Paper 023-2011

Impact of Regulations on Risk and Trading Analytics in Capital Markets for SAS® Global Forum 2011

Jeff Hong, CFA, Platform Computing, New York, NY, United States

ABSTRACT

New and pending regulations in the banking industry will no doubt have an impact on current trading practices and business relationships for capital markets firms. In particular, regulations will increase the frequency and complexity of risk analytics. This paper examines the current and future challenges surrounding risk management and analytics requirements, and the technologies that can be deployed to address them. The results of a Wall Street and Technology (WS&T) survey – jointly sponsored by SAS® Institute and Platform Computing – of over 200 large and small Wall Street firms on their preparedness to respond to additional risk requirements will also be discussed.

INTRODUCTION

While the primary focus of this paper is on the proposed Basel III framework (http://www.basel-iii-accord.com/) and its impact on Capital Markets, if anything the fallout from the global credit crisis demonstrates that Capital Markets, Retail Banking, and Insurance firms are highly interconnected and have interdependencies. The bankruptcy of Lehman Brothers and subsequent bailout of AIG illustrate this point. In the aftermath of the crisis, regulators are touting stronger regulations to correct the shortcomings of past versions, and are changing market structures. This paper discusses[1]:

- Key catalysts and the lingering aftermath of the crisis
- Basel III, and its impact on risk and trading analytics; and
- What firms are doing and what technologies are they using to comply with regulations and best practices

THE GENESIS OF THE CRISIS

In the Federal Crisis Inquiry Commission (FCIC) report published January 2011, the report concludes that the "financial crisis was avoidable". Blame is placed at the doorstep of the Federal Reserve, specifically for their failure to "stem the flow of toxic mortgages…by setting prudent mortgage-lending standards". The report cites others reasons for the mess including: "deregulation and reliance on self-regulation by financial institutions"; the "dramatic failures of corporate governance and risk management at many systemically important financial institutions;" and the "combination of excessive borrowing, risky investments, and lack of transparency." (FCIC, 2011)

UNINTENDED CONSEQUENCES OF REGULATIONS

In the post-crisis world, regulators are revising rules that promise to prevent another crisis. Cynics already dispute their future effectiveness, and point out that the crisis is itself an unintended result of regulatory changes. The latter point to the two factors:

Growth of sub-prime mortgages

In the 1990s, the U.S. Government sowed the seed of the housing bubble through its Fair Housing Act, relaxing Fannie Mae/Freddie Mac standards, and incentivizing banks to underwrite riskier mortgages. Ultimately, these acts enabled individuals to purchase homes with little to no down payment. By mid-2008, almost 50% of the outstanding mortgages consisted of sub-prime and Alt-A loans. Almost 67% of these sub-par loans were guaranteed by Fannie Mae and Freddie Mac. (Atlantic Economic Journal, 2010)

Securitization of sub-prime mortgages and the growth of OTC derivatives

In the 2000s, demand outstripped the supply of high-quality securities. Filling this demand, banks created high-quality securities by purchasing and pooling together sub-prime mortgages/assets; dividing their payments into senior and subordinated tranches; and then selling these Mortgage Backed Securities (MBS) which were rated by the agencies.

[1] Note: As the Basel Committee on Banking Supervision (BCBS) continually revises its proposed Basel III framework, the content of this paper may be outdated by its publication date.

The FCIC report states that as "subprime mortgage securitization took off, securitizers undertook due diligence on their own or through third parties on the mortgage pools that originators were selling them". The percentage of "rejected" loans – those that failed to meet guidelines without compensating factors – included in purchased mortgage averaged 39%, indicating ""*a quality control issue in the factory"* for mortgage-backed securities." (FCIC, 2011)

Simultaneously due to deregulations, Over-the-counter (OTC) credit derivatives grew in popularity. The financial services industry became a large consumer of these instruments particularly of Credit Default Swaps. A financial firm bought and sold Credit Default Swaps (CDS) for hedging, credit enhancement, or in many cases, as an "asset" in its own right. In the latter case, buying a CDS without owning the underlying (naked CDS) – often for speculation – is a controversial practice that many believe should be outlawed, "Moreover, the most traded CDS concern reference entities in the financial sector", up to 40%. (Coudert, 2010) The concentration of CDS transactions among the top banks, lack of transparency/central clearing party (CCP), and high leverage created a systemic risk to the entire financial services industry.

WHY LEHMAN FAILED

The April 2010 testimony by Mary L. Shapiro, Chairman of the U.S. Securities and Exchange Commission (SEC), testimony before the House Financial Services Committee concerning the Lehman Brothers Examiner's Report highlights several reasons for how Lehman got into financial troubles (SEC, 2010). They are:

- Insufficient risk management and oversight
- Lack of transparency and understanding of risks associated with complex products such as derivatives
- Excessive reliance on credit ratings by investors

Underestimating leverage and liquidity risk

Like many firms, Lehman used repos to fund its short term liabilities. As the appetite for higher risks instruments declined in 2007 and 2008, mark-to-market values for riskier assets declined dramatically. Repo counterparties demanded larger haircuts on collateral. At the same time, Lehman increased its repo borrowing to pay down liabilities but also to improve its balance sheet. The Examiner's Report notes that the firm borrowed $139 billion over 3 quarters starting at the end of 2007 with $50 billion in 2nd quarter of 2008 alone. (FCIC, 2011)

"The availability of repo funding was highly dependent upon the confidence of counterparties, rating agencies and the market in general." Due to the market's growing "loss of confidence in the firm's continued viability resulting from concerns regarding its significant holdings of illiquid assets and questions regarding the valuation of those assets", Lehman's access to the repo market shut down. On September 8th or thereabouts, Lehman reported it had a liquidity pool of $42 billion. By the week's end, the firm had only a bit over $1 billion, an amount "insufficient to support a loan large enough to avoid Lehman's collapse". (SEC, 2010)

Lehman was not the only firm on borrowed time (no pun intended) due to high leverage and liquidity risks. From 2007 to 2008, leverage ratios at some firms increased to extremely unsafe levels e.g. 40-to-1 whereby "a 3% drop in asset values could wipe out a firm". According to the FCIC report, "Bear Stearns had $11.8 billion in equity and $383.6 billion in liabilities as was borrowing as much as $70 billion in the overnight market" at the end of 2007. To put Bear Stearns' precarious leverage in perspective, the FCIC concluded that the Bear Stearns situation was "equivalent of a small business with $50,000 in equity borrowing $1.6 million with $296,750 of that due each and every day." (FCIC, 2011) Due to the lack of transparency and complete mistrust of ratings in 2008, dealers, funds, et al focused on unwinding their swaps, etc. the OTC derivatives market came to a complete stop.

Agency ratings were suspect (and may still be suspect)

We know now that banks purchased AAA-rated synthetics that did not warrant its ratings. Rating agencies inflated ratings - for a variety of well-discussed reasons - seducing investors to buy what they thought were low risk products. Have rating agencies now got it right?

Gllian Tett of the Financial Times notes that "agencies are stuck in a bind, as are investors and regulators. The ratings might be flawed, but nobody can afford to ignore them, or for the moment, afford to replace them". (Tett, 2010) Cynics argue that agencies still are slow to issue downgrade ratings. On the other hand, regulators feel that agencies may be causing market turmoil by downgrading issues too fast. Regulators on both side of the pond propose that banks augment agency ratings with their own independent analyses.

POST-CRISIS HANGOVER – 3 YEARS AND COUNTING

The transformation of derivatives from a hedging tool to an "asset" traded in its own right e.g. naked Credit Default Swaps is well documented. Due to aforementioned demand for high-quality securities, banks churned out synthetics

with a hodgepodge of assets. Rating agencies, with their objectivity now called into question, assigned higher quality status than warranted to some. Buyers purchased these "assets" often without additional research.

How much toxic assets remain on books?

In early 2010, Moody's chief economist, John Lonski, estimated that banks (including investment banks) held then $1.2 trillion in toxic assets, with insurance companies holding $250 billion, and US sponsored enterprises like Fannie Mae holding $240 billion. (Stcherbatcheff, 2010) However as the Irish banking crisis demonstrates, this estimate is likely low.

In 2010 alone, the Irish government provided €35 billion alone to two banks - Anglo Irish and Irish Nationwide. Irish regulators severely underestimated the amount of toxic assets on their balance sheet. Regulators have had to make four injections of capital into Anglo Irish, and now say that the bank may require an additional €5 billion "under a worst-case scenario where the property market didn't recover for 10 years". (Carswell, 2010)

Another crisis is still possible

The Irish Government has purchased an estimated €31 billion in toxic assets, and is providing billions more for regulatory capital requirements to its largest banks. As a result, Ireland's 2010 budget deficit rose to 32% of Gross Domestic Product (GDP), up from 14% of GDP in 2009. Ireland's malady is also Germany's headache as German banks hold €166 billion in outstanding short term loans to Irish banks. Other countries such as Spain with mortgage issues also pose a threat if their economies remain anemic. Contagion from PIIGS[2] is still a threat due to interlinked economies. (Carswell, 2010)

As the U.S. economy emerges from its recession, and the memories of the credit crisis fade a bit, the above is a reminder of the systemic risk posed by counterparties. In the U.S. where up to a third of mortgages are underwater, housing prices are expected to bottom out toward in the latter half of 2011. However the housing market is highly dependent on the job market; the hiring outlook for the remainder of this year is modest at best. What is the outcome for U.S. Financial Services firms, if the U.S. property market does not improve this or next year, or even in 5 years?

NEW "IMPROVED" INDUSTRY REGULATIONS AND STANDARDS

Regulators are enacting far reaching laws that will change trading practices and business relationships, resulting in both intended and unintended consequences. In particular, Basel III will increase the frequency and complexity of risk analytics for banks. Swiss regulators and more recently U.S. regulators have announced their intent to impose even stricter limits than those in the Basel III framework. Whether or not these regulations will prove effective is a subject of debate on the Street.

BASEL III: FOCUS ON CAPITAL AND LIQUIDITY RISKS

The proposed Basel III regulations – to be phased in starting in 2012 with full implementation by year-end 2018 globally – establishes stricter capital requirements via new capital definitions, reserves and ratios, and higher risk-weighted assets. (See Figure 1)

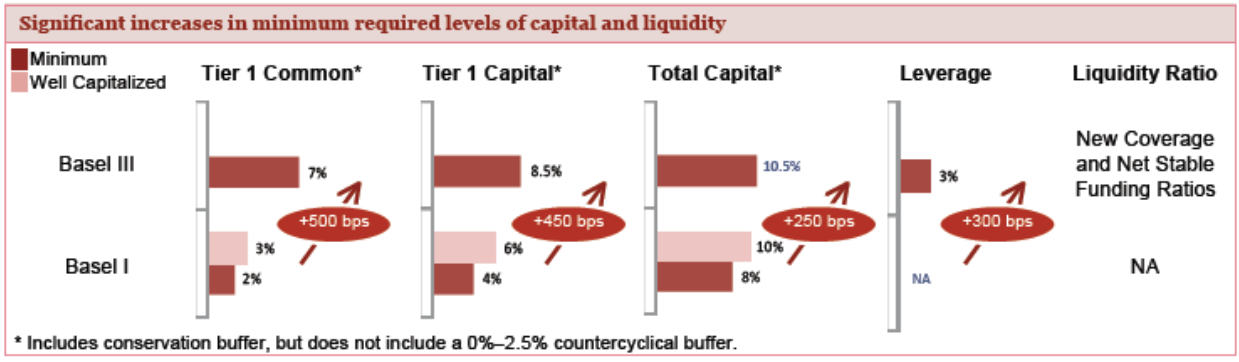

Figure 1. Stricter capital and liquidity requirements for Basel III (PwC, 2010)

[2] PIIGS is an acronym used by international bond analysts, academics, and by the international economic press that refer to the economies of Portugal, Italy, Ireland, Greece, and Spain, especially in regards to matters relating to sovereign debt markets.

Overall, key Basel III updates include higher reserves whereby banks must increase their minimum common equity requirement from 2.0% to 4.5% and "to hold a capital conservation buffer of 2.5% to withstand future periods of stress bringing the total common equity requirements to 7%" (Basel Committee on Banking Supervision, 2010) . Basel changes are focused on:

- Capital structure and charges for leverage, countercyclical buffer, etc.
- CCR, specifying additional capital including Credit Value Adjustment (CVA) under stressed VaR (Value at Risk)
- Short- and medium/long-term liquidity standards

Capital structure: revised Risk Weighted Assets (RWA)

To calculate capital requirements, Basel III now weighs securitized and re-securitized assets differently in both standardized and internal ratings-based (IRB) approaches. Basel III allocates higher risk weightings for re-securitized assets, and distinguishes senior from non-senior asset types in the IRB approach. Basel III measures more accurately risks associated with structured products. The new approach will include the composition of the portfolios underlying the structured products.

CCR charges include:

- Stressed CVA VaR (aka Stressed VaR for CVA)
  Basel III requires banks to understand the impact of CVA on VaR under prolonged stress conditions
- Different risk weights for Central Counterparty (CCP) and non-CCP deals
  Basel III tacks on an asset value correlation multiplier of 1.25 to counterparty exposures from "unregulated financial institutions and regulated firms with total assets of $100 billion or more … In a completely new addition to the rules, banks will also be required to hold capital against exposures to central counterparty (CCP) default funds." For CCP trades, Basel III indicates a 2% risk weight without a CVA capital charge. (Pengelly, 2011)
- Alternative models for calculating CVA capital charges
  Of all the new liquidity and capital charges, the CCR charge relating to CVA promises the greatest impact on dealers and has been a contentious issue for OTC derivatives participants. The original proposal introduced a zero-coupon bond-equivalent approach as a proxy for calculating CVA capital charge. Due to objections from dealers, the Basel Committee will now allow pre-approved firms to use the internal models method (IMM) and specific risk value-at-risk models. For banks without this approval, Basel Committee on Banking Supervision (BCBS) prescribes a standardized approach. (Pengelly, 2011)
- More hedging options
  The original proposal allowed only single-name CDS, and other similar ilk instruments for CVA hedging. The latest revision is more expansive allowing for some CDS index hedges with appropriate adjustments to VaR. Another criticism is the model focuses on the counterparty credit spread and not on the market risks such as interest and FX rates. Additionally, the proposal would penalize market risk hedges. (Pengelly, 2011)

Liquidity and leverage ratios

Earlier versions of Basel framework did not include liquidity risk. Basel introduces standardized liquidity and leverage ratios. They include:

- Liquidity Coverage Ratio: This short-term ratio requires banks to hold an amount of liquid assets equal to liabilities due within 30 days
- Net Stable Funding Ratio (NSFR): The NSFR requires banks to hold assets equivalent to one year expenditures, and is the ratio between Available Stable Funding (ASF) and Required Stable Funding (RSF)
- Leverage Ratio: Basel III includes a minimum Tier 1 balance sheet leverage ratio of 3%.

Other regulations and additional capital charges

For large broker-dealers, the SEC now requires information regarding balance sheet composition with a focus on particular asset classes. The SEC is also looking at raising net capital requirements and at providing granularity on classification of liquid vs. non-liquid assets, treatment of unsecured receivables and clearing deposits for net capital calculations, and leverage requirements.

In addition, the SEC now recommends that Alternative Net Capital (ANC) compliant firms apply standardized net capital charges – thereby increasing the capital required for these assets – instead of using models to calculate net capital requirements for certain MBS and ABS. (SEC, 2010).

REVISED REGULATIONS STILL HAVE SHORTCOMINGS

While the revisions plug the holes of earlier versions, a common criticism of regulations like Basel III is that they still get it wrong by regulating the form (Bank) rather than the function (Banking). At least one major insurance firm got into trouble by investing in Credit Default Swaps. Other non-banks with losses in the hundreds of millions of dollars if not billions from derivatives investments include highly regulated pension funds and endowments. Other criticisms include:

Inadequate risk weights

Noted author Pablo Triana's criticism of Basel III is that it still permits banks to be highly leveraged up; "regulators have so far failed to correct the mechanisms that unleashed the 2007-2008 cataclysms, making it possible for such problems to easily materialize again … the much-lauded capital "strengthening" … does little to assuage concerns. …. Toxic leverage, in sum, is still very much possible. The potential for another system-threatening blow up remains intact". His recommendation is to discard the RWA calculations, and apply a 100% capital charge to all riskier assets. (Triana, 2010) .

Simplified formula ignores market risk sensitivities

Dealers criticize the Basel III CVA methods, as it ignores market risk sensitivities in favor of time-to-market. ""*Simplified formulas have certain limitations and one of them is that you just can't really calculate market risk sensitivities*," says a senior risk manager at a major US bank in New York." (Pengelly, 2011)

REGULATIONS' IMPACT ON RISK MANAGEMENT AND ANALYTICS

As the financial crisis in Ireland unfolds, it is clear that regulators and banks have severely underestimated the amount of toxic assets on their balance sheets. Banks are focusing on:

- "Incorporating and integrating risk management into performance management metrics"
- Improving pricing and valuation models for offering
- Conducting deeper counterparty risk analysis

The Basel III "reforms will also require banks to undertake significant process and systems changes to achieve upgrades in the areas of stress testing, counterparty risk, and capital management infrastructure". (PwC, 2010) Post-crisis analysis will mandate that banks drive integrated stress testing, expand their risk measures, and conduct more in-depth risk-weighted assets analysis.

Main Basel III Components—RWA Requirements

7 Trading Book and Securitization (detailed guidelines)

Stressed VaR	• The stressed VaR is computed on a 10-day 99% confidence basis, but with inputs taken from times of significant financial stress relevant to the firm's portfolio. Therefore, altogether, in addition to the current requirement of between three to four times the 10-day 99% VaR, three times the 10-day 99% stressed VaR will be required. • Model inputs are calibrated to historical data from a continuous 12-month period of significant financial stress. It would be equivalent to a VaR measure calculated over a dataset including 2008 and 2009. • On a daily basis, a bank must meet the capital requirement expressed as the higher of its latest SVaR number and an average of SVaR numbers calculated over the preceding 60 business days multiplied by the multiplication factor. • Data sets update every month and reassess whenever a material change in market prices takes place. • Risk factors incorporated in pricing models should also be included in VaR calculations and omissions must be justified.
Incremental Risk	• The IRC aims to capture default risk, in addition to losses from credit migrations, widening of credit spreads and the loss of liquidity. A bank's IRC model must measure losses due to default and migration at the 99.9% confidence interval over a capital horizon of one year, taking into account the liquidity horizons applicable to individual trading positions or sets of positions. • The liquidity horizon represents the time required to sell the position or to hedge all material risks covered by the IRC model in a stressed market. Liquidity horizon for a position or set of positions has a floor of three months. • Emphasis is on incorporating nonlinear impact of options in IRC models and netting allowed only when long and short positions refer to the same financial instrument.
Securitization	• Capital charges calculated under the standardized method and applied to the banking book will be extended so that they apply to securitized products on a bank's trading book with the exception of correlation trading. • Resecuritization exposures (CDOs of ABS and CDO of RMBs) will be treated differently from securitization exposures to reflect that they are riskier. Capital requirements for resecuritization positions will be approximately double the requirements for simple positions. • There are currently two methods for calculating capital requirements for a securitization position in the banking book : 1) standardized approach, under which risk weights are based on ratings from the credit ratings agencies; and 2) internal ratings-based approach, under which rated securitization exposures are subject to the ratings-based approach and unrated securitizations are subject to the supervisory formula approach.
Correlation Trading	• Specifically, correlation trading is a structured credit trading strategy wherein banks acting in a market-making capacity buy or sell credit protection to clients based on specific tranches of credit portfolios of indices. As evidenced during the credit crisis, changes in correlations between different securities can be quite volatile, particularly when hedging strategies used proxy indexes that do not match perfectly underlying exposures. In conjunction with other complexities associated with these strategies (e.g., default correlations), standard VaR-based measures of market risk do not fully capture the risks. Banks will have to adapt their VaR models to ensure proper stress scenarios are considered.

Figure 2. More specificity in Basel III stress models and acceptable parameters (PwC, 2010)

HOW PREPARED ARE FIRMS

"I think the main challenge is estimating the impact and planning accordingly. It varies from group to group, some have been able to calculate their requirements pretty accurately and have scaled up capacity already. Others feel that they have enough capacity and some are just not sure." Senior Executive at a Leading Global Financial Firm

Under joint sponsorship by SAS Institute and Platform Computing, Wall Street and Technology (WS&T), an Information Week Financial Services publication - surveyed over 200 large and small Wall Street firms on their ability to meet post-crisis risk requirements. (Kendler, 2010) Key findings of the survey (Survey) include:

- 20% of Sell-side firms and 28% of Buy-side firms reported that they either never do liquidity risk analytics or do the analytics only when asked.
- 36% of Buy-side firms and 30% of Sell-side firms run counterparty risk analytics only on an ad hoc basis, or not at all.

The Survey reports that 57% and 51% of Buy-side and Sell-side firms respectively are interested in improved business analytics. Two-thirds of respondents were not confident that their current analytic platform/infrastructure will continue to keep up over time. This finding is in-line with finding from an Accenture survey conducted after the passage of the Dodd-Frank bill, where 66%of the US financial institutions surveyed said that their existing business models will change**.** In follow-up conversations with leading banks and funds, SAS and Platform discussed common challenges to improving analytics. This section touches only on a few of those challenges below.

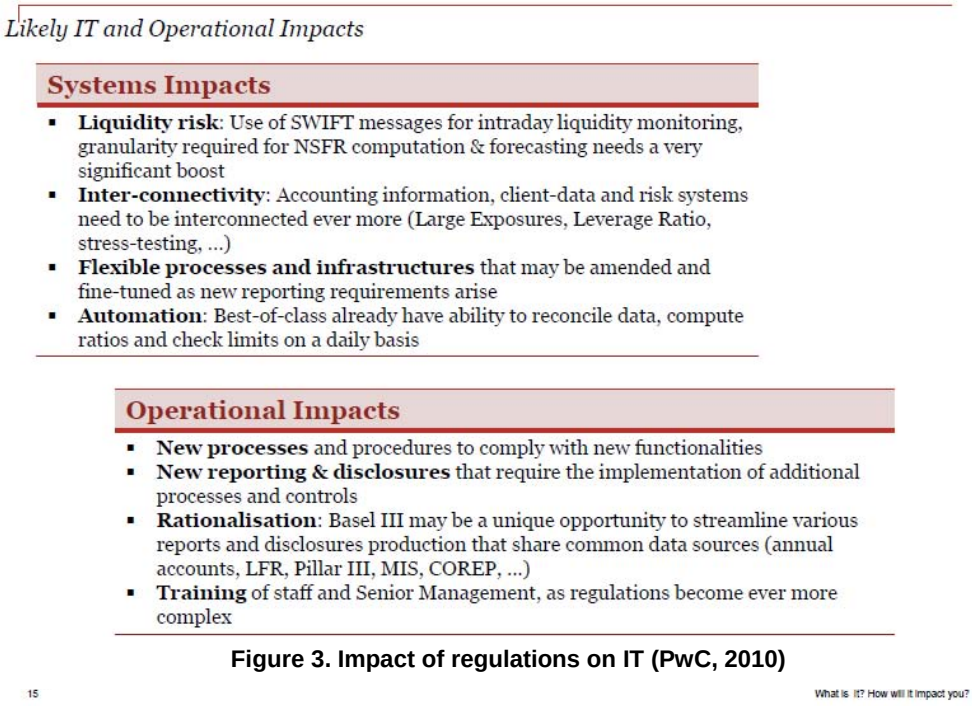

Figure 3. Impact of regulations on IT (PwC, 2010)

A bank on average may spend $100 million or more to comply with Basel III. (Crosman, 15). That number is likely a low estimate as banks will need to revamp not only their systems across the company but also their inter- and intra-company processes and data (See Figure 3). Areas that pose the greatest challenge in risk management include: (Mathghamhna, 2011)

- Getting a single coherent view of exposures across business lines (41.6%)
- Establishing a single, clean, reliable, and real-time dataset for risk applications (24.7%)
- Pricing and valuation for complex, illiquid instruments (18.2%)
- Counterparty and liquidity risk management (7.8% each)

The above challenges are in-line with the results of the Survey. (Kendler, 2010)

Key IT impact of Basel III changes on IT

- **Capital structure -** New definitions of capital and risk weightings require a consistent, revised approach for calculating capital requirements, monitoring, and reporting across lines of businesses.
- **CCR** - The IMM or standard (simpler) methods will require firms to revise their expected positive exposure (EPE) and CVA models, and conduct significant stress testing. Banks will need to model the impact of allowed and disallowed hedging methods to gauge charges. (See below for additional details)
- **Leverage ratio** - The leverage ratio is a new risk metric, and must be added to the calculation, monitoring and reporting process.
- **Pro- cyclicality risk** - Measuring systemic risk and risk correlations will affect Probability of Default (PD) and Loss Given Default (LGD) models. (Kelly, 2011)
- **Liquidity risk** - This calculation will require a single view of cash flows, and the challenges inherent to reconciling data from different sources. (Kelly, 2011)

Banks are all focused on CCR

Since the crisis, Basel III recognizes that banks need to also expand their simulations to include prolonged period of market stress, extreme volatilities, and specifically wrong way risk. Basel III is driving both big and small banks to proactively manage their CCR exposures. All banks will need to simulate hundreds or even thousands of potential scenarios in order to create exposure profiles – more than likely using Monte Carlo analyses on grid software. Most larger banks already support Basel II and have grids for Monte Carlo analyses; for them, the key Basel III changes are logical next steps. For smaller firms – particularly those without grid systems - the new CCR guidelines represent a significant technical and business process investment, likely requiring a major refresh of their systems.

CVA makes sense for some

As firms move from reactive to proactive CVA management, they face business and operational hurdles that include: revamping models and systems; aggregating and harmonizing input data; and creating a CVA desk if they don't already have one in place. Key challenges are:

- Gathering client, portfolio and market data from across the firm
- Scaling processes and analytics for standalone CVA and CVA with netting
- Managing compute and data intensive workload
- Performance and reliability of CVA systems

Many global large banks have a CVA desk. For these firms, the key challenge is likely evolving to a central CVA model and reconciling internal models with those proposed by the BCBS. For smaller and/or regional banks, the CVA desk may or may not make sense.

Most banks will calculate their CVA daily. Banks in the vanguard are already running intraday CVA calculations often up to four times a day. Ideally, banks are driving toward enabling incremental or marginal CVA calculations for better pre-trade decision making.

Improving enterprise-wide operating efficiency

In order to calculate their aggregate risk, banks will need to integrate their risk processes and systems across most if not all of their lines of businesses. Banks need to remove operational/data silos, and to create common data and business practices for compliance, speed and cost savings. One large bank noted that operating silos were left alone when their stock price was at $100 per share; however when the price is closer to $10 per share... IT budgets continue to be slashed. Operating cost and efficiency are now mantras of the day. Firms are looking to move to a shared services model delivered on a common grid and eventually via a private cloud.

Interestingly, the top barrier to a shared model was commonly cited by firms as trust. Lines-of-Business owners want guaranteed service levels, faster IT response time (to capitalize on market conditions), developer frameworks/common APIs, and transparency into/profiling of the shared service operations. The transition to a shared model will take time, but is inevitable due to regulation and cost drivers. There will be a mix-and-match of pooled and non-pooled resources for the foreseeable future.

Data growth is swamping banks

The volume and growth rates of data - historical, internally generated, and market – are challenging the analytical, network, and storage capacities of most firms. In fact, 2/3rd of Survey respondents feel that their analytics infrastructure were unlikely to keep up with changes. This is problematic especially for smaller-sized banks and funds. Such firms have significantly smaller IT operations, but will need to meet the same analytic requirements as those imposed on larger banks. (Kendler, 2010)

Volume is doubling every year

Market data is effectively doubling in volume each year. In the U.S., OPRA message rates are expected to rise by nearly 200% in 2010 over 2009. In December 2009, OPRA hit a peak of 1,470,242 mps compared with 810,999 mps a year before. Consolidated market data like CQS with the National Best Bid and Offer (NBBO) quote peaked at 166,523 messages per second (mps) at year-end 2009 compared to a peak rate of 88,249 mps in December 2008. In the October 2010 bulletin from the Financial Information Forum (FIF), the CME MDP FIX/FAST feed grew 34% to 25,753 mps over the 1 second interval. Add in mortgage loans, commercial loans, etc. and the volume of overall data can quickly overwhelm a firm's network, compute, and storage capacity. Such growth are driving firms to seek out new business models and next generation analytics software, hardware, and workload management tools.

Data harmonization is a key challenge

The Survey reported that firms felt that there was too much data and not enough data. The quantity is there but the quality isn't there. Likewise, they wanted analytical software that is flexible, configurable to support multiple business rules and views. While firms want dashboards and heat maps, they want the ability to drill down into the data as necessary. Reconciling data and having a common set of data and parameters. (Kendler, 2010)

For risk calculation at a large firm with multiple lines of businesses, risk managers will need to take care to understand differences in lines of businesses' calculation methodologies and data, harmonizing them as required. Specifically, the firm must reconcile and create a data view from different risk and reporting systems, from multiple data sources, and to support new capital requirements. For instance, banks will have to change accounting and risk systems to support the narrower definition of Tier 1 capital which now includes only common equity, retained earnings and similar ilk assets. (Crosman, 15)

Stress testing requirements

Earlier incarnations of Basel are proven now to be based on assumptions that failed during the crisis. In particular, the Basel capital adequacy rules did not fully account for extreme tail events or for the impact of counterparty on the solvency of another. The new framework emphasizes more in-depth and predictive analysis in the areas of liquidity management. "The new liquidity ratio required in Basel III will force banks to perform stress tests on their 30-day cash flows." (Crosman, 15)

Stress testing should be applied to the "firmwide portfolio in an integrated manner and take into consideration the specific risk characteristics of the portfolio. It includes techniques like sensitivity analysis of risk parameters, scenario analyses based on historically observed relationships as well as on conceived ones, the application of very severe but still plausible shocks, and reverse stress tests that identify events jeopardizing the survival of the bank Stress tests that focus specifically on credit risk include, among others, the stressing of default and recovery rates, a significant increase of correlations, collapsing collateral values, dramatic changes in interest rates and credit spreads, materializing concentration risks, widespread drawings in committed lines, and the unforeseen taking back of assets in off-balance-sheet vehicles onto the bank's balance sheet." (SAS Institute, 2009)

Adopting an enterprise view

In the aftermath of the crisis, large firms have created a Chief Risk Officer (CRO) position. This executive is focused on managing the firm-wide risk by driving a more consistent risk practice and getting a truer view of firm-wide risk. At many firms, the CVA desk reports directly to the CRO. With an executive mandate to get a handle on firm-wide risk, the CRO is driving to integrate risk systems, and enforce enterprise-wide guidelines and controls to avoid another liquidity crisis resulting from outside risks or more ominously, internal risks.

OTHER IT RISKS

> *"Increasing interoperability and interdependencies between systems might expand the channels of contagion arising from operational disruption at particular infrastructures, even in a world with multiple points of failure. Central banks are currently analyzing the implications of increasing systems interdependencies."* (Gregoriou, 2010)

Underpinning credit risk management are the inter- and intra-company systems for pre-trade, trade, and post-trade systems in particular payment and settlement systems. The last two systems are of importance in credit risk management in OTC derivatives. As the recent flash trading debacle or Lehman bankruptcy illustrates, the linkages of systems, automated trading, and incorrect/lack-of information can result in extreme market volatilities. That "…50% of FSFs that did not disclose their approach for measuring and allocating capital for operational risk are either not attempting to meet BCBS guidelines or are using a lower-level methodology" is troublesome given the dependency of financial markets on repo funding and liquidity. (Gregoriou, 2010)

TECHNOLOGIES TO ADDRESS THE ANALYTICS AVALANCHE

New, smarter technologies will significantly improve a firm's predictive analysis capability. As noted above, Basel III will require firms to process more data faster, and analyze data more deeply and frequently - perhaps on an intraday basis - for stressed CVA VaR and marginal CVA calculations.

A stressed CVA VaR calculation can spawn millions of tasks and petabytes of data. Even firms with numbers of 10GBe networks and tens of thousands of CPU cores will likely face application performance bottlenecks due to data I/O, resource contention, etc. without a refresh of their technologies. Of interest to firms in the Survey are: big data management, grid software, GPUs, analytics tools, and Software-as-a-Service (SaaS) offerings.

Analytics: Refresh, refresh, refresh

Many firms are refreshing their in-house analytical models to support the new requirements, testing with even larger data sets of historical and real-time data. In addition to adding CVA analysis, firms must refresh their predictive credit risk models including probability of default (PD), loss given default (LGD), and exposure at default (EAD) models. As firms continue to focus on cost containment, workload and resource management technology will enable multiple business lines and risk managers to share systems for running their calculations, and provide high availability desired by firms.

To do so, survey participants are looking to cluster and grid technologies to support enterprise-wide batch runs and Monte Carlo analysis with big data. Within the next two years, 51 percent of Survey respondents are considering or likely to invest in cluster technology, while 53 percent are considering or likely to buy grid technology. (Kendler, 2010) As firms already stress test using hundreds if not thousands of scenarios, grid-based Monte Carlo analysis enables firms to complete testing within an acceptable time period.

In addition to their models and agency ratings, banks are looking to 3rd party software to provide additional analytics. Grid-enabled analytics such SAS Enterprise Miner software running on Platform's grid software have enabled firms to maximize their utilization (up to 99%) of existing servers to process higher data volumes. Tools such as SAS Enterprise Miner are helpful for the design of internal rating systems used in calculating PDs, spreads for use in CVA calculations, etc. As securitization and re-securitization is a big aspect of Basel III, tools like SAS Credit Scoring for Banking can provide insight into the underlying assets of Asset Backed Securities including credit cards, loans and mortgages. Such data can be useful in assessing portfolio risks for delinquency and potentially default. For smaller firms with little to no IT staff, they are looking for 3rd party SaaS providers to fill their needs.

SaaS: Buy not build

Smaller firms now face the same compliance requirements as larger firms. However smaller firms likely have little to no IT staff, and need out-of-the-box solutions from vendors. Increasingly many of these firms are looking to SaaS and Infrastructure-as-a-Service (IaaS) offerings to solve their analytical needs. Such offerings are proffered by many of leading risk application vendors such as Calypso. Alternatively, firms like Excelian offer a multi-vendor risk offerings as a service with the same service level agreements (SLAs) and custom development support found in the IT departments of large banks.

Solving the big data problem

How are firms addressing the big data problem in analytics? There are four key concepts: common data, data cache, data affinity, and data grid. From this author's point of view (with input from key contributors), these four concepts are related as shown in Figure 4.

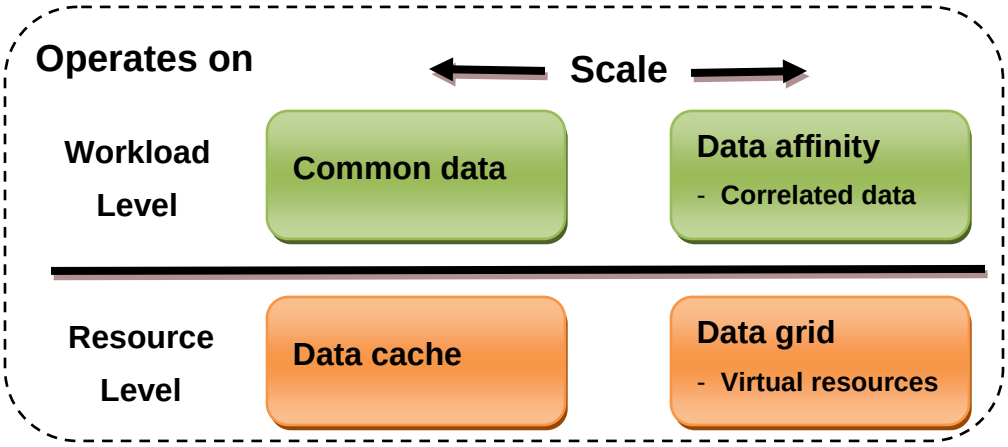

Figure 4. Big data concepts

Firms can accelerate the calculation times by minimizing I/O and movement of big data on network by identifying:

- Common data - pushed with workload, and ensuring this data is physically on the processing node and is highly accessible for re-use by multiple jobs (instances)
- Data affinity i.e. a group of data that are highly correlated – with regards to a workload – and co-locating this data close to the processing nodes, or conversely executing the workload on processors close to the data sources to avoid big data movement
- Data cache, a high speed data storage that is faster than a database and provides greater capacity than in-memory storage
- Data grid aka distributed data caches across a pool of virtualized storage devices allowing for scalability

Popular data affinity and data grid products – in production - include those products from Platform Computing, Gemstone, and GigaSpaces. In combination with compute grid technology (see below), firms are building a highly scalable compute infrastructure that delivers millions of calculations on petabytes of data as likely required by a stressed CVA VaR calculation.

Hadoop and variants of Hadoop

An emerging technology - of intense interest from banks - that addresses the big data problem is the open source Hadoop offering that supports the MapReduce programming model. Hadoop combines the data affinity, data caching

and data grid features. At this point, banks are experimenting with Hadoop. According to some publications, a typical Hadoop deployment is 10 nodes in trial and from 75 to 500+ nodes in production with support for up to10 terabytes of data per node. (DBMS2, 2010) Typical use cases include:

- Analysis for trading compliance and fraud detection
- Complex Extract, Transform, and Load (ETL) processes
- Portfolio risk calculations

The consensus in general is that the open source version is not robust enough to meet a bank's requirements, and therefore the majority of banks are looking at commercial variants of Hadoop. Data warehouse software and appliance vendors have also announced or are working on adding Hadoop-like offerings to their product lines.

Solving the performance and compute scalability problem

GPU and CPU

An emerging technology for speeding up analytics is the Graphics Processing Unit (GPU) based system. GPUs offer significantly faster performance than CPUs, therefore promising faster speed on fewer cores. According to Nvidia, a leading provider of GPUs, a GPU can be 14 times faster or more than a CPU. However there are limitations to GPU adoption at this time, including:

- Limited availability of GPU development tools. A common observation by programmers is that Nvidia CUDA programming language is hard to do well.
- GPUs are well-suited for high speed processing of massive numbers of parallel, identical tasks with small set of common data. An example would be a Monte Carlo analysis with small number of factors such as option pricing. For analysis with many factors, GPUs are not optimal and CPUs remain the incumbent.

At this time, financial firms are experimenting with GPU systems for running a select set of analytics, and looking at a combination of GPUs and CPUs for executing more complex analysis such as CVA testing.

A new challenge emerges with a mixed processor environment in order for firms to optimize performance and cost savings. Both IT and application developers will need to conduct performance analysis on their applications in order to understand: how to fine-tune the application code for the GPU and/or CPU; and to determine the best ratio of GPUs/CPUs given performance requirements, costs and space issues.

Compute grid

Compute grid technology is a well-accepted technology for scaling up and out analytics in the largest banks, and for managing a variety of tasks in risk, pricing, and back-testing. Compute grid enables firms to effectively pool and share compute resources between multiple lines of business, resulting in lower capital and operating expenditures.

The mixing and matching of compute- and data- grids to create a data-aware compute grid environment significantly improve analytics performance, particularly with large data sets. Many banks already use such a combination of commercial and in-house developed grid technologies.

For the banks, there are notable trends in compute grid implementations

- Emergence of an enterprise grid backbone for both investment and retail banking applications. The use of grid software is particularly important for disaster recovery, resource management including lending-and-borrowing, and workload management. The latter is particularly important as retail and investment banking workloads have markedly different characteristics, et al
- Resource scavenging to borrow unused resources e.g. trader desktops during non-trading hours for overnight analysis. For one large European bank, the IT department deferred a multi-million dollar capital expenditure on new servers and networking equipment by scavenging 3000+ desktops.
- Management of both CPUs and GPUs (see above)
- Movement from in-house developed grids to commercial grid software. Banks are facing continued IT budget constraints, and refocusing their developer teams from proprietary grid development to core applications. For banks with in-house grid software, they are on-boarding new applications on the commercial grid and migrating existing applications off of their proprietary grids over time. This migration process will take years.
- Doubling the number of CPU cores on the grid. Large banks are now projecting up to 100,000 or more cores to be managed by compute grid technologies such as Platform Symphony.

CONCLUSION

With Basel III, the Basel Committee on Banking Supervision addresses the systemic and counterparty risks. Despite improvement, much uncertainty remains over the implementation and effect of this regulation. Already, market participants are pushing for changes in the way CVA is modeled over the coming year. In addition to Basel III, firms

will need to comply with regional regulations from Dodd-Frank to Markets in Financial Instruments Directive (MiFID). As many firms operate in multiple Financial Services sectors, these firms will need to comply with regulations managed by different government agencies. Regulatory compliance will continue to confusing and expensive to implement for firms, and at times at-odds with one another. To avoid the fray, firms are best advised to practice prudent risk management. and operational best practices.

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CONTACT INFORMATION

Your comments and questions are valued and encouraged. Contact the author at:

Jeff Hong
Platform Computing
747 Third Avenue, 19th Floor
New York, NY 10017
jhong@platform.com