



Current exposure is typically assessed using the current mark to market (MtM) value of the relevant position, net of accounts receivable and collateral guarantees: this gives us the loss we would experience if the counterparty were to default today. MtM values can fluctuate dramatically, so even a position with a negative current value can still represent a major credit concern: its currently negative value might suddenly become positive, and the counterparty might then default.

Potential future exposure is then typically evaluated using a Monte Carlo simulation engine that estimates the potential exposure at one or more points in time during the life of the contract.

A simple and robust way to add an estimate of how much could be lost from a counterparty over a particular time horizon is to use a VaR-style measure. We refer to this measure as VaR+. If we add our current VaR+ (or related measures such as expected shortfall) to our existing MtM exposures, we can then obtain a potential MtM exposure for a given confidence level and horizon.

An example of such a VaR-enhanced counterparty risk report is given in Figure 1. In this particular case, we can see that even though the current MtM exposures with regard to BP and Chevron-Texaco are within our limits, adding in the potential fluctuation indicated by VaR+ numbers would lead to these limits being breached.

### Potential future exposure modelling

However, VaR has certain limitations as a measure of credit exposure. For example, VaR is usually calculated for short horizons, and VaR calculations

seldom take into account complex netting and margining provisions at the counterparty level. Therefore, it is important to supplement VaR+ measures with more sophisticated measures of potential future exposure.

Our future exposure is the amount that would be lost at a given point in the future if the counterparty were to default on an in-the-money position. One measure of this future exposure is the potential future exposure (PFE), which is the projected potential exposure over the life of the transaction at given degree of statistical confidence (eg, 99%). We are particularly interested in two aspects of PFE:

□ The first is the maximum potential future exposure (MPFE), which is the peak or maximum of the PFE at a

given degree of statistical confidence and is commonly used for limit setting

□ The second is the expected exposure (EE) profile, which is the average or expected exposure at various points in time in the future. The EE curve is also referred to as the “credit-equivalent” or “loan-equivalent” exposure curve. The EE is typically used as a key input into the methodology used for pricing credit charges into deals; it is also often used to calculate the economic capital to be assigned to a position.

The shape of counterparty exposure profiles is of special importance because credit exposures must be viewed over the entire life of the transaction. This is also important because different types of instruments generate quite different credit exposure profiles over time. For

## Parent company guarantees: analyse with caution

To analyse the counterparty risk of an energy firm’s trading arm, it is important to understand the business and financial linkages between units within the same group and also investigate the potential for contagion effects. Parent companies provide more transparent financial information than their subsidiaries but may not have a higher credit rating than an operating subsidiary.

However, the degree of support from a parent company to a trading subsidiary cannot be taken for granted, even if a parent company is hinting that it would support or even guarantee their subsidiaries’ liabilities. For example, many counterparties of China Aviation

Oil Singapore assumed that the firm had the backing of its parent company, a state-owned Chinese firm. However, if credit risk analysts had drilled deeper into the business model, examined their risk management structure, and checked the robustness of the parental guarantees, then they would have found significant problems with the company. The ability to “see over hills and around corners” is one of the most important skills of good risk managers.

In addition, correlations between defaults of parents and subsidiaries are often quite high, and in such circumstances the parents’ guarantees may be of little use. Parental guarantees should be viewed with caution. □

**Figure 1.**  
VaR-enhanced counterparty risk report

Counterparty	Current MtM Exposure	MtM Limit	Under/Over	Current VaR+	Potential Exposure (MtM + VaR+)	Under/Over MtM limit	Marginal VaR
<b>BP</b>	8,448	12,000	3,552	4,500	12,948	(948)	2,697
<b>Sempra</b>	5,111	10,000	4,889	1,700	6,811	3,189	921
<b>Dominion</b>	(2,481)	8,000	10,481	2,400	(81)	8,081	(312)
<b>Tenaska</b>	(13,898)	6,000	19,898	3,900	(9,998)	15,998	(474)
<b>Chevron-Texaco</b>	3,173	5,000	1,827	1,900	5,073	(73)	(408)

example, a commodity swap's MPFE typically occurs at roughly one third through its life, whereas a commodity forward's MPFE occurs at maturity. Broadly speaking, these exposures are subject to two different passage-of-time effects: the diffusion effect and the amortisation effect. The diffusion effect describes the increasing probability that the value of a position will travel further away from its initial value over time, thus tending to increase the amount exposed to default. On the other hand, the amortisation effect takes account of the fact that the remaining cashflows due on a position diminish over time, and over time this reduces the amounts that are exposed to default.

Both these effects are very visible in the PFE profile for a one-year swap, shown in Figure 2. This chart shows both expected and potential future exposures over the lifetime of the swap, with potential exposures at the 99% confidence level. The diffusion effect can be seen from the way that both types of exposures initially rise; however, over time, the amortisation effect dominates, and both types of exposure subsequently fall. The PFE analysis therefore tells us that our swap position initially has a relatively low exposure, but the exposure rises to a maximum at a horizon of about four years, and then subsequently falls again.

It is also very important that estimates of potential credit exposures take account of complicating features. One such feature is the possibility of price spikes, which can dramatically alter credit exposures in a very short time period. We can take account of such possibilities using a simulation framework that uses realistic price processes that can accommodate empirically important features such as mean reversion and jumps, seasonal factors in the forward price curve, and changes in volatilities and other model parameters. Simulation methods are also good for dealing with the additional complexities that arise where we need to adjust valuations in illiquid markets where credit is not explicitly priced.

Simulation approaches are also particularly useful when dealing with multi-dimensional problems (ie, where outcomes depend on more than one risk variable such as prices, defaults and recovery rates) and, as a rule, we can say that simulation approaches become relatively

more attractive as the complexity and/or dimensionality of a problem increases.

In addition, simulation methods can also take account of the extra complexities arising from credit mitigation methods: netting provisions, margining, collateral and guarantee terms, credit triggers, pre-payment terms, and so on (see box, *Credit risk mitigation*). The simulation framework can also incorporate other components such as market liquidity conditions and operations risks – such as outages, pipeline blowups, etc – which can also be very important for energy firms.

Due to their complexity, PFE models should be thoroughly vetted before and after they are deployed for day-to-day use. Credit risk managers and analysts can provide valuable information regarding the quality of the input and output from the model and identify potential problems (eg, unexpected results). However, it is also very important to document the assumptions and steps in the calculations, and to subject models to stress tests and back tests on a regular basis. Internal and external auditors should also confirm that the models used are suitably calibrated and implemented, and senior management need to be aware of the assumptions on which they are based and of the potential pitfalls with their use.

### Counterparty credit risk charges

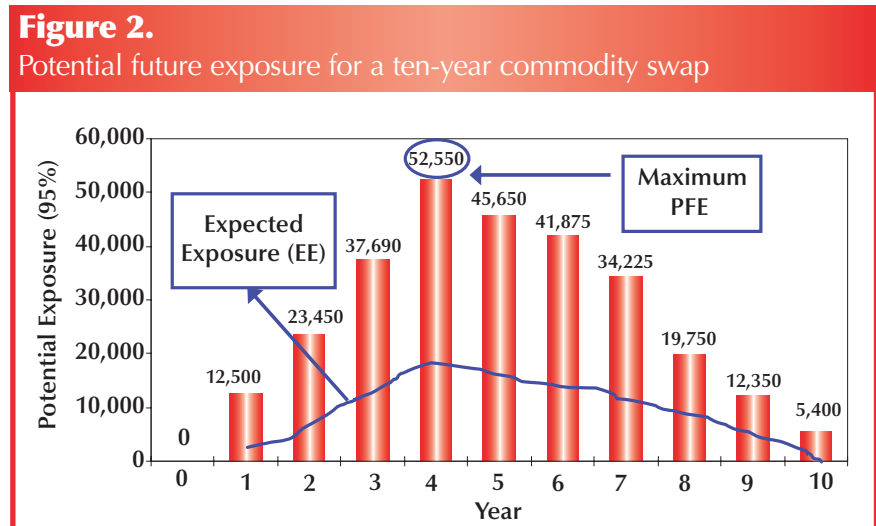
It is good practice – but still not common among many energy and commodity trading firms – to charge for counterparty credit risk. After all, counterparty credit exposure is not free, and can result in considerable potential losses for the firm.

Even though developing a system of counterparty credit risk charges can be a complex effort, the cost of inaction can be very large indeed. If the firm is acquiring credit exposures, it therefore needs to manage them properly. This also helps to create the right alignment of incentives within the firm. For example, if traders are charged for the counterparty credit risk taken, they then have an incentive to manage it properly in the broader interests of the firm. On the other hand, if traders are not charged for credit exposures, then they have no incentive to be careful with the exposures they take on. Instead, they will be tempted to take on 'cheap' deals that only appear to be cheap because no-one is taking account of costs of credit exposures. The firm could then acquire large hidden credit exposures to poor quality counterparties.

### Credit loss distributions

The PFE is an important input to calculating potential losses, but in order to obtain an indication of expected losses, we also need to include other variables. This is of course particularly important when charging for credit exposures and allocating capital to them. The probable loss on any transaction or portfolio of transactions depends on four variables:

- Potential exposure: Amount exposed to credit risk
- Probability of Default (PD): Probability of the counterparty defaulting
- Recovery rate (RR): Amount of the defaulted position that is likely to be recovered
- Conditional Loss Given Default (LGD): The amount that is likely to be lost if the counterparty defaults.



A good model of expected default loss must therefore get each of these terms 'right' (see Figure 3): it must have a good potential exposure model (the first

box), it must have a plausible probability of loss (the second box) and a plausible recovery rate (the third box). Observe that the LGD equals one minus the RR.

## Credit risk mitigation

Credit charges should also be supplemented with credit risk mitigants, such as the following:

**MtM-based collateral** – Periodically making transparent the market value of a credit-sensitive transaction and then agreeing to periodic transfers of the change in value from the losing side to the winning side of the transaction, is one of the most efficient credit enhancement techniques. Collateral payment terms can be associated with the credit rating of each counterparty. In the event of a downgrade, a firm may be required to post additional collateral.

**Netting** – A legally enforceable process called "netting" is an important risk mitigation mechanism in the derivative markets. When counterparty has entered into several transactions with the same institution, some with positive and others with negative replacement values then, under a valid netting agree-

ment, the net replacement value represents the true credit risk exposure.

**Liquidity puts and credit-triggers** – allow for early termination of trades at pre-specified dates. Credit triggers allow for early termination if counterparty's rating falls below a pre-specified threshold.

**Credit derivatives** – are off balance sheet arrangements that allow one party (the beneficiary) to transfer credit risk of a reference asset to another party (the guarantor) without actually selling the asset. They allow users to strip credit risk away from market risk, and to transfer credit risk independently of funding and relationship management concerns. Credit derivatives such as credit derivative swaps (CDS), spread options, and credit linked notes have payoffs contingent on changes in the credit quality of a specified entity. □

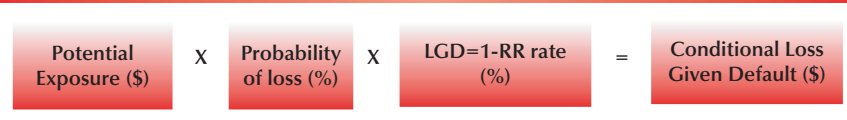
## Economic capital and credit risk

Economic capital is the financial cushion that a firm uses to absorb unexpected losses, eg, those related to credit events such as credit migration and/or default. Figure 4 illustrates how the capital charge related to credit risk can be derived. In order to achieve a particular credit rating (eg, AA), firms are expected to hold reserves against these unexpected losses at a given confidence level. The higher the credit rating desired, the lower the probability of incurring losses above the capital level over the period corresponding to the credit risk horizon, and the higher the necessary capital. More precisely, the firm needs to ensure that it has capital adequate to bring the probability of a catastrophic (ie, insolvency-inducing) loss down to a level compatible with its desired credit rating.

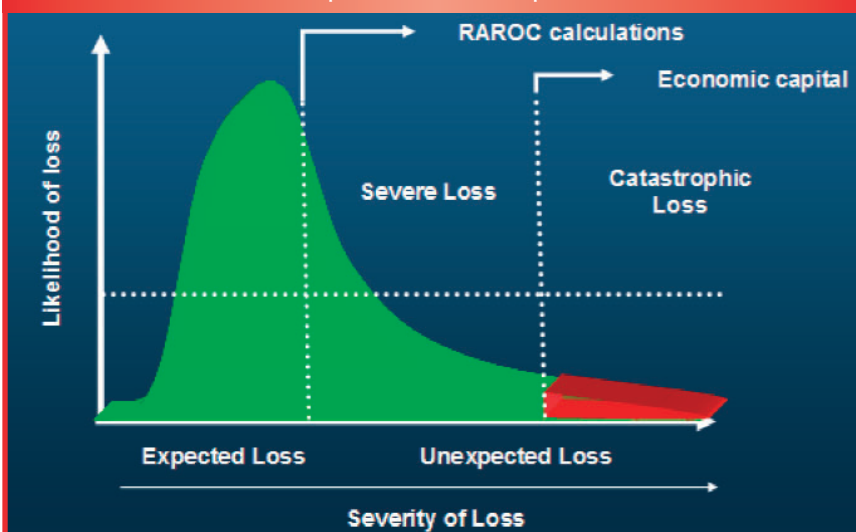
Determining the economic capital allocated to each activity or business unit provides management with a mechanism to link risk and expected return, and therefore provide a risk/reward signal that can be used not only at the firm wide level, but also at different business unit levels within the firm.

The increasing complexity of the credit risks involved in running an energy or commodity trading operation, mean that enterprise wide credit risk education and awareness should be a critical item in the agenda of credit risk takers, senior executives and board members. Anyone who has any doubts on this should consider how easy it was to lose money as the counterparty of companies such as Enron or CAO. Firms that fail to take counterparty risk issues seriously and therefore fail to put the appropriate policies, methodologies and infrastructure in place are in effect playing Russian roulette, and Russian roulette is not a particularly good strategy for long term survival. □

**Figure 3.** Potential future exposure for a ten-year commodity swap



**Figure 4.** Credit loss distribution, expected and unexpected losses



\*Carlos Blanco, is MD of Black Swan Risk Advisors (carlos@blackswanrisk.com),

\*Kevin Dowd (kevin@blackswanrisk.com) is director of research of Black Swan Risk Advisors and professor of financial risk management at Nottingham University Business School in England, and \*Robert Mark is the CEO of Black Diamond (bmark.blackdiamond@tmo.blackberry.net)