Citibank
European Structured Credit Derivatives
RSSD/NED Event #:

Exam Type:	**Target Exam**
Start & Close Date:	**October 31 – November 18, 2005**
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Date:	**November 28, 2005**
Section:	**Market Risk Management**

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As part of target review of the Citibank European Structured Credit Derivatives business, FRBNY examiners reviewed Citibank's Market Risk Management function with specific focus on risk measurement, VaR, and stress testing. The following is a summary of our findings related to these areas.

I. Market Risk Management Function

Reporting Structure

The Market Risk Management function that oversees Citibank's European Structured Credit Derivatives business is divided into two principal areas, the "in-business" Business Risk group (BR) and the independent Market Risk Management group (MRM).

The European Fixed Income BR group has reporting lines to Jeff Coulter and Rick Stuckey in New York who head the Business Risk function globally. BR is primarily responsible for aggregating risk data across all businesses, producing daily reports summarizing risk, presenting limit increase requests to Market Risk Management (MRM) on behalf of the trading desk, and communicating key risk concentrations in the European Fixed Income portfolio to management. They also work in conjunction with the front office and MRM (Dominic Wallace) in the design of new stress scenarios and in

establishing risk limits for new products. Steve Barnett, Fixed Income Business Risk, represented the group.

The MRM group has reporting lines up to the bank's Senior Risk Officer, Dave Bushnell via Jessica Palmer, Head of CIB Risk Management, and Colin Church, CIB EMEA Chief Risk Officer. MRM is primarily responsible for the setting and monitoring of risk limits, and watching key risk concentrations in the Structured Credit Derivatives portfolio. They also work in conjunction with the front office and in-business Risk Management (Steven Barnett) in the design of new stress scenarios and in establishing risk limits for new products. Dominic Wallace, Fixed Income Market Risk Management, represented the group.

Limits

One of MRM's primary responsibilities is the establishment and monitoring of risk limits for the desk's "greek" exposures, VaR, and Stress losses. MRM uses a variety of terminology when "limiting" the desk's positions. A quick summary follows:

- *Limit* – Traditional "hard" limits. Policy states that there are to be no limit breaks. Breaches of these limits are documented in the weekly risk report.
- *Trigger* – Policy dictates that MRM is to be notified of trigger limit breaches. These are designed to prompt a discussion between MRM and the desk on the specific exposure.
- *Guideline* – Guidelines are not in policy but are used for things such as desk level VaR for which there are no hard limits.
- *Threshold* – These are used primarily for Index decomposition. These are also not in policy. They are used primarily to monitor single name concentration risk that results from Index positions.
- *Waterfall* – This is a method whereby MRM allows the desk to cascade or overflow risk limits from higher risk categories into lower risk categories. For example, it would be ok to be over the A-rated concentration limit provided the cumulative position from A to BBB was not over its cumulative limit.

The limit setting process for greeks and stress scenarios involves three main inputs: risk appetite, worst-case move, and annual budget. The limits are roughly defined as the risk appetite divided by the worst case move. The risk appetite is mutually agreed between front office and MRM. For stress losses, the loss to the desk of a worst case move with all positions at limit, should not exceed the desk's annual budget. The following table summarizes the limits currently in place for three of the trading desks within Structured Credit Derivatives:

Limit	Single Name Book	Correlation Book	ABS Trading
Interest Rate (Total)	√	√	√
Interest Rate (EUR/USD)	√		
Interest Rate (GBP/JPY)	√		
Interest Rate (Other	√		

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Rating Concentration Credit Exposure (MV)	√	√	√
Single Issuer Credit Exposure (MV)	√	√	√
Recovery Rate	√	√	
Credit Spread Volatility	√		
Credit Correlation Total		√	√
Super-Senior (15-30%)		√	√
Senior (10-15%)		√	√
Sr. Mezzanine (7-10%)		√	√
Jr Mezzanine (3-7%)		√	√
Equity (0-3%)		√	√

Limits are monitored on a daily basis by MRM. They obtain risk information from two primary sources, in-business risk management and the Market Risk Reporting group in New York. The in-business risk management group, Steve Barnett principally, produces a set of daily reports that provides position information for each desk within the Structured Credit Derivatives business, as well as aggregate data for European Credit Trading & Structured Credit. Within this daily pack he includes scenario analysis with resultant p/l moves for joint shifts in correlation and credit spreads. This information is circulated each morning via a posting to the internal web. In the early to mid afternoon, MRM receives their standard limit reports from the Market Risk Reporting group in NY. These reports, sent via email, will indicate in their subject line whether there are any limit breaches for that day.

MRM follows a three step process when processing limit breaches. The first step is to consult with the front office to determine whether the excess is in fact real. If it is real, they will ask for an explanation for the excess and then agree with the front office on a plan of action to get back within the limits. Step two is to document the excess in the limits excess reporting system so that it can be communicated to senior management. Finally MRM will place a call and email to Rick Stuckey and Jeff Coulter to make them aware of the excess and the agreed plan with front office to resolve it.

Risk Aggregation & Reporting

On a daily basis, BR pulls position data from the various systems across European Fixed Income and summarizes the information in a single spreadsheet. The bulk of the data relates to each desk's CR01 exposure across different currencies. The data is then bucketed by tenor and provides aggregate CR01 exposure across all currencies for all desks.

The raw data is complemented by a 2-3 page daily commentary on the key risks of each desk. Sector concentrations are highlighted for the Single Name book whereas net correlation and capital structure (tranche) exposures are emphasized in the correlation book commentary. These reports are posted daily to an internal web page where they can be reviewed by Business Risk management as well as MRM. It is not, however, a direct

responsibility of BR to provide MRM with risk information as they receive daily reports from Market Risk Reporting in New York.

In addition to the daily reporting, there are formal weekly meetings with BR management to discuss the risks in the various fixed income businesses. Information flow from management regarding the desk's positions will often flow directly to the trading desks rather than through BR.

Deal Review & Limit Requests

Business Risk is also responsible for reviewing new product proposals with the front office and presenting them to MRM. BR will review the deal for appropriateness, risk implications, limit requirements, and modeling/technology issues. If there are new limits or existing limit increases required, BR are the ones who present the transaction to MRM and request approvals.

Key Risks in Single-Name & Correlation Books

Dominic highlighted the key risks facing the trading desks in these two businesses.

Portfolio	Key Risks
Single Name CDS	Credit Spread Risk (CR01)
	Jump-to-Default Exposure
	Sector Risk
Correlation Book	Overall Implied Correlation Exposure
	Capital Structure of Implied Correlation
	Recovery Rate Sensitivity
	Correlation by Attachment Point

VaR

We discussed VaR in general terms with Dominic. They currently do not feed data to GMR for the VaR calculation for the correlation book and the ABS trading book. There are projects underway to move these portfolios into VaR so that all risk from Structured Credit Derivatives will be captured in GMR. Dominic's view was that VaR is a "somewhat useful" number as it helps him to view some of the risk in the portfolio for businesses where there is a long history of prices and market behavior. Also, he finds it a useful tool for uncovering analytical problems with respect to the risk parameters produced by the front office models. Sometimes a large VaR result will uncover a flawed risk measure from a system. Dominic was very wary of VaR as a risk measure for new businesses such as the correlation book. In his mind the "rules" of these markets are still changing and thus make it difficult to quantify risk within a pre-specified confidence interval. He thinks VaR is perhaps not yet robust enough for something as complex as the correlation book.

Stress Testing

The first set of scenario analysis performed by risk management is done by the BR group. In these scenarios, credit spreads and implied correlations are jointly stressed with P/L results included in the risk pack produced by Steve Barnett. This scenario is run daily for the correlation book. The shifts are run with correlation flat and +/- 5% combined with moves in credit spreads down by as much as 50% and up by as much as 250%. Sample results for October 31, 2005 are in the table below (output is p/l in $mm):

	-50%	-75%	100%	150%	200%	250%
Corr +5%	4.8	5.8	14.1	56.1	121.8	193.6
Corr Flat	1.0	(1.2)	0.0	28.4	91.5	191.6
Corr -5%	5.1	(3.6)	(13.3)	(23.2)	46.0	199.0

On a quarterly basis, MRM runs a customized stress scenario referred to as the Risk Manager Estimate (RME). The procedures that guide MRM in the creation of RME scenarios are designed to be flexible. Following are some of the basic principles:

- Moves in individual risk factors are derived from historical data and represent MRM's loss estimate over a holding period appropriate to the risk factor.
- Risk Manager Estimates allow for the incorporation of:
  - Judgmental market moves and correlation between variables
  - Missing market risk variables in the statistical scenarios, due to data availability
  - Trader behavior during stress conditions
  - Average/typical and "lumpy" exposures during the quarter, rather than exposures at quarter end (since quarter end exposures may be atypical)

The key risk measures for each desk are stressed, including Credit Spread sensitivity (CR01), Correlation Skew risk (Corr01), Recovery Rate risk, and Interest Rate risk (DV01). Examples of MRM's flexibility in customizing the scenarios are evident in the RMEs for the correlation and single name books. In the correlation book, while the desk is running long spread exposure in the buckets rated A and higher, and short ratings BBB and lower, the stress scenario excludes the correlation benefit of this rating spread position. The scenario holds the A and higher rated spreads constant while stressing BBB spreads by 25 bps and BB spreads by 125 bps. This produces a higher stress loss for the desk.

In the single name book MRM has 5 spread move scenarios which have an effect similar to that just described for the correlation book. They are:

	Scenario 1 All widen	Scenario 2 Flight to Quality	Scenario 3 FI to Quality HG unch	Scenario 4 HY widen 100 HG widen 50	Scenario 5 Reverse Flight To Quality

AAA	30	-15	0	15	30
AA	30	-15	0	15	30
A	40	-20	0	20	40
BBB	60	-25	0	30	60
BB	250	250	250	250	-100
B	450	450	450	450	-175

The flexibility here is evidenced by the inclusion of the Flight to Quality scenario that holds High Grade spreads constant as well as the Reverse Flight to Quality Scenario. While these are lower probability scenarios than would be dictated by a strictly statistical approach, they can be customized according to the desk's risk concentrations.

There are no hard limits on stress test results. All desks, however, are required to have a loss "trigger" limit which is set at two months' budgeted revenue (against two months' actual revenue.

Distribution of Risk Information to Senior Management

Dominic described to us the flow of key risk information from the desk to MRM and then on to senior management. The highlights were:

- Limit utilization report from Market Risk Reporting goes to MRM daily
- In-business risk management position summary and scenario analysis goes to MRM daily
- MRM creates a weekly risk report for the Global Market Risk Committee (GMRC) meeting where key risks are highlighted and discussed
- MRM produces a 2 page weekly memo for EMEA
- Dominic meets weekly with Steve Barnett (In-Business Risk Management) and Mark Watson (Head of Fixed Income EMEA) to discuss the desk's risks.
- GMRC produces a four page weekly report to present to the Risk Committee, this meeting attended by many senior managers