KPMG

FINANCIAL SERVICES

Managing Market Risk

New attitudes, old wisdom.

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Foreword

Banks have long faced the risk of losses from undesirable market movements. But how many could have predicted how very hostile the market would become?

The pervasiveness of proprietary trading means it is more vital than ever for financial institutions to have the best possible approaches to model and manage market risk, and to calculate the capable capital reserves they need to provide a buffer against their market exposure.

In putting together this paper, KPMG wanted to capture some of the latest thinking around market risk. In particular, we wanted to help boards and risk managers to look beyond the risks commonly associated with the market – like equity risk, interest rate movements, or big shifts in foreign exchange and commodity prices. Many of the chapters in the paper explore the interrelated nature of a whole range of risks – credit, liquidity, operational, strategic and reputational – and the ways in which they may combine to threaten the business. Others examine the evolution of attitudes to risk, assess what lessons the industry can learn from the recent crisis, or go into detail on the latest techniques and models for producing realistic risk and reserve calculations.

We hope you find this document useful, and we look forward to discussing the issues with you.

Jörg Hashagen
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Managing Market Risk: new attitudes, old wisdom.

"Market risk is not a stand alone factor, it is one challenge in an interconnected network of risks which need holistic management."
Jörg Hashagen

Market risk is dead, long live market risk

Like a falling line of dominos, last year's publication of losses on U.S. sub-prime mortgages triggered off a sequence of critical events in the financial markets, culminating in a liquidity freeze and a drastic decrease in banks' refunding opportunities. These events underlined once again that, however we choose to classify different risks for technical purposes, they cannot be managed effectively on a stand alone basis.

This is not new wisdom. After all, the whole concept of risk management is built on the correlation between different risks, asset classes and liabilities. It's clear to see that the events which preceded today's market and liquidity crisis rippled through many risk areas, from credit risk (sub-prime mortgage losses) to operational risk (a major rogue trading event), to business and reputational risk (the default of a global investment bank). However, a major complicating factor is that – management competence notwithstanding – many of the models the industry is currently using to assess risk may be too static to take account of the real dynamics of the market, particularly the more extreme events.

With the old concept of what constitutes 'market risk' so badly broken, the industry urgently needs to evolve new concepts, techniques and models which take this dynamism and instability into account. But before we put the technicalities in place, we also need to question the underlying assumptions we are making about the market – and ask what lessons can be learned from recent events.

Assumption 1: We trust each other
Our first major assumption about the market is that there is transparency and trust. A market will only exist if participants have trust and confidence in each other. If trust decays, markets collapse – which was graphically illustrated when inter-bank lending seized up in the recent crisis. In the absence of a market, we quickly run into deep trouble with valuations of any financial instruments, whether they are physical, synthetic or hybrid. In the absence of a market, we can forget about any kind of hedging policy. Financial instruments around markets will only work properly if we are in a going concern environment where all the participants trust each other, and there is no threat of systemic failure.

Assumption 2: Money is available
Recent concepts about the market were based on an assumption that liquidity would be available at all levels, in all time periods, for all maturities, at an appropriate price. Certainly for the time being, we may have to relinquish this hypothesis and deal with a harsher reality.

Assumption 3: We can put our faith in the ratings
At both board and operational levels, a mystique has grown up concerning the quality of ratings and how they should be interpreted. The industry had been throwing money at AAA ratings, confident that the migration from AAA to sub-investment grades would be stable over time. This assumption proved wrong, with more extreme swings from the highest to the lowest grade in the past 9 months than in the preceding 40 years.

Assumption 4: We have the information we need
In terms of market risk, the industry assumes they have access to the right data – high frequency, high quality data – to make decisions and keep the market functioning. But in fact this is not always the case, particularly not in the new, developing markets, or where rules are not clear. Models still tend to be built around the continued relevance of past events, assumptions regarding the effectiveness and depth of markets, participants' behavior and correlations within and between different markets: other 'off-the-model' risks are often almost ignored.

Learning the lessons?

Risk awareness: the board's role
All the wisdom, energy and techniques invested in risk management over the past two decades could not prevent the recent tumultuous events. The road to recovery is likely to be long and hard. For example, the interbank money markets are showing some signs of movement, but we are still waiting for asset-backed securitized assets to recover, which has left banks sitting on a good deal of risk which they cannot currently repackage and sell on. Although the central banks have attempted to refuel the market with enough liquidity to return us to some sense of stability, who knows if they are capable of doing enough? What we do know is that their existence alone will not be enough to prevent another crisis from happening.

All of this emphasizes the importance of staying alive to risk: complacency is the industry's biggest enemy. We need to strive constantly for fresh thinking, management approaches and technical knowledge, to help ensure we stay aware of all the interconnections of risk in the market and can make sound decisions in future. It all comes down to making sure we don't forget the basics of risk management and banking.

This is where board structure and knowledge is absolutely key. The industry needs strong leadership from boards who know their market intimately, do not suffer from blindspots on IT and complex financial instruments, are capable of exercising sound commercial judgment and are disciplined enough not to cross the line beyond reasoned risk-taking. The Chief Risk Officer (CRO) should have a strong voice on the board, to help ensure its members are regularly updated on new risks and vulnerabilities under new stress scenarios. In many institutions, the CRO role is being repositioned to:

- connect more closely with strategic decision making and planning; and
- connect strongly with the business units themselves – not just the trade floors where innovation takes place, but the financial engineering hubs and remote locations.

In this way, it helps to reduce the chance of the business missing the significance of a new threat.

Focus on true risk management and risk culture

Some commentators have categorized recent events as a top-to-toe failure of risk management, fuelled by serious failings in awareness and an oversized appetite to create performance. Whether you agree with this view or not, it's probably true that in some institutions there has been too much focus on risk reporting, at the expense of true risk management. KPMG member firms still see businesses (including some major organizations) where managing risk is largely a desktop exercise – a number-crunching unit peopled by technicians, connected neither appropriately with the day to day business, nor with strategic decision making and planning.

In the more enlightened organizations, everything's connected. Risk managers talk to the trade floor and the economics department to develop strategic plans, taking into consideration factors like the terms of trade, developments in regional markets and demographics, inflation and exchange rates. Risk isn't just a number that pops out when a handle is cranked: it's connected with the business at every level and it influences risk appetite and control at the highest level. In other words, there is a risk culture.

Once again, this is where the board's attitude is central. Boards can set the tone by communicating their market understanding, their awareness of risk, and their high expectations of behavior. They can provide an environment where risk decisions are based on sound commercial judgment and proven information about the whole business case. People should be in no doubt that the board wants them to act in the spirit – and not just the letter – of the law.

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1 Where did risk management go wrong?

Reflections from the people and businesses on the frontline.

Financial services firms have poured investment into analytics, data management and human capital to manage risk. So why has risk management failed so miserably during the credit crunch, with estimated trading losses of U.S.$470 billion since the start of 2007? Steven Whiting (KPMG in the U.S.) reviews observations emerging from the people and businesses on the frontline, and defines some new risk management challenges.

It is still too early paint a finished portrait of the credit crunch. But formal disclosures by institutions and comments from the individuals involved have started to sketch the outline on the canvas. What can be concluded at this stage?

Risk measurement is *not* risk management

The evolution of the Basel regulatory capital process has driven major investments in systems and technology. Measurement and system output are critical to the capital calculation process, along with feeding the internal and external reporting requirements that Basel has spawned. But the focus on measurement comes at the expense of management and analysis. This is where the risk management process has fallen short. Measurement concentrates on the expected; management challenges arise when the unexpected occurs. For example, 'tail risks' associated with highly correlated defaults have exceeded all industry expectations, and few market participants either assessed or hedged this risk properly.

Some organizations seem to think that the act of measurement alone means they are managing risk. In many institutions, the primary purpose of the risk function is to produce reports: activities that cannot be measured in the reporting process are sidelined and not rewarded. When a business crisis develops, reports proliferate and become part of the normal cycle, but they are prone to error because they were designed in a crisis. This can create a reporting nightmare, with time wasted on reconciling siloed business reporting systems and processes.

At the transaction or business level, some risk managers have performed little analysis on risk/reward trade-offs or the assessment of risk adjusted investment returns. Simple analyses, such as 'Sharpe ratio' calculations, can provide a useful filter to assess whether a transaction makes sense. Similarly, economic capital calculations that include liquidity and other critical risk factors can uncover structural weaknesses in specific lines of business or portfolios.

Anecdotes suggest that some risk managers raised concerns about the risk profile, but their concerns were not addressed. It is clear from KPMG member firms recent epxeriences that one or more of the following conditions exist:

- analytic challenge of positions and strategies is not part of the trading risk process
- risk analysis does not focus on things that may cause the most damage (illiquidity or rising correlation)
- risk analysis is overridden by the firm's governance process

If risk management is to avoid a repeat of its current stumble, the risk process should evolve in a manner that exhibits rigorous analysis, asks difficult questions, is independent, and has the authority to alter behavior. It is not just a measurement exercise.

Today's risk personnel may be gone tomorrow

Data managers and risk analysts have very different skill sets. Data managers often do not have the product or business knowledge to interpret results or to challenge; strong risk analysts don't always have the best skills at organizing risk data production processes. Both roles are important to the business, but unfortunately, both sets of personnel tend to take short-term rotations in risk functions. Many risk personnel may be organizational 'orphans' who only see the risk function as a temporary way station until they can resume the upward trajectory of their career elsewhere.

Risk function personnel don't wear both data and analysis hats well. Nor have they contributed meaningfully to risk discussions with the business or with management, and they have had little impact on the direction of business strategy. Risk organizations should help personnel adapt to the complexities of the evolving marketplace: management must provide appropriate incentives and goals. There should be a clear career path within the risk organization that will reward people for their contribution and allow long-term institutional risk knowledge to be retained within the organization.

Corporate strategies undermine the risk framework

Senior level 'tone' has a significant impact on risk management, affecting organization governance, risk appetite, limits, compliance and control. That tone went flat in the recent cycle. For example:

- In one organization, the CRO reports to the senior risk-taking officer of the firm. This makes it impossible for the CRO to challenge the boss' poor risk taking judgments.

- A KPMG member firm knows of a global CEO who trades on behalf of his bank. While it is bad enough that the CEO is trading, the problem is exacerbated by the fact that his trading portfolios are outside of the limit and control structure that applies to all other portfolios.

- At another organization, strategic business objectives, such as business growth and industry league table rankings, took precedence over business limits and control processes. Product limits were routinely increased to accommodate growth. In some cases, deal leverage accepted by the market exceeded the thresholds observed at the peaks of prior lending cycles. Objections to accepting these highly leveraged deals by risk managers were noted, but discounted in face of the greater growth agenda.

The corporate strategy for the lines of business must reflect an organization's initial statement of risk governance. An independent, functional risk group should then work with the business in creating a web of control that promotes growth within a controlled environment. High performance racing cars still need effective braking systems.

Incentives must be realigned

In the world of capital markets trading, the extent of free market optimization is undoubtedly linked with an organization's compensation structure, but how that feedback mechanism works may not be completely clear. Questions have been raised about the appropriate length of vesting periods for incentive comp, and whether or not prior year incentive comp should be returned in subsequent years in the case of poor performance.

However, compelling employees to have 'greater skin in the game' does not by itself ensure that all behaviors will align with an organization's objectives or provide protection against the specific risk of highly concentrated poor performance or judgment. At the time of its fall, Bear Stearns' employees owned about one-third of the firm's outstanding shares, but that did not stop the firm's collapse.

What about strategic failures? How should you address the case where an organization's strategy is to lead the league tables, despite the fact that all of the market, credit, liquidity and funding costs of these activities are not measured or accounted for in the execution and evaluation of the strategy? Reviews of strategy and related incentives by an independent control function may have slowed or stopped this process.

There are no clear answers to the question of monetary incentives, and when contrasting the winners and losers in the credit crunch, there are no obvious demarcations between good and bad compensation structures. Anecdotal evidence suggests that the collective risk structure, including senior tone and direction, challenges of strong and independent risk managers and probing questions about risk and reward, contributed to lower losses at some organizations compared with others. Incentives should, therefore, be directed towards rewarding a more effective risk culture which underpins the long-term strength of an organization.

Risk management cannot function in silos

Portfolio theory has long championed the virtue of risk diversification in pursuit of long term investment objectives. One of the key principles behind this is an assumption of uncorrelated or low correlated risk factors. This assumption applies to asset types, industry exposures and geographic exposures. As a result of this premise, organizations have often aligned the risk management process to these 'independent' risk factors. In normal times, this has not caused problems, since the assumption of low correlation was supported by market behavior.

However, during the credit crunch, correlation rose dramatically. In addition, liquidity, which has been something of an afterthought risk category, emerged as a compounding factor that skewed actual measured risk outcomes from those predicted by conventional models and intuition. Risk personnel were slow to grasp the interconnected nature of the risks embedded in their positions.

When illiquidity was added to the mix, the cumulative risk was much greater than the sum of the measured parts.

To address this shortcoming, a holistic view of asset risks is required, so that the cumulative trading risk accounts fully for all of the market, credit, operational and liquidity exposures embedded in the positions. To move to this type of approach, measurement processes, analytics and the mindset and skills of risk managers should change.

Getting it right?

Risk measurement and risk management processes can no longer operate in silos, because of the convergence of risk attributes. This will necessarily impact the functional and organizational structure of the middle office, with lines blurring between market, credit, operational and liquidity risks. With a better sense of total risk, personnel will also be able to assist with valuation challenges that arise when market transparency declines. Risk practitioners will need to become more specialized and have a clearer long-term career path within an organization. Personnel and processes will change, as appropriate analytic methods evolve to support the concept of total trading risk. The risk function should give greater emphasis to analysis relative to reporting and have a stronger voice in the risk/reward discussions of an organization. As a result, rewards will eventually become more appropriately aligned with total risk, both for organizations as market participants and for employees as users of an organization’s resources.

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Getting valuation straight

Better risk management for illiquid financial securities.

Value at Risk (VaR) is one of the most popular methods of market risk analysis, but it's by no means a remedy for all ills. Steven Tait (KPMG in the UK) investigates the issues financial institutions need to address to strengthen and broaden their risk management metrics, reduce reliance on VaR and move towards more realistic risk assessment.

What is VaR?

The growing magnitude and complexity of trading accounts, coupled with increased market volatility over the last decade, have pushed financial institutions and regulators to adopt large-scale risk measurement models. VaR is one of the most popular models in the industry, used both by institutions for internal risk management, and by regulators to dictate regulatory capital requirements.

VaR: popular, but flawed

VaR is popular because its outputs are simple. The model aggregates portfolio market risk exposures into one number – signifying the loss in a portfolio's value. This simple output supports management decision making, internal governance and capital allocation decisions. However, this strength is also a weakness, with some organizations effectively simplifying risk measurement to a single number.

Nonetheless, VaR is not the panacea of risk management methodologies. It is a backward-looking model, dependent on historical data and a series of underlying assumptions. Using historical data to predict the future can fail to capture the impact of unlikely events.

Evidence presented by the Senior Supervisors Group[1] showed many organization's VaR measures performed as expected during the recent market turmoil. Yet many organizations identified weaknesses in the assumptions and specifications supporting their VaR measures, suggesting concerns over their particular implementation of VaR. Some organizations appear to have lost sight of the limitations of their models: questions arise over their ability to capture severe shocks that exceed recent or historical norms.

Innate problems with VaR

The VaR model also assumes that positions can be liquidated or hedged over a specified period. This liquidity assumption has proved invalid over the course of recent market events. The accuracy of VaR when applied to relatively illiquid financial instruments is subject to debate.

In relation to the valuation of illiquid securities, SFAS 157 was introduced by the FASB for financial statements issued for fiscal years beginning after 15 November 2007. As part of this new regulation, valuation inputs are prioritized according to their 'observability', providing users of financial statements with additional information to assess the relative risk in fair value measurements. As such, valuation input parameters are categorized as Level 1, 2 or 3:

Level 1: assets that are fully liquid and can be marked-to-market. The value is the unadjusted quoted price in the active market for identical assets or liabilities (e.g., equities listed on the London Stock Exchange)

Level 2: assets are valued based on quoted prices in markets that are not active. Such assets can be valued with the benefit of comparable (proxy) assets. An example is an interest rate swap, the value of which is computed using a yield curve constructed from market interest rates

Level 3: illiquid assets with no reliable market price, which are typically marked-to-model. Inputs to the models are unobservable and are valued by reference to firms' in-house models (e.g., a bespoke CDO)

The credit crisis has left financial markets facing issues around both the reliability of illiquid asset valuations, and the increase in the proportion of Level 3 assets as market liquidity has reduced. This raises two interesting points. Firstly, valuation models are more of an art than a science as the model value is a mathematical approximation of the market. As such, there is a risk that complex assets are not being marked to exit prices, as required by the accounting standards.

Secondly, the increase in Level 3 assets on financial sector balance sheets can be attributed to two theories:

- Investment banks are reclassifying Level 2 assets as Level 3, allowing them to not write-down the assets to the current levels of indices such as the ABX; instead, they are pricing them using their own models

- Banks are inflating their estimates of the value of Level 3 assets, using the discretion allowed in marking-to-model. In this case it would be very difficult to argue that banks are not employing valid and justifiable models. The key questions are; can we trust the valuation of Level 3 assets, should further disclosure about valuation models be required and should regulatory haircuts be applied?

The problem is that the VaR model is being used to model the outputs of another model, adding a further element of uncertainty. For VaR outputs to be reliable, organizations should have rigorous model validation and calibration processes. Where VaR models are based on approximate valuations (as is the case for many Level 3 assets) the issue of uncertainty around VaR outputs is compounded. There are products which have inherent valuation risk that could be material which would not be picked up at the 95/99 percent VaR levels, highlighting the need to establish whether VaR is appropriate to particular asset classes. This was seen recently with ABS CDOs, but other examples could include catastrophe bonds, hedge fund CPPI (Constant Proportion Portfolio Insurance) with gap risk protection, mortality linked deals and very senior tranches of corporate CDOs.

The valuation process is a critical feature of risk management and feeds directly into models such as VaR. It is essential that asset valuations reflect current market conditions, to ensure VaR models are producing reliable and consistent figures on which senior management can base competent decisions.

The large write-downs incurred by financial institutions on illiquid structured credit products suggest a breakdown in the valuation process which impinges on the accuracy of VaR calculations. Failure to test the valuation of such complex instruments with actual trade prices during the unfolding crisis left management exposed to large periodic write downs. Historically, there was an over-reliance on external rating agencies and benchmarking of instruments for which there was an inactive secondary market against instruments traded in active primary markets. This meant that assets were marked at or close to par for too long. For products like portfolio credit derivatives and asset-backed securities, VaR needs to be supported with additional risk measures.

Additional risk management metrics: back to basics?

It is clearly essential that the financial services industry recognizes where VaR is either inappropriate, or would be more informative when accompanied by additional risk measures. The need for additional measures is an issue particularly pertinent to reporting the risk of illiquid financial instruments.

In hindsight, some of the more traditional and simpler approaches to risk management may have proven valuable during the recent market turmoil. As Marcel Rohner, CEO of UBS, said: "The problem was not a failure to appreciate complexity, but rather the opposite – it was a lack of simplicity and critical perspective which prevented the right questions from being asked while there was still time."

The use of notional limits to cap the size of positions taken by each trading desk is a simple approach which allows management to assess the maximum loss in the most extreme circumstances, should asset values fall to zero. Additionally, the reporting of position sizes, both net and gross, would help management highlight potential concentrations of risk. A real life case which highlights the importance of reporting gross exposures is that of Jérôme Kervial at Société Générale. Managers may have had a better view of his exposure if they had analyzed gross positions. In addition, during recent market events, some organizations were left exposed by assuming net exposures to be zero, for example, assuming that a super-senior CDO tranche, hedged with credit protection purchased from a monoline insurer was risk flat. However, several assumptions underpinning this did not follow historical patterns, leading to a breakdown in hedges and further losses.

Other more forward looking risk management tools which can be used to complement VaR analysis include single factor stress tests and scenario analysis. Stress testing helps to identify how portfolios of assets respond to shifts in relevant economic variables or risk parameters. Scenario analysis helps firms understand the impact of severe yet plausible market events. Focus should also be placed on stress testing the unobservable model parameters such as prepayment risk, default risk and correlation. The advantage of such approaches is their adaptability; assumptions about the market environment can be changed to reflect new circumstances.

Risk oversight and governance

All of the risk metrics discussed here are quantitative in nature. However, to put quantitative analysis into perspective, you also need qualitative assessments which are relevant, consistent and communicated in a timely manner. This would help to provide a high level of insight and consistent communication to management. Organizations should ensure information flows effectively, both horizontally and vertically through the organization avoiding filtration through organizational silos so that the management team can make effective decisions.

Risk management and valuation functions therefore need high-caliber individuals possessing a strong mix of both quantitative and qualitative skills, who are empowered to influence high level decisions on risk. In addition, senior management must communicate a clear and concise message around the risk appetite of an organization and instil a culture where risk management is seen as an organization-wide objective.

Finally, a shift in strategic focus from growth towards a greater consideration of risk and reward should strengthen the new products process. Organizations should also adopt a more transparent and comprehensive approach, incorporating a wide range of adaptive risk measures. Coupled with a 'back to basics' risk management approach, this will help senior management identify, assess and manage risk more effectively.

1. Observations on Risk Management Practices during the Recent Market Turbulence.(06 March 2008) http://www.fsa.gov.uk/pages/Library/Other_publications/Miscellaneous/2008/observations_rmp.shtml

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Practical challenges for market risk and valuations

Key steps in designing financial risk reporting systems.

Risk management systems have to be capable of supporting all business lines – a tough challenge when risk factors can run into the thousands and the credit crunch is making valuation of sub-prime assets even more complex than usual. George X. Yuan (KPMG in the U.S.)[1] discusses key steps in designing financial risk reporting systems and the practical application of accounting standards for hedge accounting in financial derivatives.

Market risk measurement principles: the practical applications

Every financial institution needs a reliable risk management framework, based on a solid valuation system that enables the organization to value and model all of its financial assets and liabilities. The key principles in building a risk management system include:

1) Develop a reliable way to identify and model all pertinent market risk factors
2) Design and implement an effective, efficient way to measure market risk
3) Manage market risk in accordance with the company's short, medium and long-term strategic goals

Let's examine the key steps and challenges of each principle in more detail.

1) Develop a reliable way to identify and model all pertinent risk factors
Identification of primary risk factors is the first step. In terms of market risk, this means interest rate factors and price factors (for all commodity derivatives, including energy contracts). Next, we consider the market type (e.g. spot, futures, forward, structured products, options including exotic products, etc.). Finally, we need to consider the term structures for each relevant risk factor, which include:

- Interest rate term structure (i.e. U.S. Libor and Swap rate curves)
- Price term structure (i.e. oil future/ price curves)
- Volatility term structure derived from the options markets (i.e. implied volatilities from the options on interest rate or price factors).

Perhaps the most important and most difficult aspect of term structure analysis is identifying the relationship (also referred to as the 'correlation term structure') between the different risk factors associated with different contract terms[2].

The next crucial step is to model the uncertainty in price movement, based on the primary risk factors, by incorporating the term structures of interest rates and prices (including the correlation term structures). It is important to consistently match the pricing model with appropriate input parameters and data sources, and ensure the underlying models are calibrated to the market.

2) Design and implement an effective, efficient way to measure market risk
After modeling the risk factors, the next task is to design a reliable way to measure and manage the risk arising from daily ongoing business activities. Banking is a dynamic environment and it is vital to factor in the company's individual management culture, expertise, and ability to maintain the risk system to support its short and long term business objectives. Regulations normally require risk reports to be delivered by 9:30am each day. It is therefore important for companies to find the right balance of complexity and efficiency in preparing daily risk reports.

The Basel II Accord requires a bank's integrated risk reporting systems to capture at least three components of risk: Market Risk, Credit Risk and Operational Risk. Insurance Companies apply Solvency II with an additional component, Insurance Risk. Risk factors can range from a few hundred to a few thousand. Most sophisticated companies design a Monte Carlo simulation framework to model and report risk using approaches such as Value at Risk (VaR), conditional VaR or extreme value theory.

Risk models estimate and report business risk on a frequent basis. To validate the risk reports, the system should include back-testing and stress testing. Many regulatory bodies require these test reports to be performed daily – but daily back-testing and stress testing can be difficult if the risk system is not properly designed, resulting in a large number of changes to inputs and assumptions.

3) Manage market risk in accordance with short-, medium- and long-term strategic goals
In 2000 the Office of the Comptroller of the Currency (OCC), U.S.A., published the OCC 2000-16 Bulletin[3] with a clear guideline that financial risk systems should be periodically updated, tested and validated in terms of six components: Model Validation, Policy, Model Inputs, Model Processing, Model Reports and Supervisory summary. Key practical considerations are:

- The risk management function must be truly independent, and report to an appropriate level of senior management. In practice, KPMG member firms see many cases where the risk management team does not have an independent and influential voice with senior management. As a result, the company can end up facing huge losses or – at worst – closure of the business[4]. Risk limits need to be fully integrated into the business line, and any changes to risk limits reviewed and approved by the respective Board Committee; otherwise the internal risk control mechanism may well fail.

- The senior management team should understand that any risk report depends on the reasonableness of assumptions on inputs and market conditions. Senior management should pay attention to remarks like 'limitations of a model's result', 'the reliability and reasonableness of back testing and stress testing', 'independent review over model inputs and outputs', 'performing model validation that is independent from model construction'.

Challenges of derivatives valuation and related hedging accounts

Organizations face several financial reporting challenges in applying U.S. GAAP or IFRS on Hedging Activities (SFAS 133/IAS 39) and Fair Value Measurements (SFAS 157/IFRS 7), including:

1. SFAS157 requires 'fair market value' to include a Credit Risk Adjustment in the quantitative model to address market, credit and model risk together.

2. The correct document on the design of the Hedging Account, the corresponding Quantitative Testing, and the method used for its Accumulated Other Comprehensive Income (AOCI) 's financial report in measuring designed hedging account's ineffectiveness at the inception and ongoing basis in the practice by following SFAS 133 or IAS 39 account standard.

SFAS157 requires valuation techniques for measuring fair value to maximize the use of observable inputs and minimize the use of unobservable inputs. SFAS 157 classifies financial instruments into the following three levels:

Level 1: Quoted prices are available in active markets for identical assets or liabilities

Level 2: Inputs other than quoted prices included within Level 1 are observable for the asset or liability; the valuation is based on some internal valuation mode (for example, in pricing swap derivatives)

Level 3: Unobservable inputs; valuations are based entirely on the company's internal valuation models which are based on assumptions including market conditions

It is always a challenge in practice to value financial instruments such as:

- Tangible and intangible assets including goodwill
- Thinly traded, privately placed or restricted equity, and other illiquid securities and investments, e.g. employee stock options/awards and many OTC transactions
- Most asset backed, mortgage backed and collateralized securities and structured products

Generally, level 2 and level 3 valuations are based on the company's best estimates. The focus should be on the quality and timeliness of input, data and sources, and the key assumptions used in the valuation model.

As defined by SFAS 157, 'fair value' is: "The price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants in the market which would be the most advantageous for the asset or liability." This definition focuses on exit values – the value when an asset is sold – rather than entrance values. This means that there are instances where a financial derivative's transaction value is zero (because it was executed at market rates/price), but the marking-to-market (MTM) fair market value may not be zero (which can be explained by the bid/offer spread).

Determining fair value can be complicated, as we have seen through the credit crunch/sub prime asset crisis. The challenge is to make the appropriate adjustment by applying the concepts of 'non performance risk' and 'counterparty risk'. These adjustments are essential to adequately reflect fair value due to the current illiquid credit markets[5].

To ensure assets are not overpriced or undervalued, it is critical to identify the liquidity risk in the following components:

- The input parameters (e.g. the proper discount rate adjustment in calculating the present values of the cash flows)
- The market risk in terms of changes in the timing or amounts of cashflow
- Credit risk in terms of spreads by incorporating the credit rating
- Additional assumptions such as the holding period of the investment (i.e., how long the investor can hold the Auction Rate Securities (ARS) if the auction fails)
- The general assumptions embedded in the internal valuation model

Though it is not clear what impact valuation models played in Bear Stearns' huge losses, it is clear that most of the loss was from mortgage backed securities (MBS) – generally a Level 3 valuation. In all mortgage backed securities and other structured finance products such as Collateralized Debt/Loan Obligation (CDO/CLO) valuations, the two key assumptions are the default probabilities and the correlation of default probabilities for all individual loans in the pool. Traditionally, we assume that the default probability is in a range from less than 3 percent to 10 percent, and that there is little correlation between two individual assets' default probabilities. However, in the sub-prime markets meltdown everything changed: default probability soared (ranging from 20 percent to 70 percent), with very high correlation on default probabilities – but banks made a fundamental mistake and failed to take this into account in their modeling.

One way to apply SFAS 157 for credit adjustments is to add the appropriate credit spreads to the discount rates when calculating present values[6]. If banks use the spread approach to make the credit adjustment, they should officially document how they have applied SFAS 157, to ensure that all asset and liability MTM valuations are conducted in a consistent way.

Another good example of how to link market risk and credit risk in practice is to model expected loss for structured finance products by applying the accounting interpretations of Fin 46 (R) on the Special Purpose Vehicle/Entity (SPV/SPE). In practice, this expected loss is the combined result of both market risk and credit risk factors.

Establishing minimum sample sizes to test hedge effectiveness

SFAS 133 and the FASB's Derivatives Implementation Group (DIG) require 'high correlation' to demonstrate hedge effectiveness. High correlation is demonstrated by (R-Square) being 0.8 or greater with a Slope of 0.80 to 1.25 (in absolute value) that results from applying a regression analysis to such changes (by using linear regression method).

Though the guideline for hedging accounting is once again under review[7], KPMG believes that one of the fundamental demands is still to require quantitative testing on the hedging account at inception and on an ongoing basis (at least quarterly) for all hedge accounting relationships. One challenge is that there may not be enough data for quantitative testing, which raises the question:

What is the minimum number of data points which might guarantee a reliable conclusion (allowing a reasonable error, e.g. less than 5 percent) in terms of whether the hedging account is highly effective (a Slope in the range of 80 percent to 125 percent and an R-Square >=80 percent) when using Regression Analysis testing method?

The Regression Analysis method of testing hedging effectiveness
Based on the linear regression model below:

$$\text{Model: } Y_i = \theta_0 + \theta_1 x + \epsilon_i,\ i = 1, 2, ..., n \text{ where } \epsilon_i \text{ are i.i.d. } N(0, \sigma^2)$$

$$\text{Where } \hat{\theta}_1 \text{ is at least squares estimate of slope, it follows from the model that } \hat{\theta}_1 \text{ is distributed as } N(\theta_1, \sigma^2 / \Sigma_{i=1}^{n} (x_i - \bar{x})^2)$$

where Y is the hedged instrument value, and x is the hedging instrument's value. If we assume that the difference of the hedged instrument's value and the hedging instrument's values expressed by the model above are independent and normally distributed we can draw the following conclusions:

- **Conclusion I:** By allowing an error rate of 5 percent (in 95 percent of the cases we reach the right conclusion), and by assuming the market is not very volatile[8], the minimum sample size is 7

- **Conclusion II:** By allowing an error rate of 5 percent, and by assuming the market is quite volatile , the minimum sample size is 13

See Appendix for the detailed calculation.

Taking steps to meet the challenge in practice

One of the biggest challenges for financial firms is to establish a framework for enterprise risk management that successfully combines three key elements:

- Quantitative analysis to model risk factors and valuations for many different instruments
- Supervision processes for risk management and internal controls
- Market discipline (e.g. compliance with the Basel II Accord for the financial sector, and the guideline Solvency II for insurers)

To help ensure that existing internal models provide solid support for the business, the senior management team and board members should have a clear understanding of how their model works at all levels of the business, and what to do about any gaps. This can best be done through an independent 'model validation' process which examines:

1: Objectives: what decisions do you need to model?

2: Methodology: is your model fit for purpose?

3: Data source, input and consistency: are inputs accurate? How are the input parameters derived? Is the financial risk system consistent with exposures from an accounting standard perspective?

4: Implementation: is the methodology correctly implemented?

5: Governance: how effective are the process and controls around the model?

6: Business decisions and assumptions: how are decisions and assumptions based on the model re-incorporated into the system?

1. Thanks to Tom Sanders, Professor Bruce Smith and Professor Quoqi Qian for their comments and suggestions on this paper.
2. E.g., one month versus two month WTI crude oil futures' price changes.
3. See http://www.occ.treas.gov/ftp/bulletin/2000-16.txt for details.of the OCC 2000-16 Bulletin.
4. One example is CAOHC – a subsidiary of China Aviation Oil (Singapore). It was found to have failed to inform the Singapore Stock Exchange of its massive losses of U.S.$550 million resulting from oil derivative trading on November 17/2004 which had a VaR substantially higher than its VaR limit.
5. Beginning January 2008, there are also pricing challenges for auction rate securities/certificates (ARS/ARC) which are also a consequence of illiquid credit markets.
6. In this way, the absolute values of present values would be smaller, as the discount rates are higher than the discount rates without adding the spread.
7. FASB proposed Statement, Accounting for Hedging Activities, June 6, 2008 and FASB Statement No.133, Accounting for Derivative Instruments and Hedging Activities, June 1988, as amended, see www.fasb.org
8. Which means that the noise volatility is almost the same as the hedge instrument's price volatility, so that $\sigma^2/V_{xx} = 1$ (See Appendix A).
9. Which means that the noise volatility is around twice the hedging instrument's price volatility, so that $\sigma^2/V_{xx} = 2$ (See Appendix A).

4

New challenges for Asset and Liability Management

Re-engineering the ALM framework.

Banks are exposed to a constantly shifting range of risks. But while many market participants have focused on assets and credit risks, the dependency of the banks on long term liquidity was mainly ignored – until it triggered the current liquidity crisis. This environment highlights the need for an integrated approach to managing risk, especially within banking books. The big challenge for the banking system now is to strengthen the existing Asset and Liability Management (ALM) framework and to develop an integrated view of liquidity, interest rate and FX risks – before the next crisis starts. Report by Matthias Mayer (KPMG in Germany), Barbara Chiodi (KPMG in Italy) and Andreas Hackenbroich (KPMG in Germany).

Today's bank risk managers face a major challenge: taking care of the bank's potential liquidity requirements, whilst still maintaining an environment where market units can perform successfully and profitably. To meet these objectives, the industry needs a truly progressive approach to ALM, with:

- Full integration of ALM into the risk and business strategy of the bank
- Comprehensive and active management of liquidity, interest rate and FX risks from banking book positions, including a funds transfer price system for liquidity and interest rate risk
- Management of banking book risk on a sufficiently granular basis, together with significantly increased precision and reporting frequency in measuring risk, performance, present value and accounting P&L

An organizational model for modern ALM

While many banks have always taken the credit risks of banking and trading books into account, other issues (in particular liquidity risk) have received less attention, due to the seeming liquidity surplus. The current liquidity crisis has demonstrated that the integration of ALM – by which we mean integrating the liquidity, interest rate and FX risk of the banking book into the overall risk and business strategy of the bank – is vital for successful bank management.
To achieve this integration, key steps include:

- Defining limits for liquidity, foreign exchange and interest rate risk (i.e. volumes, sensitivities and impact on revenues) including implicit optionalities
- Defining specific stress scenarios and integrating scenario analyses into ICAAP
- Regular back testing of all model assumptions (liquidity and interest rate risk)

Whereas banks have been actively managing interest rate risk positions within the banking book for many years. Liquidity risk has typically been 'managed' by most market participants in a more passive way. The best examples are the lack of liquidity sensitivity analysis within many banks and insufficient pricing and management of liquidity risks. In particular, a fully integrated and implemented funds transfer price systems for liquidity risk, which is market price based and configured for specific products , is not yet the market standard. Given that charging appropriately for liquidity costs is key to competitiveness, banks need to analyze whether they have really grasped how changes in liquidity costs or interest rates could affect their earnings forecast.

EaR – an increasingly vital tool

As things stand, most banks focus on the calculation of Value at Risk (VaR), resulting from market risk methodologies and systems. However, stochastic measures which look at the probability distribution of earnings such as Earnings at Risk (EaR) are an increasingly useful tool. Within a given time horizon (typically one year) and a defined confidence interval, EaR measures the maximum loss on banking book positions in terms of earnings. This allows banks to estimate how much their margin could change given different market and liquidity risk environments. This measure can help the bank to take strategic or market actions to protect itself from reduced earnings or sudden losses – which could otherwise result in falling profits or declining stakeholder confidence.

In addition, EaR techniques can be very useful in analyzing how adding a new business strategy or a new product might affect bank earning (Marginal Earnings at Risk).

Need for a stable database and resilient reporting structure

Aside from VaR analysis, a detailed liquidity maturity profile should form the basis for integrated risk management. The model can be cut at various levels and dimensions (e.g. deterministic and modelled cash flows, liquidity options, and also across currencies and asset classes). Sensitivity analyses with respect to liquidity spread changes and exchange rates should accompany this liquidity maturity profile, complemented by reports describing performance, present values and accounting P&L. Additional detailed reports may provide information about the funding structure and the exposure in derivatives.

In terms of managing interest rate risk, there are many different techniques, from simple classical methods such as 'gap analysis' to more sophisticated methodologies and dynamic modelling techniques which can capture the full range of risk exposures (repricing risk, yield curve risk, basis risk and option risk).

From an earnings perspective, we can simulate hypothetical changes in business activity (i.e. balance sheet composition and/or volume growth) and in future market scenarios. On the basis of this assumption, we can then project expected cash flows through time and estimate future earnings for various types of business strategy. This approach enables asset and liability managers and risk managers to take a proactive role in strategic analysis and in business planning, and support the management team in identifying the optimal balance-sheet risk/return profile.

The risk and profit analyses should typically be conducted on an individual trade level. Aggregation should be the exception, and should only be applied to products with non-defined maturity profiles and homogenous counterparty structures.

Many banks are currently using replicating portfolios to define the duration of non-defined maturity products like cash accounts and savings. The replicating portfolio needs to be built using a sophisticated technique combining:

- An econometric model to simulate deposits, interest rate values and viscosity coefficients that represent the relationship between these rates and market risk rates

- A statistical model to simulate the liquidity buffer, the core component and the relative amortization schedule

With much stronger interconnections between ALM and overall bank management, banks will need to be able to measure risk and profit much more precisely, so that they can determine the effect of management decisions. Daily performance reporting and (at least) monthly reporting on present values and accounting P&L should be mandatory. By closely monitoring all outcomes in this way, any necessary counteractive measures can be taken quickly.

Responding to current market conditions

The financial market crisis of the past year clearly underlines how vital it is to take into account the 'double whammy' of very high volatility within many asset classes, combined with temporarily non-rational market movements. Major adaptations of the management of market and liquidity risk are necessary for a modern ALM.

Manage proactively, act fast

The high volatility of funding spreads for financials and interest rates requires active management of banking book risks across all asset classes. A passive management approach – especially if the decision-making process is lengthy, and done by committees with a buy and hold approach – is not appropriate to volatile market circumstances. Banks with an active and close-to-market management of banking book risks have been able to react faster and more systematically to irrational market movements, and limit their losses more efficiently. To handle the new challenges the market has to face, banks need to react faster. The current market conditions – and the danger that a flattening or inverse yield curve will have a huge impact on projected earnings – brings the whole business model of an ALM with a passive management approach into question. To make the full effects of market price changes and risk positions clearly visible, banking top management should be seeing comprehensive and more regular reports.

Question past practices

All correlations and cause-effect relationships – which have basically been considered stable up until now – need to be questioned (at least within stress scenarios) and risk potential should be measured. In particular, the separate management of liquidity and interest rate risks in the banking book is no longer appropriate and could result in significant basis risk. The obvious example of

basis risk is the complete uncoupling of the prices for cash and derivatives money market products over a long period, but the correlation between covered and government bonds as well as interest rate swaps and bonds has to be challenged, too.

Negotiate secured funding carefully

The difficulty of generating unsecured funding in the inter-bank money market, arranging long term unsecured funding or raising customer deposits pushes the focus towards secured funding. In this case, efficient management of collaterals is decisively important. Central banks and other market participants have widely differing requirements on the quality of pledged assets or the level of the calculated haircuts, which presents borrowers with a challenge to find the best deal in terms of funding volume and cost.

5

Seeing the bigger picture on counterparty credit risk

Integrated market and credit risk from OTC derivatives.

The financial crisis of recent months has underlined how vital it is for banks to have an effective grasp of all the risks that arise from trading book derivatives: market risk management procedures alone cannot hope to capture all the nuances. Here, Tomaso Papetti (KPMG in Italy) and Steven Hall (KPMG in the UK) propose a more broad-ranging system to drive the models and procedures the industry currently uses to determine the level of risk on the trading book and the policies and procedures for risk mitigation.

The use of OTC derivatives has grown tremendously over recent years: these types of financial products can be tailored to specific needs and offer unlimited possibilities for risk transfer or speculation. But OTC derivatives can be a double-edged sword – they are subject to counterparty credit risk (CCR) that needs careful management. Approaches to estimating and monitoring of this risk have come under the spotlight in recent years due to:

- **Regulatory issues:** The new Basel 2 Framework addresses how financial institutions must estimate CCR exposures. A major innovation allows the use of an Internal Model (EPE Model) to estimate the potential future exposure of counterparties, providing greater estimation accuracy than before; and

- **Business issues arising from the credit crunch:** Recent counterparty defaults and near misses have increased pressure on banks to predict the exposure of derivative portfolios with greater precision, and prevent potential future losses.

More fundamentally, the relevance of CCR actually relates to its hybrid nature, bridging credit and market risks, accentuated by the steady increase in complexity of the instruments traded. Regulators agree with this view of the inter-dependence between risks. The objectives of a sound risk management structure should therefore be based on an integrated system for risk evaluation, which could result in:

- Monitoring the risks at an enterprise level;
- Considering the potential correlations between risks; and
- Developing rational strategies to prevent losses from correlated movements of all risk factors (Enterprise-wide Risk Management).

Sound basis for CCR management structure: methods for estimating exposures

The basis for robust CCR management is the estimation of risk exposures generated by the relevant trading instruments. As Basel 2 states, the instruments that generate exposure to CCR are OTC derivatives, Securities Financing Transactions (SFTs) such as repurchase and reverse repurchase

agreements, security lending and borrowing and margin lending transactions, and Long Settlement Transactions. A sound methodology for estimating the effective potential future exposure of these instruments is a fundamental requirement for analysis of the hedging processes needed.

Focusing on OTC derivatives portfolios (considered to represent the 'core' of CCR issues), the calculation of exposures presents the following key issues:

- The exposures of derivatives are stochastic. Potential future changes at many time horizons should be estimated, preferably until the maturity of all contracts;

- Exposure estimates must take account of credit mitigation techniques, which requires detailed modelling of netting agreements and collateral. Collateral values may be stochastic and path dependent, requiring specific modelling; and

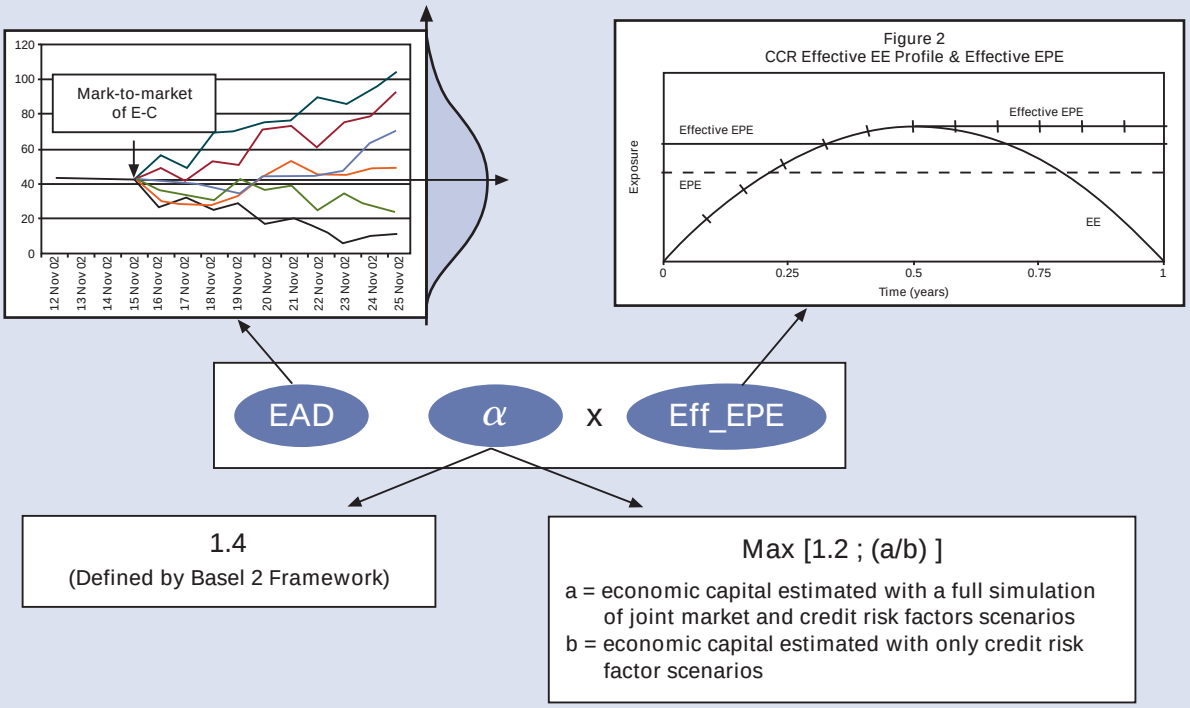
- Exposures and collateral may be dependent on credit events e.g. the exposure value may be highly correlated with the credit worthiness of the counterparty Managing such wrong-way exposures also requires consideration of joint market moves and credit events

The Basel Committee on Banking Supervision (BCBS) has issued new guidelines on exposure estimation, based on models developed through close interaction with the industry. Pillar I of the Basel II Framework gives financial institutions the choice of three main approaches:

- **Current Exposure Method:** The main method allowed under the previous Regulatory Framework (Basel I). It captures the current exposure without any need for estimation, then adds a factor (add-on) to reflect the potential future exposure over the remaining life of the contract;

- **Standardised Measurement Method:** A new approach, which is again a prescriptive methodology. It does not require any regulatory approval, but aims to capture the variation of exposure within netting arrangements more appropriately; and

EAD for counterparty risk through an Internal Model Method

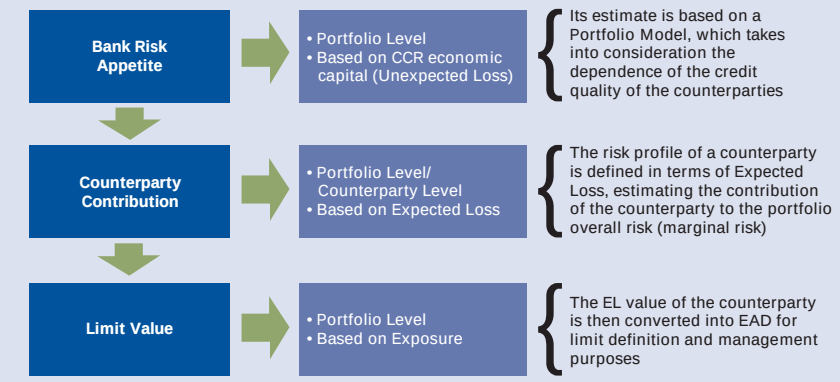


Source: KPMG in Italy, 2008

- **Internal Model Method (IMM):** This is generally considered the most relevant part of Basel 2 related to CCR. Its use is subject to supervisory approval. No single model is prescribed and the model adopted could be analytic or more complex (e.g. simulation-based). However, given the complex stochastic nature of exposure profiles, as well as the detailed modelling required, Monte Carlo (MC) simulation remains the most popular and reliable approach.

Many mid-sized and large players are currently aiming for the IMM, since it is considered the most valuable for CCR. Its strength lies not in the direct regulatory capital savings that can be obtained but in the possibility of using the risk measures (such as Expected Positive Exposure, Potential Future Exposure, Total Exposure, etc.) for business purposes. In other words, an advanced internal model approach like EPE is a first step, for example, to a comprehensive estimate of economic capital for CCR, with a default-only perspective or an economic loss perspective. This presents the possibility of structuring a solid grid of limits (based on exposures and on expected and unexpected losses); a correct management of the risks; accurate analysis of a portfolio's exposures from many points of view (e.g. analysing peak exposures in stressed market risk factor conditions, analysing possible concentrations of losses); and supports implementation of an active credit portfolio management structure.

Top down approach for limits grid definition



Source: KPMG in Italy, 2008

Limits to CCR: start with risk appetite

The first step in monitoring and managing CCR is to structure a sound system of limits, and define procedures for limit management. Limit values are based on the risk appetite of the financial institution, which means estimating the required economic capital at a portfolio level and taking into account the dependence between the credit quality of the counterparties. To account for this dependence, a bank needs to calculate the distribution of loss for its entire portfolio through a portfolio model, then quantify portfolio risk from this distribution and allocate this risk to individual counterparties to determine their contributions to the portfolio risk.

As shown, a robust limit system needs accurate values for the CCR exposures (i.e. estimated with an IMM through a Monte Carlo simulation), which are directly dependent on movements of market risk factors. It should also consider the credit state of the counterparties which comprise the bank's portfolio and the dependence between the counterparties. Therefore, the credit risk factors should also be considered, the correlation between them, and the correlation between the market and credit risk factors.

Portfolio model for unexpected loss to CCR: Managing market and credit risk together

Modelling portfolio loss is even more complex than estimating credit exposure, as it requires modelling correlated credit events and modelling net exposures to all counterparties. A benchmark approach (already implemented in an international financial institution) is synthetically based on the following steps:

1. Simulate thousands of scenarios of market factors over time, taking correlation into account
2. Re-estimate the Mark to Market (MtM) of the instruments through full re-pricing for each scenario
3. Calculate potential exposure for each scenario
4. Simulate for each market scenario thousands of scenarios of potential defaults and loss given defaults
5. Calculate the final loss distribution considering only the cases in which the scenario simulated led to a counterparty default. The loss value, in that case, would be equal to the product value of the exposure in a specific market scenario multiplied by the simulated loss given default

Step 4 represents the link with the portfolio model. The simulations required should be based on a previous estimation of the sensitivities of the counterparties' default probability to macroeconomic factors, on an estimate of the correlation between these factors, and on the estimation of the correlation between these factors and the market risk factors which originated the exposure scenarios (steps 2 and 3).

Step 5 refers to calculating a loss value for CCR through a default-only perspective. Banks which have already moved to an IMM approach for CCR exposure estimation face the challenging task of taking into consideration, within the final loss value, the possible migration of the credit state of the counterparties (economic capital with an economic loss perspective). To reach this objective, the approach would be based on the following variables:

1. Credit Value Adjustment (CVA): the methodology for the estimate of the CVA could be seen as a possible work-around in order to include the effects of market spreads, not usually included in the pricing formulas of derivative instruments, in the estimation of the exposure profile of a counterparty:

$$\mathrm{CVA}(K) = \sum_{J} (\text{Expected Exposure}_{K,J} * \text{Forward CP Spread}_{K,J} * \mathrm{Dt}_{J} * \mathrm{df}_{J})$$

Where:

CVA(K) = CVA of counterparty K

Expected exposure $_{K,J}$ = Expected exposure of counterparty K at time step J

Forward CP spread $_{K,J}$ = Forward value of the credit spread of the counterparty K related to time interval J-1/J (where J identifies a time step)

Dt_J = time interval between time step J and time step J-1

df_J = discount factor

Estimating the CVA in different scenarios of the credit state of the counterparty means we can evaluate the level of risk if the counterparty migrates from one credit state to another.

2. Expected Loss (EL): this approach is based on a portfolio model considering an economic loss perspective. The total loss distribution would depend on the scenarios in which a default has occurred, and also on the different EL that would arise from a new credit state.

In conclusion

Although derivatives are usually considered as typical trading book instruments, they cannot be considered typical in terms of market risk. Comprehensive and solid risk management procedures need to take account of the intrinsic credit risks when estimating derivatives exposure. This view of convergent risks is evident in the New Regulatory Framework and highlighted by its requirement of integrated risk structures. The result of all this is that Enterprise-wide Risk Management looks like a strict requirement, from both a regulatory and management standpoint.

6

Rogue trading: have we learned the lessons

Key steps to fight fraud in the trading environment.

Current market conditions could exacerbate losses run up by rogue traders, according to the UK's Financial Services Authority[1], which has warned organizations to improve their controls and culture. Even after SOX and Basel II, regulatory compliance and internal controls should stay at the top of the management agenda for banks. Koen De Loose and Stéphane Neuville (KPMG in Belgium) suggest some key steps to fight fraud in the trading environment.

Major fraud incidents in the dealing room

International financial markets have been plagued with incidents of significant loss from fraudulent trading activities in recent years. These incidents display striking similarities in terms of factors contributing to the losses. Notorious examples include:

Year	Organization	Loss	Instrument	Main Cause
2008	Société Générale	U.S.$ 7.2 billion	Plain vanilla futures hedging on European equity market indices	Unauthorized and concealed trading – failure of controls
2007	Crédit Agricole	U.S.$ 347 million	Credit market indices	Excessive size of position – lack of proper oversight
2002	Allied Irish Banks Plc	U.S.$ 691 million	Currency options	Unauthorized and concealed trading – failure of controls
1996	Sumitomo Corp.	U.S.$ 2.6 billion	Commodity futures trading	Excessive size of position – lack of proper oversight
1995	Barings Investment Bank	U.S.$ 1.4 billion	Equity index futures and options	Unauthorized and concealed trading – failure of controls

Losses like this do not just happen: they are all the result of action (or inaction) by one or more people – some of whom have the best intentions, and some of whom do not. But it is never just a question of individual action. Frauds like this tend to happen in an environment that fails to prevent their occurrence and usually fails to detect their impact. It is only when the organization can no longer sustain the resulting negative cash flows that they come to the surface.

This article identifies some of the main factors that make dealing rooms so conducive to fraud, and suggests some pragmatic strategies to fight fraud in the trading environment.

The 'fraud triangle'

First, it is essential to understand what would make someone commit fraud. From a theoretical viewpoint, there are three important enabling factors: opportunity, motive, and rationalization – often called the 'fraud triangle'.

In order to commit fraud, people need to perceive opportunities – usually a combination of weaknesses in internal controls which, considered as a whole, create an atmosphere where fraudsters believe they are likely to be successful and undetected. Of course, people do not commit fraud simply because the opportunities exist. They commit fraud in order to reach an objective – usually linked to financial benefit. And once the fraud has been committed, they generally have a need to self-justify and rationalize their actions, convincing themselves that they are 'owed' this extra remuneration by the employer. Bearing these factors in mind it is easy to see that, given the nature of trading activities, dealing rooms offer plenty of potential opportunities and motives to commit fraud.

Profile of the fraudster

The results of the *Profile of a Fraudster Survey 2007*[2], conducted by KPMG in Switzerland, revealed a broad picture of those who commit fraud and the conditions in which fraud takes place. At first glance, an average fraudster is not much different from anyone else. Often, they are the ones who are known to be helpful, polite and inconspicuous. Most importantly, they enjoy the absolute trust of both superiors and colleagues. This makes it all the more crucial for management to exercise a well-considered balance between trust and control.

The typical fraudster is male, between 36 and 55 years old. Over 60 percent of perpetrators are members of the top management team. He typically works in the finance department, and commits the deed alone. He is driven to crime by a desire for money, and by opportunity.

The KPMG survey included fraud investigations from a variety of environments, not just trading. In a trading room, a more junior profile could be expected, given the young environment. Aside from that, the trader profile seems to fit well with the description of the typical fraudster.

Dealing rooms: the ideal breeding ground for fraud

As we have seen, many trading loss incidents display great similarities, either in terms of the opportunities or the motives for fraud. Key factors have included:

- Lack of adequate understanding of complex financial instruments and strategies traded by the supervising and controlling entities. The KPMG survey indicated that, in 49 percent of profiles, perpetrators were able to commit fraud primarily by exploiting weak internal controls
- Trading activities are generally highly profitable, so supervising entities often fail to question high profitability of apparently low-risk activities
- There can be a lack of oversight, due to the high number of transactions
- Traders are entrusted with sensitive company information and are in a position to override internal controls

- Lack of segregation of duty often puts the decision-making process in the hands of just a few people (and often, only one person). The survey reinforces this fact by indicating that in 68 percent of the profiles, fraudsters acted independently

- Trading rooms are typically young, dynamic environments. People with a certain level of ego can be tempted to take big risks to outperform others and to be seen as the 'golden boy'

- There is heavy pressure to meet financial targets. The survey's findings reinforce the notion that the overriding motivations for white-collar crime are greed, opportunity and the pressure to meet budgets and targets

- Incentive rewards are not necessarily aligned to business objectives. The bonus system is often considered as a free option. The bonus can only be positive and if the trader performs well, it can be very high, often independent of the level of risk taken. Sometimes trader's excessive lifestyle causes additional financial pressures.

Protecting your business: what can be done?

Despite the fact that past fraud incidents tend to exhibit very similar root causes, it seems as if we are still not learning the lessons of history. Time and again KPMG member firms witness head office blindness, lax local management, manipulation of internal audit, and poor HR systems: a potentially disastrous recipe for continued trading losses. So what can be done? Just as the fraud triangle pinpoints the causes of fraud under three headings, there are also three major fronts on which to fight against fraud: prevention, detection and response.

Preventing fraud

The cornerstone for fraud prevention is a robust fraud risk management framework, including a comprehensive fraud and misconduct risk assessment to help management understand their unique risks, identify gaps or weaknesses in controls (e.g. segregation of duties) and develop a plan for targeting the right resources and controls.

In a trading environment, a well-implemented code of conduct and vigilant employee and third party due diligence (including background checks and follow-up of references for all employees) is nothing more than good practice.

The basic fraud risk management framework needs to be further reinforced with additional pragmatic measures. An example might be a 'trading after hours' policy and minimum holiday requirements for traders: we observe that rogue traders often work long/unsocial hours or over holidays to cover up their fraud.

Another necessary measure is developing incentive systems that reward control and oversight of traders. Knowledgeable senior management and risk management professionals need to continuously challenge traders – not least the 'golden boys', who require the closest scrutiny.

Last but not least, IT security is a matter of life and death. Too often basic principles are treated in a careless way. Does the 'Make me like Joe' principle for providing access rights to users sound familiar?

Detecting fraud

One of the reasons why fraud may stay undetected for long time is that people do not always dare (or know how to) react to a potential fraud or misconduct. In this respect, hotlines and whistleblower reporting mechanisms provide employees and third parties with an effective way to report possible fraud and misconduct and to seek advice when the appropriate course of action is unclear. Proactive forensic data analysis tools can help identify fraud and misconduct that would otherwise remain unnoticed by management, possibly for years. In a trading environment, analysis of cancelled and amended trades, unreconciled intercompany positions and suspense accounts are indispensable.

Responding to fraud

Setting up a disciplinary system detailing enforcement and accountability protocols is key to effectively deterring fraud and misconduct. It signals that managing fraud and misconduct risk is considered a top priority. Both fraudsters and those in management positions who failed to prevent or detect the fraud need to be sanctioned.

In case of actual fraud or misconduct, an immediate and thorough internal investigation should seek to identify the root causes and key responsibilities. Management should consider public disclosure of the fraud or misconduct to combat negative publicity, demonstrate good faith and assist in putting the matter to rest.

Lessons learned?

Traders can make millions for their employers every year. However, a market culture that rewards risk-taking can easily lead to traders taking unauthorized positions and committing frauds that can bring an institution to the verge of disaster. No system of controls will ever be a hundred percent foolproof, but the lessons are clearly there for the learning. Constant vigilance, combined with a robust fraud risk management framework, should put banks in the strongest possible position to help ensure they are not the next victim of a rogue trader.

1. FSA newsletter, March 2008
2. The survey studied hundreds of actual fraud investigations conducted within Europe, India & the Middle East and South Africa (EMA)

7

Looking for the right measure

Specific Risk: the credit risk components of market risk.

Specific Risk was one of the major innovations introduced by the New Basel 2 Regulatory Framework on market risk management matters. Even though the impact of this risk on bank portfolios is obvious, there is no clear, well-established procedure for estimating specific risk using internal model methods. Francesco Cerri (KPMG in Italy) proposes an approach.

Defining Specific Market Risk

According to the New Regulatory Framework, market risk can be divided in two kinds of exposure:

- General Market Risk: risk related to potential losses arising from a general decrease in the prices of trading book instruments. For example, in the case of debt securities this risk would arise from an adverse variation of interest rate values. For equity securities, this risk would arise from a general market slowdown.

- Specific Market Risk: defined as the risk of losses related to a decrease in prices of trading book instruments due to some event related to the issuer. More specifically, this risk consists of three major components: idiosyncratic risk, event risk and default risk.

– Idiosyncratic Risk: the risk arising from price variations related to the daily trading activity of the instruments
– Event Risk: the risk of a considerable fall in the prices of the instruments (e.g., due to a credit state variation or to a merger announcement), which is more consistent than a general movement of market prices
– Default Risk: the risk related to the default of the issuer

This risk (given the event and default components) is a hybrid of Market and Credit risk. Risk practitioners therefore need to adapt credit portfolio model procedures to market risk, in order to capture all of its nuances. Bonds and Equities usually represent a significant portion of the positions of the bank which give rise to specific risk.

Internal model for market risk (VaR Model)

The internal model for market risk introduced by the New Basel 2 Framework requires the bank to allocate an amount of capital which is strictly dependent on the daily Value at Risk estimated. The regulatory capital equals the maximum value between the following two variables:

- The VaR measure of the previous day plus, if relevant, the incremental default charge

- The average value of the daily VaR measures of the previous 60 days multiplied by a factor which depends on the back testing results, plus, if relevant, the incremental default charge

More analytically, the capital requirement for Market Risk estimated with an internal model is the result of the following formula:

$$C_t = \max\left(VaRGS_{t\text{-}1}; \beta * \frac{1}{60}\sum_{i=1}^{60} VaRGS_{t\text{-}1}\right) + RD$$

Where:

Ct is the capital requirement relative to day "t";

VaRGSt-1 is the Value at Risk estimated through an internal model of the portfolio of day t-1 and related to General Market Risk and Specific Market Risk (idiosyncratic, event and default);

β, is the factor dependent on back-testing activity;

RD is the portion of default risk not "captured" by the model (VaRGS).

Idiosyncratic component

For bond instruments, the idiosyncratic component of specific risk should be estimated through the daily variability of the credit spreads: prices of bonds strictly depend on the amount of premium which is granted to the buyer in order to cover the expected loss due to a possible default of the issuer.

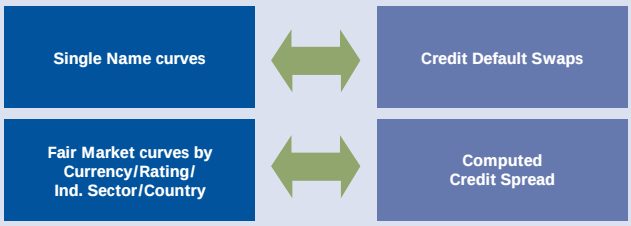
$$\text{Price}^* = \sum_{j=1}^{n} \frac{CF}{(1 + i_j + cs_j)^{T_j}} + \frac{\text{Redemption}}{(1 + i_n + cs_n)^{T_n}}$$

Risk Free Rate — Credit Spread

The estimation of the risk related to this component through an internal model (VaR) could be approached with the calculus of the Credit Spread VaR. That means, in the case of an historical simulation approach, calculating a conditional VaR due only to the historical movements of the credit spread of the bonds.

The main issue of this approach would therefore be the availability of historical series of credit spread curves, and the correct approximation in the case of absence of a specific curve. What most banks usually face is the unavailability of complete historical series of single name credit spread curves (derived from CDS). This unavailability could be solved by the use of benchmark credit spread curves (obtained by the difference between fair market and free risk zero curves) whose link to bonds could be driven by four main variables, which could be considered as the most significant in terms of impact on credit spread value:

Diagram 1 **Single name vs benchmark curves**



Source: KPMG in Italy, 2008

- currency
- rating
- industry sector
- country

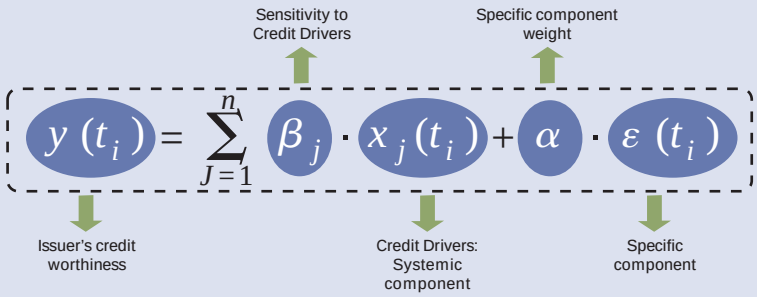
For equity securities, the idiosyncratic component of the risk could be implicitly captured by the use of historical series of the prices of the instruments (using benchmarks in case on unavailability of complete series).

Event Risk component

As stated above, the event risk refers to the possibility of a consistent decrease of the price of the bonds, due to some event related to the issuer[1]. Limiting the focus only to the analysis of the potential down grade of the credit state of the issuer, the approach proposed is related to the use of a portfolio model usually employed for credit risk purposes (Credit VaR estimation). This would result in an estimation of loss distribution exclusively generated by the migration of credit state of the issuer (economic loss perspective). More specifically, the event risk would be originated by the following steps:

- Analysis of the relevant credit drivers: the first step is to determine the macroeconomic factors whose variations have a considerable impact on the issuers' creditworthiness.

Diagram 2 **Issuer's credit worthiness**



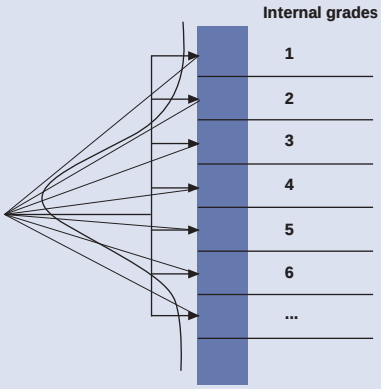
Source: KPMG in Italy, 2008

- Analysis of the sensitivities to credit drivers: the sensitivity of the creditworthiness of the issuers to specific credit drivers should be estimated. Contextually, an evaluation should be made of how much the idiosyncratic characteristics of the issuer have an impact on its Probability of Default. The counterparty credit state could be considered as influenced by a systemic and a specific component:

- Montecarlo Multistep simulation of the credit drivers: simulating thousands of scenarios of possible values of credit drivers, it is possible to calculate different levels of creditworthiness, resulting in different possible credit states of the issuers:

Diagram 3 Migration and default status simulation

$$y(t_i) = \sum_{J=1}^{n} \beta_j \, X_j(t_i) + \propto .\varepsilon(t_i)$$



Source: KPMG in Italy, 2008

- Full re-pricing of the bonds: for each scenario generated, the new value of the bonds should be estimated using the benchmark Credit Spread Curve related to the new credit state which has been simulated.

- Migration Risk: the difference for each scenario between the current value of the bond and the future value simulated is the loss due to migration (in the case of down grading). This value is the basis of a final estimation of the loss distribution at a portfolio level, and it is introductory to the estimate of the event risk due to migration (which would be a specific percentile of the portfolio loss distribution).

For equities, the event risk component could be implicitly captured by using historical series of prices of the instruments. The big issue here will be careful consideration and treatment of corporate activity such as mergers and acquisitions throughout the lifetime of the equity.

1. Migration risk is the most frequent event which could result in a considerable price variation, whereas mergers and acquisitions are not predictable

8

Putting a figure on commodity risk

A commodity risk management framework.

This article introduces a general commodity risk management framework for energy companies, providing guidelines on key aspects and issues of the commodity risk estimation process. Starting with a definition of the risk portfolio structure, Stefano Fenocchi (KPMG in Italy) guides us through the analytical representation of positions and underlying asset models, and defines a series of measures to estimate risk.

Risk portfolio structure

An electricity producer portfolio can be modelled as a combination of two sub-portfolios: sources and allocations. The sources portfolio consists of power plants and third-party supply contracts; the allocations portfolio derives from selling electricity to customers. Electricity generators adopt many business models, but they can be classified in two main groups:

1. Direct sell model: power produced by plants and/or acquired from third party suppliers is sold directly to end customers. To match the hourly consumption profile of end customers to the power plant's production profile, the company buys or sells electricity in the market in order to balance any mismatch between them.

2. Indirect sell model: the company sells generated energy to the electricity network, at the market price. It then buys electricity from the market to supply customers. In this setup, sources need to be considered as a portfolio costs (plant running costs and/or wholesaler energy buying costs) and revenues (gains from selling electricity to the market). Similarly, allocations must be considered as a portfolio revenues (payment for electricity supply) and costs (the cost of buying electricity from the power network). The market price earned by selling electricity will sometimes be different from the market price paid for electricity, as regional prices can differ.

For both models, source costs can be defined as follows:

- Power plant running costs (oil, coal, costs of maintenance). If the power plant produces electricity from renewable sources, the only running cost is maintenance

- Cost of energy supplied by third parties

Again for both models, allocation revenues are usually indexed to a range of commodity prices or indexes linked to different market parameters, such as gas and oil. Given this framework, both models generate risk for the company because of (i) different indexation formulas between revenues and costs and (ii) different production profiles between the supply and sell sides (volume risk).

Financial institutions are exposed to electricity price risk when they trade commodity derivatives. They trade for two reasons: to sell protection to generators and other corporates, or for speculative purposes. The structure of hedging contracts varies by region, due to different conventions and market structures. Types of hedging derivative include futures/forwards, plain vanilla options, spark-spread options, electricity swaps, and commodity swaps. The simplest and most common hedging instruments are fixed price forwards and swaps for physical delivery or cash settlement. Some instruments can be either traded on exchange markets (as with futures and options) or traded on over-the-counter (OTC) markets. Larger electricity markets have a wider range of possible listed derivatives and maturities, whereas in smaller markets operators need to trade OTC more often. Speculative trading by banks can significantly influence commodity prices, even over longer periods.

Contracts and power plant modelling

Electricity contracts are modelled by reproducing contractual payoffs, which are usually indexed to fixed values or various underlying assets (e.g., market electricity price, or baskets composed of gas, oil, Brent and so on). Valuation of these contracts is done by simulating correlated underlying commodity prices, taking into consideration market quotes for future expectations.

Power plants can be modelled using the spark-spread methodology. Since electricity is sold directly on the market, the model assumes that a power plant is switched on only when the electricity market price is higher than commodity costs involved in running the plant (i.e., oil, coal, gas etc.). The formula used to represent the spark-spread for a generic plant is:

$$SparkSpread = max(0;\ S_{mkt} - S_{cmdty}\, h)$$

where:
S_{mkt} is the electricity price on the market (EUR/Mwh)
S_{cmdty} is the market price for commodity inputs (i.e. gas)
h is the heat rate (efficiency of the power plant in transforming oil into electricity)

Hydroelectric power plants follow a different model from the spark-spread methodology. For modelling purposes, there are differences between flowing power plants and lake-basin power plants:

- Flowing power plants generate electricity whenever water is available to activate the turbines. Water cannot be stored for future or delayed production. Modelling these power plants requires only an estimate of future water volumes

- Lake-basin power plants allow the company to schedule production in the most profitable hours of the day, i.e. when the electricity price is higher. These power plants require complex models that provide the schedule of production over time, based on an estimate of future prices, future volumes, environmental constraints and correlation between linked basins.

Underlying asset modelling

In estimating future prices, the first model we can apply is the classic Black-Scholes framework. The evolution of the energy price can be determined by a stochastic process known as 'geometric brownian motion', described by the following differential equation:

$$ds_t = \mu S_t + \sigma S_t \, dw_t$$

where:
S_t is the energy price at time t
μ is the average growth of the price
σ is the expected volatility
dt is the simulated time period
dw_t is a so-called Wiener process.

This model is the current standard for equity derivatives pricing and can be easily adapted to fit commodity price expectations, quoted on the markets as future prices. The main issues when applying it to commodities are:

- The Black-Scholes model applies to storable items requiring a cost for holding the underlying asset, or that pay a dividend yield over time
- Replacement of the constant dividend yield concept with the cost of holding the commodity (estimation of convenience yield)
- The behavior of a commodity price is not a normal distribution: it has spikes and/or jumps not usually observed in financial markets parameters
- Commodity prices follow a mean reverting process
- Underlying volatility is not constant over time

Electricity price models which include mean reversion include the Cox-Ingersoll-Ross and Ornstein-Uhlenbeck models. The latter can be extended to include spikes and jumps in the price process through so-called 'jump-diffusion' behavior: the disadvantage of this is that the model needs to be calibrated to market data prior to each use. The differential equation that describes this model is:

$$ds_t = \alpha \, (\mu - S_t) \, S_t dt + \sigma S_t dW_t + \Sigma_i log(Z_i)$$

where the term $\Sigma_i log(Z_i)$ introduces random jumps in the price process and α is a parameter that needs to be calibrated. Another model which includes mean-reversion and jump diffusion is the Markov Regime Switching model, which randomly changes the behavior of electricity prices following the transition probabilities of a Markov chain.

The further we move away from a standard Black-Scholes model, towards more sophisticated approaches that better fit the reality of price behavior, the more the following issues arise:

- Complex calibration processes to estimate model parameters to fit market prices
- Need for extensive market information to carry out the calibration

Mean reverting Ornstein-Uhenbeck processes are also used for modelling other commodity prices, such as natural gas.

Risk evaluation

Two common risk measurement methods are Value at Risk (VaR) and Cash Flow at Risk (CaR).The aim of both is to provide a single number summarizing the total risk in a portfolio of assets due to changes in market quotes. These measures rely on the same methodologies, but provide risk estimations which are suitable for different circumstances.

VaR is used to provide a number that states, with a certain level of confidence, the maximum loss that can occur in a defined time horizon, usually anything from one day up to a few months. The loss is calculated as the fall in market price of all or part of the portfolio. In a typical bank's trading portfolio, profit is generated by buying and selling financial assets many times in a day. The relatively short time period and pricing perspective make the VaR measure particularly suitable for banks or trading companies.

The concept of CaR does not incorporate the idea of a time horizon, since its purpose is to measure the total extra cash expenditure faced by a company's portfolio with a certain level of confidence, over the whole life of the portfolio.

VaR and CaR can be calculated using at least three different approaches:

- The parametric method
- The historical simulation method
- The Montecarlo method

A complete risk estimate for an energy producer requires the inclusion of volume risk into VaR and/or CaR measures. This is an important issue for renewable-based power plants because there is uncertainty about the amount of electricity they can produce in future; it is also an important issue for gas or coal based plants, because of the volatility of demand. In a Montecarlo framework, two main modelling approaches can be adopted:

1. **Statistical approach:** Given the volume historical series, the models determine the theoretical distribution that returns the best fit with the available data. Once estimated, the theoretical distribution can be used to simulate future volume behavior

2. **Fundamental approach:** This solution requires the identification of a driver set that best represent the observed volume volatility. Drivers may include data related to rainfall, temperature and GDP, which can be employed to forecast future volume behaviors.

The more information we include on issues like volumes, demands and supply behavior, company costs/revenues and spark-spread into VaR/CaR measures, the closer our risk analysis moves towards estimating Profit at Risk (PaR). This kind of risk indicator is meaningful for energy generating companies which need to manage the profit risk of the whole company, considering both sources of energy and allocations.

9 Economic capital: time to update your approach?

Economic capital should provide a solid buffer against unexpected losses, even in turbulent times. Matthias Mayer and Holger Spielberg (KPMG in Germany) explore the lessons the industry can learn from the current crisis, and how practices can be improved in determining economic capital for the future.

The current financial markets crisis is a clear demonstration of how abruptly market conditions and volatility can change, hammering home the message that discontinuous market behavior is an essential part of market risk. In fact, far from being extreme events, financial market shocks seem to be becoming the norm. In the twenty years between 1987 and 2007, the world has seen at least seven major financial market crashes[1].

The world's financial institutions have been struggling to cope with losses resulting from the current crisis, and many have been obliged to raise new capital. This fact might surprise some onlookers, since Basel II already requires them to hold enough capital to cover their risks and withstand any potential losses. It is common best practice in the industry (and stipulated by Basel II's second pillar) to determine the amount of capital to hold against potential losses through the concept of economic capital. This is typically based on at least two different approaches: the debt-holder perspective and the going-concern evaluation.

Given the recent frequency and severity of financial market shocks, this is a good time to review some key aspects of how the industry determines economic capital for market risk positions, and identify potential short-falls.

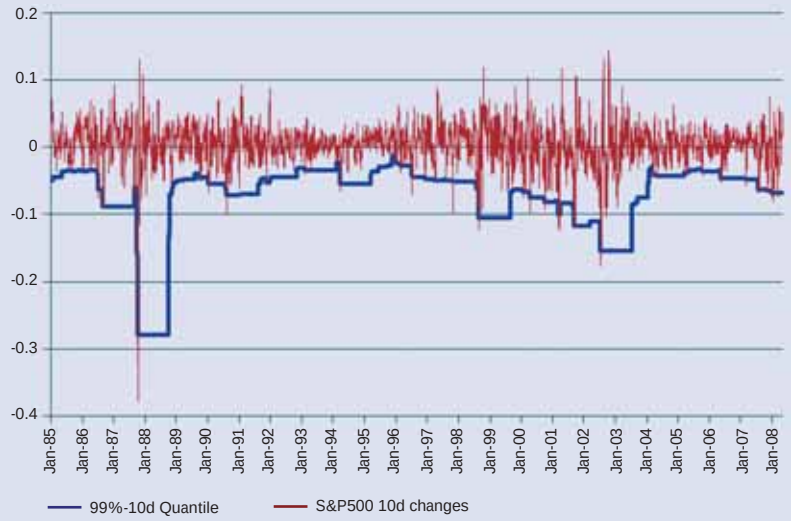
Economic capital measurement for market risk

Both the debt-holder and going-concern approaches for economic capital are typically based on the Value-at-Risk concept. The difference between them is that whereas the debt-holder perspective is typically associated with very high confidence levels relating to the probability of default for a target rating (e.g. 99.97 percent for AA), the going-concern evaluation focuses on events that might occur once in 10-20 years. The original holding period considered is typically 1 year for all risk classes. However, for market risk it is often reduced to a shorter period (say, 10-30 days), because the liquidity of market risk positions allows management to intervene and close the position if significant losses occur.

To determine the market risk contribution to economic capital, the normal approach is to start with a 99 percent Value-at-Risk (VaR) with a holding period of 1 or 10 days, and scale to the appropriate levels of confidence and holding period through the normal distribution assumption and square-root-t rule. The 99 percent VaR is typically based on a 1-year market data history. As a method of determining the right amount of economic capital to protect against financial market crashes, this approach has severe weaknesses:

- The market data history of 1 year typically only covers the build-up of a 'bubble' before a crash, a phase that is often associated with low volatility. In other words, it typically does not track previous crash phases or other phases of high volatility. Diagram 1 shows this effect for 10-day relative logarithmic changes in the S&P 500 since 1995.

Diagram 1 S&P 500 ten day changes and ten-day 99 percent VaR based on one year data history



Source: Bloomberg and KPMG calculations

- The way management intervention is taken into account is often flawed. The typical approach is to say that the position could be closed after, say, 30 days, and then apply the square-root-t- rule to this time horizon. However, this only gives you the maximum loss during a single 30-day period with the given confidence level (i.e. probability of 95 percent for a once-in-twenty years event). But what is actually needed is a figure for the maximum loss during one year with the probability of 95 percent, given that any potential loss sequence is cut after 30 days. We need a 30-day Value at Risk with a confidence level[2] of:

  $95\%^{1/365} = 99.98595\%$

  Diagram 2 shows the difference between the two approaches, where we use the normal distribution assumption to scale the confidence level. While the VaR determined through the scaling approach described above seems to be much closer to a once-in-twenty years event, we still observe eight independent periods[3] where the actual loss exceeds the VaR.

To improve "back-testing" results, we need to combine both approaches – longer data histories (e.g. 10-20 years) with the right scaling rule. However, there is a classic dilemma in using longer time series: firstly, there isn't always a long data history (e.g. for sub-prime CDOs); secondly, there is always the question of whether events so far into the past can actually predict the immediate future.

In addition, when looking at less liquid asset classes than the S&P 500 index, market liquidity might become the defining issue – as it has in the current financial crisis. Many institutions were forced to keep positions for months that, under normal market conditions, would have been liquidated within days. Relying mechanically on historical time series analysis might therefore not be enough to determine adequate economic capital, even with the going-concern approach. It is very important to supplement statistical analysis with qualitative considerations, such as stress and scenario analysis, and base economic capital numbers on the outcome of this combined analysis.

Diagram 2 **S&P 500 30-day changes and proper scaling to one year with a 30-day liquidation period**

Source: Bloomberg and KPMG calculations

This is even more the case for more complex investment and trading books which depend on many risk drivers and correlations. The high number of risk drivers amplifies the need to consider longer time series to capture all potential joint movements of the risk drivers. It might also be necessary to interpolate from movements in one set of risk drivers to other sets.

What has the industry learned from the current financial market crisis?

The fact that the current financial market crisis originated in the U.S. sub-prime mortgage market has important implications for how the industry determines economic capital for market risks:

- Banks posted huge losses (see Table 1) as a direct consequence of the sub-prime crisis. Most losses were not due to classic credit risk, but primarily to market value changes of structured credit products[4]. This increases the need to include new market risks, such as credit spread risk, when determining economic capital, and to apply an integrated approach for credit and market risk management and measurement for such products.

- The high market risk losses for a wide spectrum of securities also resulted from a sudden drop in market liquidity from very liquid to practically illiquid, forcing their owners to keep these securities on the balance sheet and watch their market value drop. Holding periods should refer to stressed markets rather than normal markets.

Losses posted by banks worldwide due to the sub-prime crisis

Company	Losses	Company	Losses
Citigroup	$40.7bn	Washington Mutual	$8.3bn
UBS	$38.0bn	Deutsche Bank	$7.5bn
Merrill Lynch	$31.7bn	Wachovia	$7.3bn
HSBC	$15.6bn	Credit Agricole	$6.6bn
Bank of America	$14.9bn	Credit Suisse	$6.3bn
Morgan Stanley	$12.6bn	Mizuho Financial	$5.5bn
Royal Bank of Scotland	$12.0bn	Bear Stearns	$3.2bn
JP Morgan Chase	$9.7bn	Barclays	$3.2bn

Source: Bloomberg and company reports. news.bbc.co.uk, May 19, 2008

What you need to consider

Financial institutions need to review how they determine economic capital for market risk positions in their trading and non-trading books, taking the following issues into account:

- Check the coverage of the risk driver set applied, in particular the coverage of non-traditional market risks such as credit spread risk
- Consider the liquidity of the position in a stressed market situation (both in the trading and non-trading book) when determining what holding period should underlie the economic capital calculation
- Consider much longer data histories than usual: replace the typical 1-year history with data histories of at least 10 years – both for determining volatility as well as market liquidity
- If taking into account a shorter holding period than 1 year, make sure you rescale the confidence level so that it still reflects, for example, once-in-20 years events
- Do not rely on statistical analysis alone. Combine your calculations with qualitative stress/scenario analysis, and take analogies into account (for example, if one market has fallen in one crisis by 40 percent, what other markets could behave in a similar way?)
- Determine the proper economic capital amount on the combined outcome of statistical analysis and stress/scenario analysis
- For positions in the non-trading book that are not accounted for at fair value, it is advisable to differentiate between impacts on the different components of the risk taking capacity (e.g. no p&l effect but impact on equity, impact on hidden reserves and losses only) to improve the interpretation of capital adequacy calculations

If you apply all these principles, the economic capital charge for trading and investment positions will most likely increase, and be more stable over time – the latter of which could certainly be seen as a positive side effect. In particular, it will no longer be possible to increase positions in times of lower volatility in the markets (given that the same level of risk capital is put aside), which seems to be a reasonable result. The different calculation might or might not trigger a change of the day-to-day market risk model. If not, the corresponding limits need to be regularly reviewed (e.g. monthly) to reflect changes in short-term market volatility.

1. Black Monday 1987; Japanese crisis commencing 1990; Black Wednesday (UK) 1992; Asian Financial Crisis 1997; Russian Financial Crisis 1998; dot-com bubble crash 2000; sub-prime crisis 2007
2. For this formula we have assumed that we want to apply this confidence level to the time series of overlapping 30-day periods, having starting points at each single calendar day (i.e. 365 samples per year) . If only trading days are considered, the exponent in the formula would be 1/250 (assuming 250 trading days). Also note that for simplicity we have disregarded auto-correlation
3. Oct 87, Nov 87, Jan 96, Mar 96, July 96, Aug 98, March 04 and Aug 07
4. While it is a common perception that a significant portion of market risk losses of sub-prime CDO will eventually turn into credit losses, this is more disputable for many other asset classes such as other CDOs, ABS paper or corporate bonds.

Appendix

Detailed calculation of sample size for hedging effectiveness testing

Model: $Y_i = \theta_0 + \theta_1 x + \epsilon_i$, $i = 1, 2, ..., n$ where ϵ_i are i.i.d. $N(0, \sigma^2)$ Where $\hat{\theta}_1$ is at least squares estimate of slope, it follows from the model that $\hat{\theta}_1$ is distributed as $N(\theta_1, \sigma^2 / \sum_{i=1}^{n} (x_i - \bar{x})^2)$

To test $H_0: \theta_1 = \theta_{10}$ against the alternative $H_1: \theta_1 = \theta_{11} > \theta_{10}$ at level α with power $1 - \beta$, you need a sample size

$$n = \frac{\sigma^2}{V_{xx}} \frac{(z_{2-\alpha} + z_{1-\beta})^2}{\delta^2}$$

where $V_{xx} = \frac{1}{n} \sum_{i=1}^{n} (x_i - \bar{x})^2$, $\delta = \theta_{11} - \theta_{10}$ is the difference in means, and $z_{1-\alpha}$ and $z_{1-\beta}$ are the $1 - \alpha$ and $1 - \beta$ percentiles of the normal distribution.

Note that V_{xx} is the sample variance of the X's (the independent variables). it depends on the sample size *n*, but if you have a random sample of X's from some population, you can think V_{xx} as the variance of the population, which the sample variance will converge to.

To use the formula, you need to specify δ, you need a prior guess at $\frac{\sigma^2}{V_{xx}}$ and you need to specify α and β.

e.g. if testing at level $\alpha = .05$ with power $1 - \beta = .8$ then use $z_{1-\alpha} = 1.645$ and $z_{1-\beta} = .84$. If $\theta_1 = 1$, $\theta_0 = 0$, and $\frac{\sigma^2}{V_{xx}} = 1$ then the required sample size is

```
> (qnorm(.95)+qnorm(.8))^2
[1] 6.182557
```

or 7

With the same level, power, and σ, but assuming noisier observations for which $\frac{\sigma^2}{V_{xx}} = 2$ then the required sample will be 2*6.18, which is rounded up to 13.

Notes

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