleverage the firm – an obvious impossibility for banks.

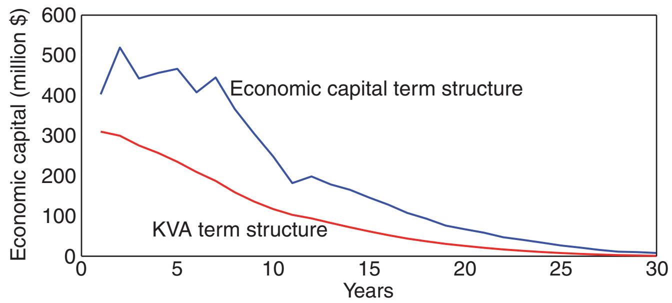
Desks are assigned economic capital and are tasked with generating returns at a certain 'hurdle rate' set by management at a level sufficiently high for the bank to be profitable but not so high for it to be uncompetitive. In our case study, we choose a hurdle rate $h = 10.5\%$.

CET1 differs from the market price of equity liabilities since investors are risk averse and demand a discount, ie, a risk adjustment. In this paper, we introduce the concept of risk-adjusted CET1 (RACET1). The KVA is the risk adjustment, ie, CET1 minus RACET1. To recognise market incompleteness, earnings are reported as variations of RACET1, and banks aim to optimise their balance sheet by reducing the KVA.

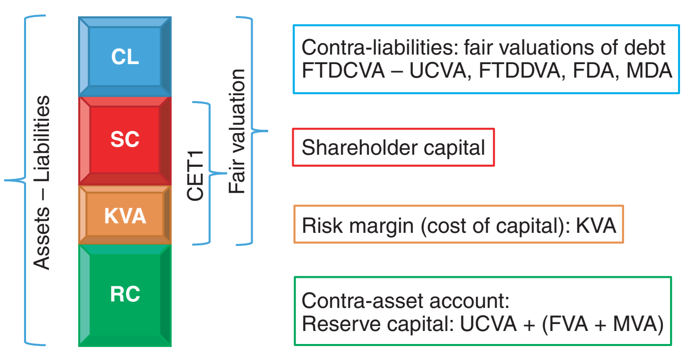
Mathematically, the KVA is a stochastic process that converges to zero at the final maturity of the portfolio by decreasing on average at a rate given by the product of a hurdle rate h and the shareholder capital-at-risk.

Economic capital is a concept defined in Basel II Pillar 2 to quantify shareholder capital-at-risk. Economic capital is earmarked to absorb exceptional losses and is supposed to exceed Pillar 1 regulatory capital. Our economic capital model is defined consistently with the FRTB as the expected shortfall metric with confidence level equal to 97.5%

1 The term structure of economic capital computed as the expected shortfall with 97.5% confidence for capital return distribution compared with the term structure of KVA



2 The economic structure of a bank



computed on CET1 returns with a yearly holding period. We are interested in economic capital as a stochastic process $\mathrm{EC}(t)$ over the lifetime of the portfolio. We assume the portfolio is held on a runoff basis, ie, that no new trades are entered in the future. Since trades gradually expire, $\mathrm{EC}(t)$ systematically decreases with time (see figure 1).

Reserve capital is always struck at the mark-to-market value of CVA and FVA adjustments. However, as losses due to defaults, funding costs and CVA and FVA volatility occur, the residual variation has an impact on CET1. These losses are compensated for by the systematic decrease of the CVA and FVA deductions, to the point that CET1 follows a martingale process, ie, has zero drift. Even if CET1 were depleted to an extreme extent by a one-in-40-years event with a probability of 2.5%, it should still be able to absorb losses since it exceeds economic capital.

As new trades are booked in the portfolio, an incremental KVA is received from clients and is retained. KVA is loss absorbing and contributes to economic capital, the difference being provided by shareholder capital. See figure 2 for a schematic of the economic structure of a bank. As time progresses, the KVA is regularly marked-to-market and gradually released into earnings. This wealth flow compensates for CET1 variations, which, as mentioned, follow an unbiased martingale process. If losses in the reserve capital account exceed KVA earnings, the bank issues new shares and shareholders suffer dilution losses. If released earnings are instead in excess of losses in reserve capital, shareholders either receive a dividend or benefit from share appreciation.

Removal of 'Capital structure in incomplete markets' from figure OK? Add it to caption?

As explained in Albanese & Andersen (2015), capital is a form of funding and as such it can be used for the purpose of posting variation margin. As a consequence, the presence of economic capital mitigates the FVA. In this paper, we discuss a representative case study of an over-the-counter portfolio of mostly long-dated derivatives where the reduction is by a third.

Our definition of KVA closely follows the principles of the SST and Solvency II. However, they deviate substantially from the definition put forward by Green, Kenyon & Dennis (2014) in several respects.

Firstly, the KVA in Green, Kenyon & Dennis (2014) is conceived as a CET1 deduction. However, the Basel III Accord was calibrated based on CET1 defined as the fair value of shareholder capital, not on the risk-adjusted variant RACET1. Also, Solvency II considers the risk margins as loss-absorbing capital and not as deductions.

Secondly, the KVA in Green, Kenyon & Dennis (2014) is defined on the basis of replication arguments. We work instead under classical finance theory and see KVA and FVA as quantifications of market incompleteness.

Thirdly, we perform portfolio-level aggregation and avoid the practice of restricting metrics to ones requiring only netting set aggregation (see Albanese & Andersen (2015) and Albanese, Andersen & Iabichino (2015) for a discussion).

Fourthly, we use Pillar 2 economic capital as opposed to Pillar 1 regulatory capital. One reason for this is that regulatory capital is only a lower bound to economic capital; another is that regulatory capital is computed by means of simplified formulas that can potentially distort risk sensitivities. Regulatory capital should still be simulated to ensure that economic capital actually exceeds regulatory capital – a non-trivial condition given the large overlap that plagues simplified Pillar 1 charges.

Pykhtin discusses the logic behind regulatory formulas for CVA capital charges in Pykhtin (2012), where he explains how these formulas aim to capture the 99% VAR of CVA mark-to-market variation. Assuming normality, this is equivalent to expected shortfall being within a 97.5% confidence interval. In general, fat tails make expected shortfall more conservative. Granularity of default losses is accounted for by modelling credit factors explicitly. We account for the volatility risk of funding costs and FVA. Model risk can also be included by means of a Bayesian approach like that of Black and Litterman, as discussed below.

A further consideration is that Pillar 1 capital formulas are not stable and are improving with the passing of time. It is natural to speculate that over the lifetime of long-dated trades they will be better approximated by economic capital than by present-day Pillar 1 formulas. In our view, economic capital is best computed directly with a holistic credit-market simulation and should be projected to the furthest time horizon in the portfolio.

One more difference with Green, Kenyon & Dennis (2014) is that we use nested Monte Carlo simulations. Market and credit factors are jointly simulated through primary and secondary scenarios and we aggregate at the funding-set level. Nested simulations are used to simulate CVA/FVA metrics through time. The total number of scenarios we generate between primary and secondary adds up to about a billion.

To compute economic capital, we find the distribution of CET1 returns over yearly periods. Although challenging, this modelling exercise is fully within the bounds of feasibility even for massive portfolios if one uses suitable mathematics optimised to the right hardware and software architectures.

As discussed in Albanese *et al* (2016), an additional requirement for this sort of nested simulation is that the models used for derivatives ought to be of high quality. In Albanese *et al* (2016), we discuss credit limits, stress testing and model risk within the framework set out in this article. We show that low-quality models such as the Hull-White model for interest rates are inaccurate in low-interest-rate environments.

A model for economic capital projections

Consider a situation where we are given an OTC portfolio at time 0 and we evolve it in the future on a runoff basis. To this end, we interpret CET1 as the fair valuation of shareholder capital.

Following Albanese, Andersen & Iabichino (2015), CET1 is given by:

$$\mathrm{CET1}(t) = \mathrm{EC}(t) + A(t) - L(t) - \mathrm{UCVA}(t) - \mathrm{FVA}(t) \qquad (1)$$

where

- EC is the economic capital at time (t);
- $A(t)$ (respectively $L(t)$) is the fair value of assets (respectively liabilities) at time t computed neglecting counterparty credit risk;
- UCVA(t) is the unilateral credit valuation adjustment at time t, which is given by:

$$\mathrm{UCVA}(t) = \sum_i \mathbb{E}_t\bigg[\exp\bigg(-\int_t^{\tau_i} r_{\mathrm{OIS}}(s)\,\mathrm{d}s\bigg) \times \mathbb{1}_{\{t<\tau_i<T\}}(1-R_i)(V_i(\tau_i) - c_i(\tau_i))^+\bigg] \qquad (2)$$

where the index i runs over counterparties, $V_i(t)$ is the exposure of the ith netting set, ie, the value of the ith netting set ignoring counterparty risk and funding costs, $c_i(t)$ is the total margin posted by the counterparty in virtue of the CSA agreement, and OIS stands for overnight indexed swap; and

- FVA(t) is the funding valuation adjustment computed at time t, given in first approximation by:[1]

$$\mathrm{FVA}(t) \approx \mathbb{E}_t\bigg[\int_t^{\tau_\mathrm{B}} \exp\bigg(-\int_t^{u} r_{\mathrm{OIS}}(s)\,\mathrm{d}s\bigg) s_\mathrm{B}(u) \times \bigg(\sum_i (V_i(u) - \bar{c}_i(u))1_{u<\tau_i}\bigg)^+ \mathrm{d}u\bigg] \qquad (3)$$

where $\bar{c}_i(t)$ is the re-hypothecable margin received, net of the margin posted by the bank in virtue of the CSA agreement, s_B is the funding spread of the bank on short-term unsecured debt, τ_B is the default time of the bank, and τ_i is the default time of the ith counterparty.

[1] This formula is not exact as it does not account for the use of capital as a source for funding and is only used as the initial guess for an iterative solution of a fixed point problem, see (13) below.

The funding spread is sometimes computed as a 'blended rate' that is lower than the credit default swap (CDS) spread to account implicitly for the possibility of using economic capital for funding purposes and avoid double counting with the hurdle rate. In this paper, we will model equity financing explicitly and hence choose s_B to be the CDS spread. However, one of the applications of our methodology is precisely to provide a principled calculation of a blended funding curve including capital funding.

The CVA and FVA flow into reserve capital. Regulatory reserve capital $\mathrm{RRC}_t(s)$ measured at time s and priced in dollars at time t is given by:

$$\mathrm{RRC}_t(s) = M_t(s)^{-1}(\mathrm{UCVA}(s) + \mathrm{FVA}(s)) \qquad (4)$$

where:

$$M_t(u) = \exp\bigg(\int_t^u r_{\mathrm{OIS}}(s)\,\mathrm{d}s\bigg) \qquad (5)$$

The realised reserve capital at time s is given by the initial reserve capital at a previous time $t < s$ minus the realised costs of funding and the default losses in the time interval $[t, s]$, ie:

$$\mathrm{RC}_t(s) = \mathrm{RC}(t) - \int_t^s M_t(u)^{-1}(\mathrm{d}D(u) + \mathrm{d}F(u)) \qquad (6)$$

Here, $\mathrm{RC}(t) = \mathrm{RC}_t(t)$, $D(t) = \sum_{\tau_i<t} M_{\tau_i}(t)(1-R_i)(V_i(\tau_i) - c_i(\tau_i))^+$ is the cumulative default losses suffered by the bank, and $F(t) = \int_0^t M_s(t) s_\mathrm{B}(s)(\sum_i (V_i(s) - \bar{c}_i(s))1_{s<\tau_i})^+\,\mathrm{d}s$ is the cumulative funding cost expenditures. The difference between regulatory and realised reserve capital:

$$L_t(s) = \mathrm{RRC}_t(s) - \mathrm{RC}_t(s) \qquad (7)$$

is a discounted martingale process in s. While regulatory reserve capital is funded by equity liabilities, the difference $L_t(s)$ represents a loss that can be funded with debt and adds to the FVA costs of funding.

Derivative portfolios are often simulated on a runoff basis, ie, assuming no new trades are added to the portfolio in the future. This is particularly useful when the objective is to assess the incremental impact of new trades. From this viewpoint, CET1 at time s measured in dollars at time t follows the discounted martingale process:

$$\mathrm{CET1}_t(s) = \mathrm{CET1}(t) - L_t(s) \qquad (8)$$

Banks allocate economic capital as a buffer against exceptional losses of reserve capital.

Following the FRTB, we define EC(t) as the expected shortfall of CET1 variation at time t with a confidence level of 97.5% and a holding period Δt of one year. The VAR measure for CET1 at time t with confidence level 97.5% is:

$$\mathrm{VAR}(t) = \inf[\mathcal{E} : \mathrm{Prob}_t(\Delta L(t) - \mathcal{E} > 0) \leqslant 2.5\%] \qquad (9)$$

and economic capital at time t is given by expected shortfall:

$$\mathrm{EC}(t) = E_t[\Delta L(t) \mid \Delta L(t) \geqslant \mathrm{VAR}(t)] \qquad (10)$$

Here:

$$\Delta L(t) = L_t(t + \Delta t) - L_t(t) \qquad (11)$$

'entirely on average' OK? Not sure what this means.

To ensure that exceptional losses do not deplete CET1 entirely on average, one needs to ensure that:

$$\text{CET1}(t) \geqslant \text{EC}(t) \qquad (12)$$

As explained in Albanese & Andersen (2015), repoing assets into cash to post as variation margin does not reduce CET1 since the margin posted against hedge payables is compensated for by a reset of the hedge valuation to zero. Furthermore, the loss $L_0(t)$ on reserve capital incurred up to time t also needs to be financed from the same sources as the variation margin itself. This implies that the formula for the FVA in (3) needs to be refined as follows:

$$\text{FVA}(t) = \mathbb{E}_t\bigg[\int_t^{\tau_\text{B}} M_t(s)^{-1} s_\text{B}(s) \times \bigg(\sum_i (V_i(s) - \bar{c}_i(s))1_{t<\tau_i} - \text{EC}(s) - \text{RC}_t(s)\bigg)^+ \,\text{d}s\bigg] \qquad (13)$$

This equation expresses a fixed-point problem for the process $\text{FVA}(t)$, which can be solved iteratively. Technically, (13) is a so-called backward stochastic differential equation for the process $\text{FVA}(t)$ (see Albanese, Caenazzo & Crépey 2016).

In what? Equation (13)? Clarify?

Moreover, for numerical tractability, economic capital $\text{EC}(t)$ therein is approximated by its time projection in the sense of the following term structure:

$$\overline{\text{EC}}(t) = E_0[\Delta L(t) \mid \Delta L(t) \geqslant \text{VAR}(t)] \qquad (14)$$

The approximation in (14) reduces the evaluation to a simply nested simulation as opposed to a doubly nested simulation for (10), while introducing some convexity error.

KVA risk adjustments, reported earnings and transfer pricing

As returns on equity fell in the aftermath of the crisis, banks became increasingly aware of the need to design a sustainable and robust method for costing capital and distributing earnings. The recognition of risk adjustments in accounts is an essential part of the solution.

Since Solvency II already incorporates the concept of KVA, international accounting boards already went through a decade-long process to address KVA in the context of insurance contracts. Discussions are summarised in a series of exposure drafts for IFRS 4 Phase II (see IFRS 2013).

Insurance markets are incomplete by their very nature. This means that the entry price at which an insurance firm agrees to accept a liability is not only a function of the discounted expectation of future expected cashflows, but also includes a risk adjustment. The risk adjustment is related to the capital-at-risk, ie, to the term structure of economic capital projections.

The academic literature on the topic of risk adjustments is extensive and revolves around the notion of expected utility pricing.

The risk preferences of a rational investor are characterised by a utility function U and a probability measure P. A payoff A is preferable to a payoff B if and only if:

$$E^P[U(A)] \geqslant E^P[U(B)]$$

A useful class of utility functions is given by the coherent risk measures, one example being expected shortfall. In the special case of complete markets, replication is possible and preferences are irrelevant. The cost of replication is the OIS-discounted expectation of future payoffs under a risk-neutral measure.

IFRS 4 Phase II draws a distinction between the fair valuation of claims and a risk adjustment add-on. The risk adjustment is an intertemporal portfolio-level metric that is not by itself a coherent risk measure but is derived from a choice of coherent risk measures and has the financial interpretation of cost of capital.

In the case of derivative portfolios, we propose using a risk adjustment $\text{KVA}(t)$ corresponding to retained earnings fitted to the objective of a sustainable remuneration of shareholders' capital at a target hurdle rate h, given a risk measure that is used for setting economic capital. Since retained earnings are part of economic capital, shareholder capital-at-risk is given by the difference $(\text{EC}(t) - \text{KVA}(t))$. We are looking for a dynamic amount $\text{KVA}(t)$ such that, starting from an initial profit $\text{KVA}(0)$ received at trade inception and deposited in a risk-free account yielding OIS, $\text{KVA}(0)$ can be distributed in time T by yielding on average $h(\text{EC}(t) - \text{KVA}(t))\,\text{d}t$ as dividends at each intermediate time t. In other words, we are looking for a process $\text{KVA}(t)$ satisfying:

$$E_t\bigg[\frac{\text{d}\,\text{KVA}(t)}{\text{d}t}\bigg] = r(t)\,\text{KVA}(t) - h(\text{EC}(t) - \text{KVA}(t)) \quad \text{on } [0, T] \text{ and } \text{KVA}(T) = 0 \qquad (15)$$

The unique solution to (15) is given by:

$$\text{KVA}(t) = hE_t\bigg[\int_t^T \exp\bigg(-\int_t^s (h + r(s))\,\text{d}s\bigg)\text{EC}(s)\,\text{d}s\bigg] \qquad (16)$$

so:

$$\text{KVA}(0) \approx h\int_0^T \text{e}^{-hs} Z_0(s)\overline{\text{EC}}(s)\,\text{d}s \qquad (17)$$

where Z_0 is the discount function at time 0. We emphasise that (16) is the only way to guarantee an average hurdle rate of h on shareholder capital $(\text{EC}(t) - \text{KVA}(t))$ at any time t. The quantity $(-\text{dKVA}_t)$ corresponds to dividends whenever positive and losses to shareholders due to recapitalisation and dilution when negative. Equations (15) and (16) hold up until the time where exceptional losses occur and EC and KVA are subject to depletion, at which point the drift condition becomes invalid.

Upright 'd' used for the differential element and sloping d retained when there is a 'd' that doesn't look like a differential. Please check all 'd/d' are typeset correctly throughout. Also, in the displayed equation you have 'd KVA(t)' and then in the text you have '$-\text{dKVA}_t$' – should this be made consistent or are these different things?

Managers may decide to induce a change of hurdle rate towards a target h_0. In this case, if $\text{RE}(t)$ denotes the level of retained earnings at time t, we define the implied hurdle rate $h_i(t)$ by setting:

$$\text{RE}(t) = \text{KVA}(t, h_i(t)) \qquad (18)$$

To cause the implied hurdle rate to drift towards the target, managers would price new deals at the target hurdle rate and not pay dividends as long as $\text{RE}(t) \leqslant \text{KVA}(t, h_0)$. In the insurance industry, such strategies cause implied hurdle rates to move in cycles, whereby events of industry-wide capital depletion are followed by periods of gradual tightening of hurdle rates driven by competition.

RACET1 is defined as follows:

$$\text{RACET1} = \text{CET1} - \text{KVA} \qquad (19)$$

RACET1 represents a model-based valuation for shareholder capital. As we explained earlier, RACET1 includes a KVA risk adjustment due to earnings volatility and because of the dilution risk shareholders face when economic capital is depleted. The choice of the hurdle rate h and of the risk measure that is used for determining economic capital are entity specific and reflect risk preferences. IFRS 4 Phase II leaves the choice entirely to management, except for specifying that the chosen definition should be applied consistently both for retained earnings and for entry prices. This policy is also consistent with the prohibition of day-one earnings.

In Albanese, Andersen & Iabichino (2015), we define the transfer pricing policy in such a way as to preserve CET1 with respect to the addition of new trades. If we include economic capital funding and risk adjustments, this principle needs to be revised by saying that managers should ensure that RACET1 stays invariant. More precisely, the adjustment to fair valuation passed on to clients is the risk-adjusted funds transfer pricing amount given by:

$$\text{RAFTP} = \Delta\,\text{UCVA} + \Delta\,\text{FVA} + \Delta\,\text{KVA} \tag{20}$$

We stress that Basel III does not make any reference to risk adjustments. Regulators calibrated the models in Basel III to CET1 defined as the fair value of shareholder capital, not to the risk-adjusted variant RACET1. In particular, it would be unjustified to consider the KVA as an adjustment to the fair valuation of trades that feeds into CET1.

A regulatory treatment for KVA already exists in the context of Solvency II, which stipulates that economic capital must be larger than or equal to KVA. This can be achieved by setting:

$$\widetilde{\text{EC}} = \inf\{C; C \geqslant \max(\text{ES}, \text{KVA}(C))\} \tag{21}$$

where ES is expected shortfall and $\text{KVA}(C)$ means the process obtained by (16) with a putative economic capital process C instead of $\text{EC} = \text{ES}$. However, we often have $\widetilde{\text{EC}} = \text{EC}$. The equality stops holding when the hurdle rate is high enough, and the term structure of EC starts very low and has a sharp peak in a few years.

Model risk can be included in our definition of KVA by adopting a Bayesian approach and averaging scenarios over model uncertainty. This involves introducing a Bayesian prior over uncertain parameters and performing an average of the distribution of the loss process $L_s(t)$ prior to taking the expected shortfall that defines EC. This approach is particularly useful when studying the problem of robust hedging for CVA/FVA exposures by means of a variation of the Black-Litterman method for portfolio optimisation.

The prudent valuation document by the European Banking Authority (2015) mandates earnings provisions through additional valuation adjustments (AVAs). AVA targets model risk and other unhedgeable risks not included in Basel III, such as close-out risk. Our definition of KVA is in a similar spirit but covers all unhedgeable risks by reflecting them in economic capital. The point where we differ from the prudent valuation document is that we do not advocate deducting KVA from CET1, but instead we treat it as a risk adjustment in IFRS 4 Phase II.

Banks are already in the habit of reporting earnings in a dual fashion, on both a Gaap and a non-Gaap basis. Typically, non-Gaap earnings neglect contra-liabilities. In the case of debit valuation adjustment (DVA), since regulators have de-recognised DVA as a contributor to CET1 capital, banks do not recognise a DVA benefit to clients. DVA still contributes to income and to P&L, giving rise to a day-one DVA profit. Day-one profits also arise because of the other contra-liability terms discussed in Albanese, Andersen & Iabichino (2015), ie, the difference UCVA − FTDCVA and the funding debt adjustment term. These profits are, however, not included in non-Gaap earnings. Given this precedent and in the spirit of IFRS 4 Phase II, we also advocate deducting KVA from non-Gaap earnings.

A. KVA and adjusted FVA

XVA	Value (million $)
UCVA	242
UDVA	198
FVA without EC, stochastic UCVA and FVA	126
FVA with EC, stochastic UCVA and FVA	62
KVA	275
FCA	296
FBA	179
SFVA	117

A case study

As a case study, we consider a representative fixed-income portfolio with about 2,000 counterparties and 100,000 fixed-income trades including swaps, swaptions, foreign exchange options, inflation swaps and CDS trades. A nested simulation with 100 underlying time points and yearly secondary branching points up to 50 years in the future is launched to recalculate the CVA and FVA. Using 20,000 primary scenarios and 1,000 secondary scenarios, this amounts to a total of one billion scenarios. The calculation takes three hours using a single GVL Esther appliance. We compute the return distribution of CET1 and evaluate the quantiles that define economic capital according to (10), assuming a hurdle rate of 10.5%.

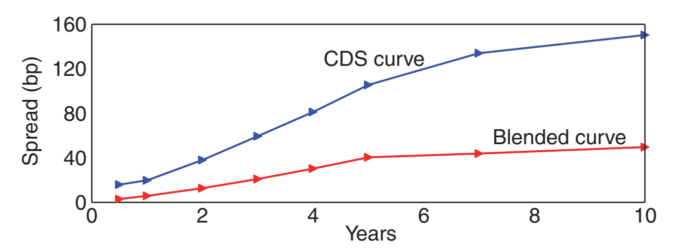
Primary scenarios are generated based on a historical measure, while secondary scenarios are generated under the risk-neutral measure and are used to value CET1 with yearly frequency. CET1 variations account for default losses, funding costs and the mark-to-market variation of both UCVA and FVA.

Risk-neutral processes are calibrated to derivative data using broker data sets for derivative market data. The historical measure is obtained by adjusting parameters of the risk-neutral models in such a way as to satisfy backtesting benchmarks. In particular, historical measures for interest rates have an adjusted drift to account for the fact that yields are not good predictors of future rates.

Table A shows the XVA results for the case study portfolio. Figure 1 instead shows the term structure of economic capital along with the term structure of KVA. The KVA computed as per (16) amounts to \$275m, roughly 15% above the UCVA. We report several FVA numbers to show how this gets reduced when we consider additional funding sources.

The funding cost adjustment (FCA) and funding benefit adjustment

3 Rigorously computed blended curve



(FBA) metrics are defined as follows (see Burgard & Kjaer 2013):

$$\mathrm{FCA}(t) = \sum_i \mathbb{E}_t\bigg[\int_t^{\tau_B} \exp\bigg(-\int_t^u r_{\mathrm{OIS}}(s)\,\mathrm{d}s\bigg) s_B(u) \times ((V_i(u) - \bar{c}_i(u))1_{u<\tau_i})^+\,\mathrm{d}u\bigg] \quad (22)$$

$$\mathrm{FBA}(t) = \sum_i \mathbb{E}_t\bigg[\int_t^{\tau_B} \exp\bigg(-\int_t^u r_{\mathrm{OIS}}(s)\,\mathrm{d}s\bigg) s_B(u) \times ((V_i(u) - \bar{c}_i(u))1_{u<\tau_i})^-\,\mathrm{d}u\bigg] \quad (23)$$

Finally, SFVA $=$ FCA $-$ FBA. The FCA deducted from capital under FCA/FBA accounting (cf. Albanese, Andersen & Iabichino 2015) is as large as \$296m.

The FVA number accounting only for re-hypothecation of variation margin received on hedges amounts to approximately \$126m. However, if we consider all additional funding sources due to economic capital and UCVA/FVA collateral, we arrive at an FVA figure of \$62m: almost half of the re-hypothecation-only FVA.

Neglecting the (FBA-DVA) correction to capital, which is small anyway, the deduction from capital would be \$62m as opposed to \$296m: a reduction by about a factor of five. However, KVA is significant at \$275m and gives the leading contribution to risk-adjusted transfer prices.

The reduction in funding needs achieved by EC, UCVA and FVA is also clearly shown in figure 3 for the blended funding curve. This curve is defined as the funding curve that – whenever it is applied to the FVA computed neglecting the impact of economic and reserve capital – gives rise to the same term structure for the forward FVA as the calculation that is instead carried out including capital in the calculation as a source for funding. This blended curve is often inferred by consensus estimates based on the Markit XVA service. However, here it is computed from the ground up, based on fully fledged capital projections.

Conclusions

We introduce KVA as a risk adjustment aimed at compensating shareholders for the risk of earnings volatility. Using an accounting framework inspired by IFRS 4 Phase II, shareholders are compensated in proportion to capital-at-risk times a hurdle rate decided by management. KVA also enters into entry prices by quantifying cost of capital.

We conclude that KVA reporting would improve transparency in dividend distribution policies and make the derivatives business more sustainable and less prone to developing bubbles. We also find that FVA is materially reduced once we account for the possibility of pledging economic capital. ■

Claudio Albanese is the chief executive officer of Global Valuation, Simone Caenazzo is ... and Stéphane Crépey is ... They are **grateful to Leif Andersen, Fabrizio Anfuso, Peter Carr, Darrell Duffie and Stefano Iabichino for comments and discussions. The research of Stéphane Crépey benefited from the support of the Chair Markets in Transition under the aegis of Louis Bachelier laboratory, a joint initiative of École polytechnique, Université d'Évry Val d'Essonne and Fédération Bancaire Française.**
Email: claudio.albanese@global-valuation.com,
????.

Further author bio details needed.

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