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Lehman Brothers

# ICAAP Supporting Document:

# Market Risk Management Overview

*May 2008*

LEHMAN BROTHERS

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# 1. Market Risk Management

# 1 Market Risk Management

## 1.1 Market Risk Management overview

Market Risk Management (MRM) is a globally integrated organization with teams located in the regional trading centres: New York, London, Tokyo and Seoul. MRM managers are aligned on a business and regional basis. The Global Head of MRM reports into the CRO and is based in New York.

Market risk represents the potential change in value of a portfolio of financial instruments due to changes in market rates, prices and volatilities. MRM has global responsibility for developing and implementing the Firm's overall MRM framework. To that end, it is responsible for the development of the policies and procedures of the MRM process; determination of market risk measurement methodology in conjunction with QRM; monitoring, reporting and analysis of the aggregate market risk of trading exposures; and administration of market risk limits as appropriate. Market risks inherent in positions include, but are not limited to, interest rate, equity, traded credit and foreign exchange exposures.

## 1.2 Risk Measurement

MRM uses a suite of risk methodologies to measure, report and limit the market risks taken by the Firm. These include the statistical VaR, Risk Appetite and Risk Equity models as well as various stress tests and scenario analyses.

VaR is an estimate of the potential decline in the value of the Firm's trading positions due to normal market movements over a one-day holding horizon at a certain confidence level.

The Firm's Risk Appetite represents the amount of money that the Firm is "prepared to lose" over one year due to market, event and counterparty credit risk. Risk Appetite is measured at a 95% confidence level over a one-year holding horizon. The Risk Appetite framework aims at balancing risk and return. Lehman Brothers sets its Risk Appetite at a level which ensures that the Firm can achieve minimum financial targets, as well as generate acceptable through cycle returns.

Risk Equity represents the required equity capital to sustain the operations of the Firm under adverse market conditions. Risk Equity is the greater of the economic capital associated with market, event, counterparty credit, operating, and legal risks and regulatory capital. Regulatory capital is the capital required by business units operating in regulated entities. Risk Equity is calculated at a 99.5% confidence level over a one-year or longer holding horizon, depending on nature of the trade.

VaR and Risk Appetite are calculated daily on a Firm-wide basis. Lehman Brothers' limit framework consists of VaR and Risk Appetite limits at the Firm-wide level, which are then cascaded down through the divisions to the lines of business, both globally and regionally. These limits are complemented by non-statistical measures of risk where appropriate.

## 1.3 Risk Reporting

Market risks across the Firm are reviewed daily by MRM managers reporting to the Global Head of MRM, and in turn to the CRO. On a weekly basis, the Risk Committee, which consists of the Firm's Executive Committee, the CRO and the CFO, reviews risk exposures, position concentrations and risk taking activities.

The Firm's exposures to market risk include, but are not limited to, linear and non-linear components of interest rate, credit spread, mortgage basis, swap spread, foreign exchange, equity price, inflation, volatility, correlation, and the level, slope and shape of the yield curves in a wide range of countries. These risks also include exposure to the basis between different but related instruments, such as the basis between government bonds and futures, the calendar basis between futures contracts, and the basis between differing mortgage securities. Market risk related concentrations of risk are captured within the Firm's VaR/Event risk and Risk Appetite frameworks and are further monitored by MRM managers in their daily risk reports where large top concentrations of position by business are highlighted.

## 1.4 Limit Setting and Escalation Procedures

**Overview**

Fundamental to risk management is the establishment and maintenance of a sound system of integrated market risk limits to control the range of market risks inherent in trading and investing activities. Limits define the level at which intervention is required from Senior Management with the appropriate authority (see "Management Action Triggers" discussed below). Market risk limits expressed in terms of potential loss associated with the Firm's activities have been defined with the following objectives:

- To be within the Firm's risk appetite;
- To protect the Firm's capital base;
- To reduce the volatility of the Firm's trading returns.

The overall risk limit framework is driven by the Firm Risk Appetite limit, which is approved by the Risk Committee on an annual basis and reviewed for possible updates periodically, as necessary. Risk Appetite limits are supplemented by VaR limits as well as by other guidelines using additional relevant metrics, as appropriate to the specific products and business. Limits are set at a Firm-wide level and cascaded down to the Divisions and Lines of Business within each Division on a global and regional basis. In addition, while the Firm does not manage risk on a legal entity basis, limits are nonetheless applied to the Firm's regulated legal entities as required.

The limits process is administered by Market Risk Management (MRM) in conjunction with the Global and Regional Business Division Heads. Limits are set annually as part of the Firm's budget process, and may be reviewed and amended during the course of the year, as may be appropriate in the context of changes in markets and the business.

**The Cascading Limit Framework**

The aggregate Firm-wide Risk Appetite limit is set by the Risk Committee, and any changes to, or breaches of, this limit require approval of the Risk Committee. In addition, the Risk Committee approves the allocation of the Firm-wide Risk Appetite limit to Business Divisions, based on the recommendations of Market Risk Management.

The Firm-wide Business Division Risk Appetite and VaR limits and the region-wide cross-Divisional limits for Europe and Asia form the set of Level 1 limits. Changes to, and breaches of, Level 1 limits require authorization from the Global Head of Risk Management and the Business Division/Region Head, as appropriate. Limits set within a Business Division, which may be either regional or for a global Line of Business, depending upon the business organization, are set by

MRM in conjunction with the Business Division Heads and form the set of Level 2 limits. Changes to Level 2 limits require the approval of the Global Head of Risk Management and the Business Division Head.

Business Managers have the authority to set additional limits, including individual trader limits, if deemed appropriate, which form the set of Level 3 limits. Level 3 limits may be reallocated by Business Managers as they see fit so long as the Line of Business/Region stays within its limit overall.

## 1.5 VaR Limits for LBIE

Limits for LBIE are set against the 1 Day 95% VaR only and are classified as shown below:

| Business (LIBIE only) | Limit Level | Sign off approvals |
|---|---|---|
| FID division | Level 3 | Business Heads |
| Equity Division | Level 3 | Business Heads |
| LBIE (Legal entity) | Level 2 | Any two LBIE Board members |

Details of VaR against limits usage is shown in Appendix F.

# 2. Market Risk Measurement

# 2 Market Risk Measurement

## 2.1 Scope

All valuation and risk measurement models, methodologies and frameworks apply to Lehman Brothers Holdings Inc. (LBHI) as well as its significant operating subsidiaries, including LBIE.

## 2.2 Valuation Methodologies

Pricing models are used by the Firm's trading units to value, aggregate and hedge risk positions. In general, the models are based on a robust body of published financial-economic theory, mathematics, probability theory and statistics as well as market data. The models are designed to price cash flows relative to the tradable instruments used in static or dynamic replicating strategies. The models contain assumptions about the stochastic processes followed by market prices, implied volatilities and correlations. The most intensely used models are well-known, industry-standard models (e.g. Black (1976), Black-Scholes (1973), and HJM (1991)). The Firm also employs internally developed models. The pricing models produce valuations and risk-factor sensitivities (e.g. deltas, vegas, gammas) which feed into the risk models used by the GRMD.

The pricing models are developed by Quantitative Research. They are implemented by Technology within the respective businesses. The business, Quantitative Research, Technology, the GRMD, and Product Control have specific responsibilities in the model control processes. Quantitative Research is responsible for developing, testing and fully documenting the models. Quantitative Risk Management (QRM) works closely with the Quantitative Research groups from the early stages of model development. The Model Validation Group (part of QRM) independently reviews the models. Additional documentation, explanations and tests may be required during the independent review process. Product Control validates the inputs and outputs of the models on an ongoing basis. External price sources are used where available to validate model inputs. Some models contain parameters or inputs that are not readily observable in the market and prudent model valuation adjustments are assessed when required. Technology maintains and controls the computer code of the models, implements regression tests and provides notifications of code changes and releases. Model-related issues are addressed in the periodic meetings of the Model Control Committees of the Fixed Income and Equities Divisions. Those committees are staffed by people from the business units, Quantitative Research, the GRMD, Technology and Product Control. The Model Control Guidelines detail the model control framework and the responsibilities of each group within this model control environment.

## 2.3 Value at Risk (VaR)

### 2.3.1 Determination of VaR

VaR is an estimate of the potential decline in the value of the Firm's trading positions due to adverse market movements over a specified time horizon and is expressed at a given confidence level.

Our VaR model accounts for general market risk and specific risks, through the use of granular market data as well as modelling.

For the general market risk factors (e.g. interest rates, foreign exchange rates, and option implied volatilities) the Firm uses historical simulation based on the most recent four years of market data. For linear risk, the sensitivities of the current portfolio to the relevant risk factors are multiplied by the 4-year historical daily changes of these risk factors, resulting in about

1000 possible scenarios of P&L impact on the current portfolio (simulated P&L vector). For any level of aggregation that is needed, for each historical date, the total potential P&L across different factors and different positions / books / businesses can be added, resulting in an aggregated P&L vector. The correlations between general market risk factors are implicitly determined by the historical simulation methodology.

Individual stock price series are used for the simulation of equities risk wherever those series are available. Thus, the equities-risk methodology automatically captures the general and specific risks of stock returns. When there are not enough data (< 25 days) on a recently issued stock (e.g. recent IPO), the Firm employs an interim model using default regression values (beta =1, error volatility = 55% p.a.) for the individual stock return. For single stocks with longer history (>= 25 days but less than 4 years) VaR is based on the linear coefficient and the error volatility from the daily regression against the country index returns.

For debt-related instruments, general risk is represented by bond indices constructed for currency-rating-maturity-industry buckets. The specific risk component is modelled based on the residuals of the constituent bonds with respect to each bucket.

The VaR model captures material nonlinear risks using gamma / convexity approximation and stress matrices. All modelled specific risks are assumed to be independent of every other general and specific risk factor in the VaR model.

VaR is the basis of daily internal reporting of market risks to businesses and senior management. The results of the model are compared on a daily basis against VaR limits and these results are input into the Firm's measures of Risk Appetite, Risk Equity, Return on Tangible Equity and other performance evaluations.

The Firm calculates VaR daily over a one-day horizon at a 95% confidence level. The market data are weighted toward more recent history The Firm currently uses an exponential decay factor of 10% per month (21 business days), resulting in an averaging life of approximately 9 months of the market data, compared to the average life of 2 years if the data is un-weighted / equally-weighted.

The VaR model has been developed and implemented by the GRMD. QRM has primary responsibility for the methodologies and implementation of the VaR model. Risk Technology reports into the Global Head of QRM and the Information Technology Division, jointly. MRM managers work jointly with QRM to ascertain that the risk models are designed and effectively implemented.

### 2.3.2 Development, Testing and Validation of VaR

The VaR models undergo almost continuous enhancement (mostly of a minor nature). These enhancements include, but are not limited to covering more products, more risks, remapping to better historical time series, enhancing methodology, etc. In each of these cases the stand alone, marginal to business and marginal to Firm impact is estimated and analyzed. It is carefully scrutinized in QRM and MRM before being accepted or rejected.

VaR changes are initiated within QRM / MRM. Specifications are passed to the product specialists group in Risk IT for testing and further to LehmanRisk for implementation. LehmanRisk has a parallel staging environment where the same data as in production is loaded every day. Any new enhancements are tested in this environment. We freeze the code 1-2 weeks before the release. At that point users verify all the results in the UAT environment. An ACM ticket is created for the release and appropriate users are required as approvers. The release proceeds only after all necessary approvals are received.

Tests performed on a staging environment and moved into a production only after successful completion. Reports are generated on excel spreadsheets and posted on the web. Designated risk managers scrutinize these reports for methodology, trade population and final results. Validation is a result of a continuous comparison with production environment on a "what if" basis, adjusting parameters and rerunning reports until desired outcome is achieved. If needed further tests are performed including back-testing and scenario analysis.

### 2.3.3 Implementation, Testing and Release of VaR

The Market Risk IT group is responsible for the development and implementation of the internal VaR model. The Market Risk Analytics group, in conjunction with the Market Risk Managers, are responsible for the requirements specification of the internal VaR model. This is provided to the Market Risk IT group, who produce a specification of the technical changes to the VaR model, implement those changes and release the changes.

The implementation and UAT process depends on the type of the change. The types of changes can be split into the following classes:

- feed improvements (e.g. additional indicative data);
- feed changes (e.g. changes to the representation of the exposures); and
- VaR methodology changes.

In each case the VaR results are calculated not only for the entire portfolio, but also for a wide range of different selections e.g. Trader, risk factor (currency, interest rates, credit spreads), strategy. This allows the comparison testing to check that only the sub-portfolios that are expected to be impacted by the change are actually affected.

All of the source code of the VaR model is registered in the Market Risk IT Concurrent Versions System (CVS) change control repository. Each program code module is registered in CVS and is assigned a version number. When a program code module is modified as a result of a bug fix or enhancement, it is registered in CVS and the program code module is assigned a new, higher version number. The developer also writes a comment on the reason for the change to the program code module. This allows changes to be tracked through the system as a change is developed, tested and then released to production.

When a release is made, a Remedy Release Request Ticket is raised by the developer. This ticket contains the details of the release and the intended release date. A list of approvers is also added to the ticket, which includes the Risk Manager that requested the change and the overall system owner.

The Remedy Release Request Ticket process also ensures that all alterations or removals to the data feed are notified to the Market Risk IT group. Each system at Lehman is modelled in the Asset Database System (ADb). This contains all of the infrastructure components used by each system, together with a list of the source systems that provide the dependant systems with data feeds. This allows the system owners to identify which systems are impacted by a change to their system. If there is change to a system that impacts a feed to a dependant system, then the owners of the dependant system are added to the approval list of the Remedy Release Request Ticket. The release can only go ahead if all of the necessary approvals are obtained.

Requests for the introduction of data feeds come from the Market Risk Managers, who specify how the new data feeds should be processed in the system through the internal model and how the Market Risk reports are impacted. The Asset Database System (ADb) is updated to indicate the new feed dependency that Market Risk Management have, specifying the system that provides the data feed. If there are any changes to the system that provides the data feed, then the Market Risk IT group will be informed about those changes through the Remedy Release Request Ticket process.

The Market Risk Managers approve the release of changes to the internal VaR model for their respective area. The Market Risk IT group is then authorised to alter the models. Only this group has access to the code base and can make releases to the production system.

The Market Risk Analytics group is responsible for producing and maintaining the VaR model specification documentation. When there is a change to the internal model, the Market Risk Analytics group update the documentation and then publish the document to the Market Risk Managers and Market Risk IT groups.

The Market Risk IT group is responsible for producing and maintaining the technical documentation that describes how the model has been implemented. This documentation is reviewed when there are changes to the VaR model implementation. If changes to the documentation are required, then the documentation is updated.

(Note that all IT processes detailed above follow the firm's general standards framework for application development, application change management and the overall production change management process).

## 2.4 Event Risk

In addition to Value at Risk, the Firm's internal risk framework also uses statistically measurable analyses to capture stress and "gap risks" which go beyond potential market risk losses associated with:

- defaults for high yield credit products, including high yield convertibles;
- downgrades for high grade credit products, including convertibles;
- property value losses on real estate (not in LBIE);
- deal break risk for merger arbitrage positions; and
- NAV gap risk for fund derivatives. (not in LBIE)

For default risk for high yield products:

- the loss given default is estimated as the current market value less recovery for cash instruments and the value-on-default (VoD) measure for credit derivatives and exposures are netted by issuer;
- recovery rate is based on rating agencies' studies of historical recovery, or internal research information if available;
- the probability of default for each issuer is based on rating agencies' annual historical probability of default , scaled to a 3-month horizon
- the portfolio loss distribution is obtained using a Gaussian copula model which accounts for correlated defaults amongst issuer. The associated correlations are based on the issuer credit rating consistent with the AIRB approach; and
- the loss at the desired confidence level (95% for internal Risk Appetite purposes) is calculated.

For downgrade risk for high grade products:

- the loss given downgrade is the P&L impact of the spread widening from the current credit rating to the one-letter rating down, estimated from the spread DV01 and the spread differences between the two ratings; exposures are netted by issuer;
- the probability of downgrade for each issuer is based on rating agencies' historical transition matrix;
- the portfolio loss distribution is obtained using a Gaussian copula model which accounts for correlated defaults amongst issuer. The associated correlations are based on the issuer credit rating consistent with the AIRB approach; and
- the loss at the desired confidence level (95% for internal Risk Appetite purposes) is calculated.

For Event risks in M&A positions:

- Event risk arises from the potential failure of an M&A deal. To the extent that the target stock price differs from the deal price, the market is expressing uncertainty that the deal will close. A "market implied deal break probability" can be defined by assuming that the price is the probability-weighted average of the deal price and a break price. The determination of the break price is quite uncertain. We assume that the target price simply returns to its pre-announcement level.
- With the deal break price in hand, the probability of breakage is

  $\text{Prob} = \dfrac{P_{Deal} - P_T}{P_{Deal} - P_{Break}}$ where $P_{Deal}$ is the target price under the terms of the deal, $P_{Break}$ is the deal break price and $P_T$ is the current price of the target stock. This formula will be less than zero if the target price exceeds the deal price – in this circumstance, the deal break probability should be set to zero.

- The loss in the event of deal break can be calculated using the deal break price. With the probability and loss determined, the event risk can be calculated as assuming independence amongst the events. For portfolios of high grade and high yield products, the loss distribution can be derived combing the downgrade and default events.

## 2.5 Market Data

The Historic Market Database (HMD) is a system of databases and corresponding tools used in Lehman Risk to store, update and retrieve time series for the VaR calculation.

Lehman Risk currently downloads data from multiple internal and external sources. The major external sources / vendors are FAME and Bloomberg. A significant amount of data is sourced from internal Lehman Brothers' trading desks, front end systems, and research structures. This data is stored in corporate repositories: FAME, GMD, GEM, POINT, etc. and daily updated into HMD for the previous 10 days. Fixed Income data and some equity indices and volatilities time series are stored and updated daily in HMD.

Data in HMD is stored as daily time series. There are instances where updating frequency of data occurs at lower frequencies. For the purpose of the VaR computations, time series are retrieved from HMD with "filled forward" values. This means that all gaps in time series are filled with the previous non empty value.

Various automated control procedures exist to ensure the accuracy of source data. When source data is not directly available, procedures such as interpolation and extrapolation are applied.

## 2.6 Market Risk Reporting Process

The MRM team in London produces risk reports and VaR reports on a daily basis for all European businesses and for global businesses that are booked in LBIE

Risk reports are generated automatically once feeds from Front Office valuation systems have been received. The risk sensitivities and position information is processed through the VaR model in LehmanRisk to generate VaR results. Once generated the reports are reviewed by the risk manager for reasonableness. All material movements are analyzed and confirmed with the trading desk. Reconciliations are undertaken at a position level on a daily basis, between LehmanRisk and Finance P&L systems, to ensure accuracy and completeness. Any errors are investigated and necessary adjustments made on either the risk reports or the P&L.

Once fully reviewed, reports are distributed to traders, senior business managers in London, global business managers in the afternoon. The standard risk reports generated on a daily basis show risk sensitivities at the following different levels of aggregation:

- line of business – [BPM1 and BPM2];
- trader; and
- strategy.

The target time for finalising the reports is 3pm. All reports are issued as final.

We report VaR to the desk on a business line level (at 95% confidence level, one day holding horizon), to senior management on both a business line and legal entity basis (at both 95% and 99% confidence level, one day holding horizon) and for regulatory capital on a legal entity basis (at 99% confidence level, 10 day holding horizon). To show diversification effects at any given reporting level, the VaR reporting system allows the MRM team to produce tailored or ad hoc reporting for a combination of trading books or portfolios. These show aggregated P&L and the VaR associated with the portfolio. The VaR methodology applied and risk sensitivities reported are consistent globally, however the local reporting format may vary.

## 2.7 Backtesting

### 2.7.1 Overview

Ensuring robustness of the model encapsulates two distinct requirements; first, to ensure that all material trading book exposures are being captured by the risk engine used to calculate VaR; and second, that the methodologies implemented for the subsequent VaR calculation are apposite and do, indeed, represent the likely maximum loss at a given confidence level.

Positions which are held in the Firm’s Trading Books & Records, and which are therefore feeding the P&L account, must also all be feeding into risk management and capital calculation systems. The intention is that there will be no difference between the portfolio of instruments covered by the VaR figure and those incorporated in the P&L measure used for backtesting. Were there to be positions which were not feeding into risk systems, over time we would expect to observe P&L events in excess of the forecast VaR, to an extent greater than that which would be expected statistically, given the model parameters.

Given our internal VaR methodology, which calculates VaR at a 95% confidence level over a 1-day holding horizon using historical simulation and data-histories over a 4-year look-back period, we would expect to see extreme losses in excess of our VaR forecast (termed “back-testing exceptions”) about 13 times per year. Greater incidences of back-testing exceptions than this could indicate that the VaR calculation was not fully capturing risk, either through missing positions, or else through not fully incorporating all risk-factors. Regardless of the cause, a surfeit of exceptions would indicate a potentially deficient VaR process and would trigger immediate action to further investigate the issues and correct any discovered deficiencies.

### 2.7.2 Back-testing Process

We back-test our internal VaR model against the subsequent clean P&L out-turn systematically on a daily basis using both 95% confidence level and 99% confidence level VaR forecasts. We take a time-series for the daily VaR forecasts and the corresponding clean P&L out-turns at the same level of the corporate hierarchy in order to carry out back-testing. Finance is responsible for supplying time-series of daily clean P&L at the following levels:

- line of business (i.e. BPM); and
- legal entity.

Risk Management are responsible for calculating VaR on a daily basis on a number of hierarchies, including the BPM, legal entity and by trader. At each level, VaR calculated for positions as of the close of business on day T is compared with the subsequent P&L out-turn for day T+2 on a daily basis.

At this point, all losses which exceed the VaR forecast are termed “potential back-testing exceptions” and are individually investigated as to the cause.

In cases where it is determined that the VaR engine was fed with incorrect positions, or that the data-histories used to calculate the VaR were incomplete, leading to a material understatement of the true VaR, the VaR calculation will be re-performed. If such re-calculation using correct data results in the VaR now being in excess of the loss, the potential back-testing exception shall be regarded as false and recorded as such, together with the explanation. False exceptions shall not contribute towards the aggregate of genuine back-testing exceptions.

Likewise, if it is determined that the P&L was materially misstated, resulting in a false potential back-testing exception, then the P&L will be corrected, and the exception not counted as genuine.

If investigation determines that both the P&L calculation and the VaR calculation are materially correct then the potential back-testing exception will be recorded as genuine, documented as such, and shall contribute to the aggregate of back-testing exceptions.

If, over time, the accumulated exceptions indicate that the VaR calculation is deficient (i.e. if we experience more than 15 genuine exceptions in any twelve-month period at any level of the corporate hierarchy for the 95% confidence level VaR forecast, or more than 3 genuine exceptions for the 99% confidence level VaR forecast) then the VaR calculation process will be examined by Market Risk Management and Quantitative Risk Management to ensure that material positions are not being omitted, and to ensure that the calculation methodology is embellished sufficiently to address any short-comings which may have caused VaR to be understated. We do not use any other methods for evaluating backtesting results.

Back-testing results and such actions as are deemed necessary for modification of the VaR model shall be documented by Risk Management.

# 3. Market Risk Exposures and ICAAP Capital Calculations

# 3 Market Risk exposures and ICAAP capital calculation methodologies

## 3.1 Summary of Market Risk Exposure as of cob 30 May 2008 at 10 day 99% plus Event Risk

| Legal Entity Var in $('000) for May 30, 2008 LBIE Global | | | | |
|---|---|---|---|---|
| **Business** | **Global VaR 95+%** | **Global VaR 99%** | **Global VaR 10 Day 99%** | **Event Risk** |
| **Fixed Income** | | | | |
| IR Products | 4,507 | 9,066 | 28,670 | 11,745 |
| Foreign Exchange | 801 | 1,223 | 3,866 | |
| High Grade | 3,257 | 5,647 | 17,858 | 74,385 |
| High Yield | 2,176 | 3,180 | 10,057 | 60,682 |
| Pipeline and Commitments | | | | |
| CDO | 1,384 | 2,080 | 6,577 | |
| Securitized Products | 1,449 | 3,128 | 9,890 | |
| Muni | 1,062 | 1,603 | 5,069 | |
| **Fixed Income TOTAL** | **8,191** | **12,161** | **38,456** | **146,812** |
| **Equities** | | | | |
| Cash | 6,727 | 14,604 | 46,181 | |
| Convertibles | 902 | 1,566 | 4,953 | 125,777 |
| Volatility | 7,421 | 11,593 | 36,661 | 46,866 |
| Equity Strategies | 3,610 | 5,923 | 18,730 | 62,210 |
| Portfolio | 758 | 1,261 | 3,987 | |
| Event Driven | 172 | 251 | 793 | |
| Emerging Markets | 12,080 | 17,611 | 55,692 | |
| Quants | 3,174 | 6,038 | 19,095 | |
| Latin America | | | | |
| **Equities TOTAL** | **12,007** | **19,153** | **60,566** | **234,853** |
| **Prime Services** | | | | |
| Firm Financing | 2,353 | 5,318 | 16,816 | |
| **Prime Services TOTAL** | **2,353** | **5,318** | **16,816** | |
| **Principal Investing Portfolio** | | | | **42,400** |
| Global Principal Strategies | 32 | 63 | 199 | |
| Global Trading Strategies | 3,937 | 5,709 | 18,053 | |
| **Principal Investing Portfolio TOTAL** | **3,915** | **5,682** | **17,968** | **277,253** |
| **Firm Wide TOTAL** | **17,045** | **23,499** | **74,311** | **424,065** |

## 3.2 ICAAP capital calculation for Market Risk

For ICAAP capital purposes, we use a "regulatory plus" calculation with the following components:

| **Components** | **ICAAP Capital** |
|---|---|
| **VaR x 4** | **297,245** |
| **Event Risk** | **424,065** |
| **Estimate for potential changes to risk methodologies** | **120,000** |
| **Total Market Risk for ICAAP purposesl** | **841,310** |

- **VaR for 99% 10 day scaled up**

The one-day, one-tailed VaR at a 99% confidence level is calculated from the simulated P&L vector directly and is multiplied by a factor of √10 to obtain the 10day 99% VaR. For the market risk ICAAP capital calculation, the 10 day 99% VaR is multiplied by as estimated CAD

II multiplier of 4. The factor of 4 is used for the legal LBIE entity as the VaR models have not been approved by the FSA as yet. This multiplier will be amended as and when CAD II is granted.

- **Event Risk**

Event Risk calculated using the Lehman Brother's event risk models to capture stress and "gap risks" which go beyond potential market risk losses as described above. Aggregation within business unit is either using the Monte Carlo simulation model or a zero correlation assumptions (sqrt of sum of squares). Aggregation across business units is performed using a simple sum i.e. no offset is permitted across business units. The above event risk estimate ($435k) is different to the one I sent before (~$230k). So not sure about the exact methodology employed for that estimate. Before the methodology was: (Note issue is that LR does not support the ER for LBIE in credit businesses at the moment hence we regress LBIE ER against the JTD charge for LBI for the credit businesses)

- For the credit businesses: Compute the implied correlation of the JTD capital charge in *LBI*. If the implied correlation *w* is positive it is used as the weight factor in the linear convex combination of the zero correlation and perfect correlation 95% LBIE event risk estimates. No diversification benefit is given in the LBIE event risk calculation. Hence the zero correlation event risk estimate for LBIE is the lower limit for the total LBIE 95% event risk estimate – even if the implied correlation in LBI JTD charge is negative.
- For the equity businesses, different event risk types (Deal Break and Credit event risk) are aggregated by the sqrt of the sum squares.
- Only the positions in GTS as parts of PIP are exposed to event risk, for which the same applies as stated before for equities.

In all instances the normality assumption is used to scale the 95% loss quartile to 99.5% loss quartiles.

- **Estimate for potential changes to the VaR and Event Risk Methodologies**

This is an estimate for the following:

  - Potentially certain risks that are currently not captured in the VaR model due to materiality or the lack of infrastructure support;
  - Potential changes to the trading book capital requirements with regard to event risk (also called Incremental Event Risk Charge). The banking industry is currently in consultation with the regulators about the detail of this charge but it is most likely to lead to an increase in the trading book capital charge by the end of 2008. Our event risk charge is based on an internal model and does not as yet take into account any potential regulator add-on which we have estimated for in this charge.

- **Total Market Risk for ICAAP purposes**
  - The sum of the scaled up 99% 10 day VaR plus the Event Risk calculation plus the estimate for potential changes to risk methodologies forms the Pillar 1 Market Risk number reported in the ICAAP Capital.

# 4. Stress and Scenario Testing

# 4 Stress and scenario testing

## 4.1 Introduction

Of great concern to senior management is the vulnerability of the Firm to exogenous shocks which may give rise to extreme market moves, such as those during the global stock market crash in 1987, or the Russian default and subsequent liquidity crisis surrounding LTCM in 1998. Equally relevant are scenarios in which the Firm's ability to access liquidity and credit are impaired, such as may be caused by a rating downgrade for the Firm, or an inability to access capital markets for unsecured short-term funding.

To address such concerns we subject the Firm's overall portfolio to a number of coherent macro-economic scenarios in which pertinent market factors are shocked by extreme, although plausible amounts. The scenarios which are relevant at any particular time will be driven by the nature of our exposures. To determine the plausible shock-factors to apply to our portfolios we draw upon our experience of historic events. Although stress events, by their nature, are relatively rare, and history is not bound to repeat itself exactly, we use examples of historical events as a means of judging the magnitudes of plausible shock-factors and the extent of plausible correlation changes. Correlation changes during extreme market events may be very significant, which implies that stress test results may not be deduced merely by taking multiples of VaR.

## 4.2 Definition of Scenarios

The Firm currently calculates the following:

- 10 scenarios different scenarios, covering a range of different market shocks for market and counterparty credit risk.
- 3 scenarios for counterparty credit risk covering sovereign risk shocks on FX and interest rates and an operational risk event;
- 4 additional market risk shocks covering systemic market risk dislocations such as a liquidity crisis or an oil supply crisis.

Details of these scenarios are detailed in the Appendix.

New scenarios are added to the scenario listing as and when market events indicate that a new scenario is needed due to changing market conditions. The most recent addition is a scenario depicting the recent credit crunch.

## 4.3 Use of stress testing

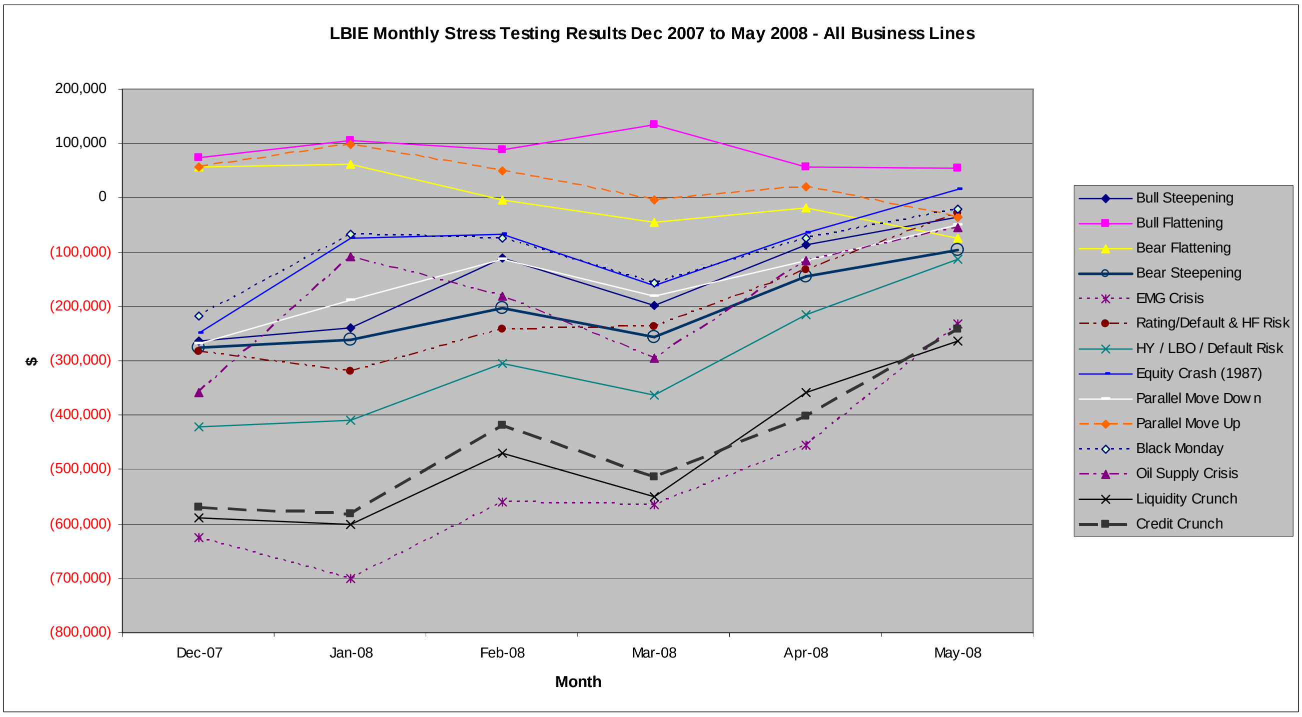
The scenarios are run on a monthly basis for LBIE and for the Europe Region, using the same feeds and positions as used for the VaR model. These results are broken down by regions as well as by business. The LBIE scenario results are sent to management within risk and to the FSA on a monthly basis.

The firm-wide results are evaluated in detail on monthly basis and are submitted to the following users:

- Board of Director meetings;
- Audit Committee meetings;
- Weekly meetings of the Executive Committee and senior risk managers;
- Discussions with the individual businesses regarding risk;

- Rating agency presentations/discussions;
- Meetings with regulators (e.g. SEC).

Below are 6 months of stress testing results for LBIE for all scenarios showing a decreasing trend for losses arising from adverse market moves due to the deleveraging of balance sheet across the firm in general during the second quarter of 2008.



# 5. Appendices

# 5 Appendices

## 5.1 Appendix A - Market Risk Positions and Limits

Incorporate standard reports showing utilisation of the 1 day 99% VaR against limits.

| LBIE Report in $('000) for May 30, 2008 vs. May 29, 2008 LBIE Global | | | | | |
|---|---|---|---|---|---|
| **Business** | **Global VaR Today** | **Global VaR Prior** | **Global VaR Change** | **Limit** | **Utilisation %** |
| **LBIE Report** | | | | | |
| **Prime Services** | | | | | |
| Firm Financing | 2,353 | 2,479 | -125 | | |
| **Prime Services TOTAL** | **2,353** | **2,479** | **-125** | | |
| **Fixed Income** | | | | | |
| **IR Products** | | | | | |
| Government | 2,840 | 2,425 | 415 | | |
| Derivatives | 2,574 | 2,220 | 354 | | |
| Rates Prop | 22 | 22 | 0 | | |
| FX Prop | 154 | 205 | -51 | | |
| **IR Products TOTAL** | **4,507** | **3,472** | **1,036** | | |
| Foreign Exchange | 801 | 692 | 109 | | |
| **High Grade** | | | | | |
| HG EMG | 2,399 | 2,635 | -236 | | |
| **HG Loan Total** | | | | | |
| HG Trading | 1,634 | 1,779 | -145 | | |
| **High Grade TOTAL** | **3,257** | **3,668** | **-411** | | |
| **High Yield** | | | | | |
| HY EMG | 452 | 472 | -20 | | |
| HY Trading | 2,102 | 2,168 | -66 | | |
| **HY Loan Total** | | | | | |
| **HY Loan Total TOTAL** | | | | | |
| **High Yield TOTAL** | **2,176** | **2,211** | **-34** | | |
| CDO | 1,384 | 1,179 | 205 | | |
| **Real Estate** | | | | | |
| PTG | | | | | |
| CMBS | 1,284 | 1,205 | 79 | | |
| **Real Estate TOTAL** | **1,284** | **1,205** | **79** | | |
| **Muni** | | | | | |
| Cash | 0 | 0 | 0 | | |
| Derivatives | 1,062 | 1,109 | -46 | | |
| Muni GIC | | | | | |
| **Muni TOTAL** | **1,062** | **1,109** | **-46** | | |
| FID Corp | | | | | |
| **Securitized Products Total** | | | | | |
| ABS | 1,449 | 1,478 | -28 | | |
| Non Residential | | | | | |
| **Securitized Products Total TOTAL** | **1,449** | **1,478** | **-28** | | |
| **Fixed Income TOTAL** | **8,191** | **8,219** | **-28** | **19,000** | **43** |
| **Equities + Principal Investing Portfolio** | | | | | |
| **Equities** | | | | | |
| Cash | 6,727 | 5,674 | 1,054 | | |
| Convertibles | 902 | 965 | -63 | | |
| Volatility | 7,421 | 6,463 | 957 | | |
| Equity Strategies | 3,610 | 3,629 | -18 | | |
| Portfolio | 758 | 759 | -1 | | |
| Event Driven | 172 | 174 | -2 | | |
| Emerging Markets | 12,080 | 11,712 | 368 | | |
| Quants | 3,174 | 3,089 | 85 | | |
| Latin America | | | | | |
| **Equities TOTAL** | **12,007** | **13,115** | **-1,108** | | |
| **Principal Investing Portfolio** | | | | | |
| Global Principal Strategies | 32 | 470 | -437 | | |
| **Global Trading Strategies** | | | | | |
| Equity | 3,061 | 3,019 | 42 | | |
| Credit | 1,809 | 1,809 | 0 | | |
| **Global Trading Strategies TOTAL** | **3,937** | **3,902** | **35** | | |
| Global Opportunity Group | | | | | |
| **Principal Investing Portfolio TOTAL** | **3,915** | **4,049** | **-133** | | |
| **Equities + Principal Investing Portfolio TOTAL** | **12,515** | **12,362** | **153** | **21,000** | **60** |
| **LBIE Report TOTAL** | **17,045** | **16,830** | **215** | **30,000** | **57** |

## 5.2 Appendix B – Risk Reports

The main risk reports for Europe region are:

A European Region report showing VaR, Risk Appetite, Stress scenarios and other position level information. The filename of this report is LONRISK.xls and is sent to the FSA every month end.

A LBIE legal entity report showing VaR, Risk Appetite, Stress scenarios and other position level information. The file with this report is called LBIERISK.xls and is sent to the FSA every month end.

## 5.3 Appendix C – Stress and Scenario Tests

Below is a fuller explanation of the definition of the standard scenarios.

**10 Scenarios Applied to Market / Counterparty Credit Risk**

- **Bull Steepening** – Modelled after post 9/11, Flight to Quality (11 September 2001 – 25 September 2001)

- **Bull Flattening** – Modelled after the period before the major rates backup in the summer of 2003. Generally strong market tone across all asset classes due to signs of economic recovery and low inflation expectations, but reduced demand for energy (1 May 2003–15 May 2003)

- **Bear Flattening** – Treasury down trade caused by asset reallocation and yield searching. Spreads generally moderately tightened, and Equity and high yield asset classes outperformed others (modelled after the period 30 October 2001–14 November 2001)

- **Bear Steepening** – Modelled after post LTCM (28 September 1998–13 October 1998)

- **EMG Crisis** – Market meltdown driven by EMG (Russian default) with spiked idiosyncratic risk, higher defaults, higher correlations, falling energy demand (modelled after the period 17 August 1998–30 August 1998)

- **Rating / Default and Hedge Fund Risk** – Significant rating risk (e.g. GM), one name default in CDX or HVOL coupled with hedge fund blow-out on structured credit products causing panic selling, significant market widening with CDS basis gapping out (modelled after the period 18 July 2002–2 August 2002)

- **HY / LBO / Default Risk** – Global default rate increase coupled with lower recovery. Investor demand dries up after "hot" market, leading to a longer syndication time line or no syndication in large LBO or M&A loan deals (modelled after the period 16 September 2002–17 October 2002)

- **Equity Crash (1987)** – Weakening US dollar, deteriorating US current account deficit, escalating US government debt, High P/E's low dividend yields (modelled after the period 5 October 1987–19 October 1987)

- **Parallel Move Down** – Modelled after Post 9/11 Flight to Quality (11 September 2001 – 25 September 2001)

- **Parallel Move Up** – Similar to 30 October 2001–14 November 2001 period

**For Counterparty Credit Risk, the following scenarios are also adopted:**

- **Avian Flu** – Simulation of a catastrophic event such as an Avian Flu pandemic

- **Country Risk FX** – Sovereign risk shock of spot FX exchange rate and interest rate based on country currency tier

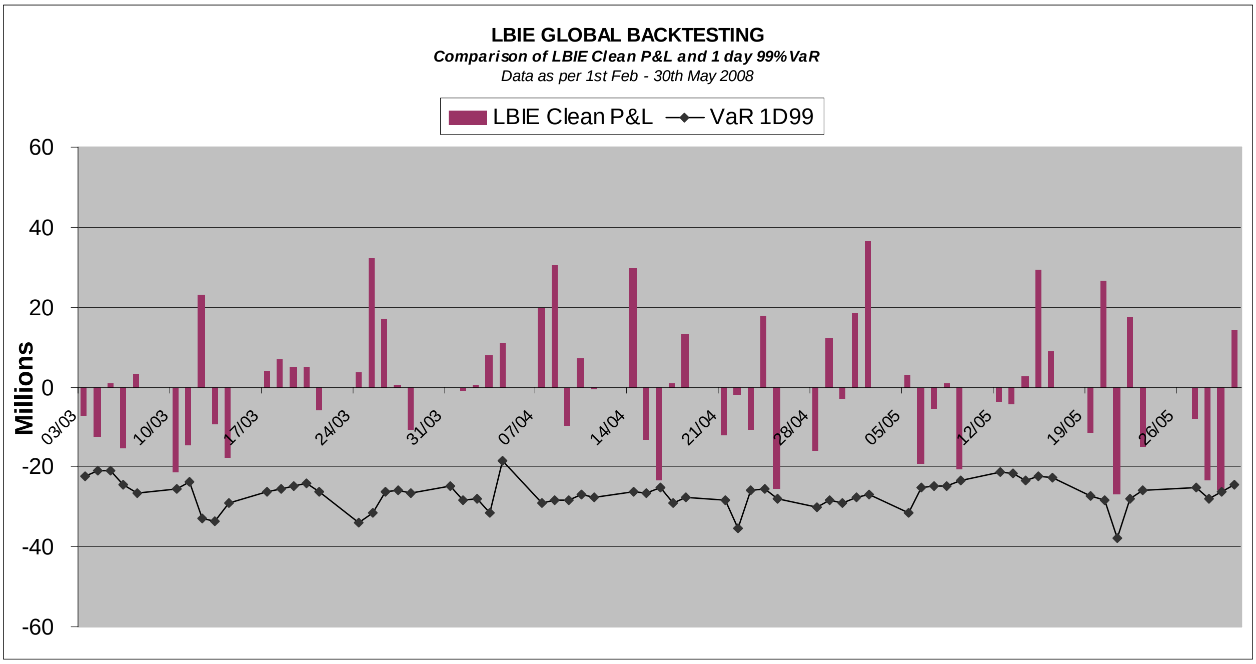
- **Country Risk IR swap** – Sovereign risk shock of interest rate based on country currency tier

**For Market Risk, the following scenarios are also adopted:**

- **Black Monday –** Modelled after 10/16–10/19 1987
- **Oil Supply Crisis –** Major oil supply disruption at the source, with great uncertainty around supplies returning to normal levels in the near future
- **Liquidity Crunch –** Hawkish Federal Reserve and major Central Banks continuing on a path of raising rates, draining the extra liquidity enjoyed previously, resulting in a decline in the risky assets and spread products.
- **Credit Crunch –** Widening of credit spreads similar to but not limited to what was seen during July-August 2007.

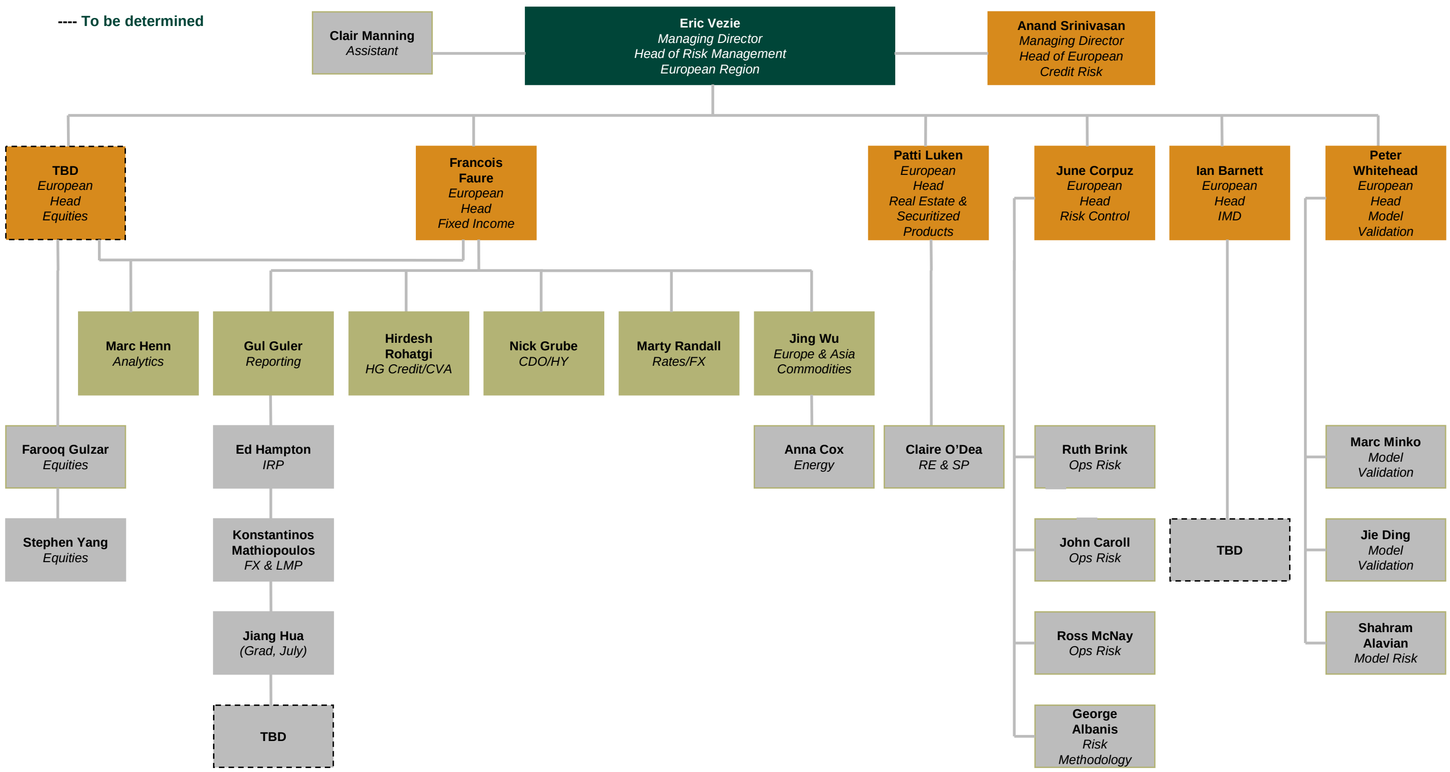
## 5.4 Appendix D – LBIE Backtesting Reports

No back-testing exceptions in LBIE legal entity.



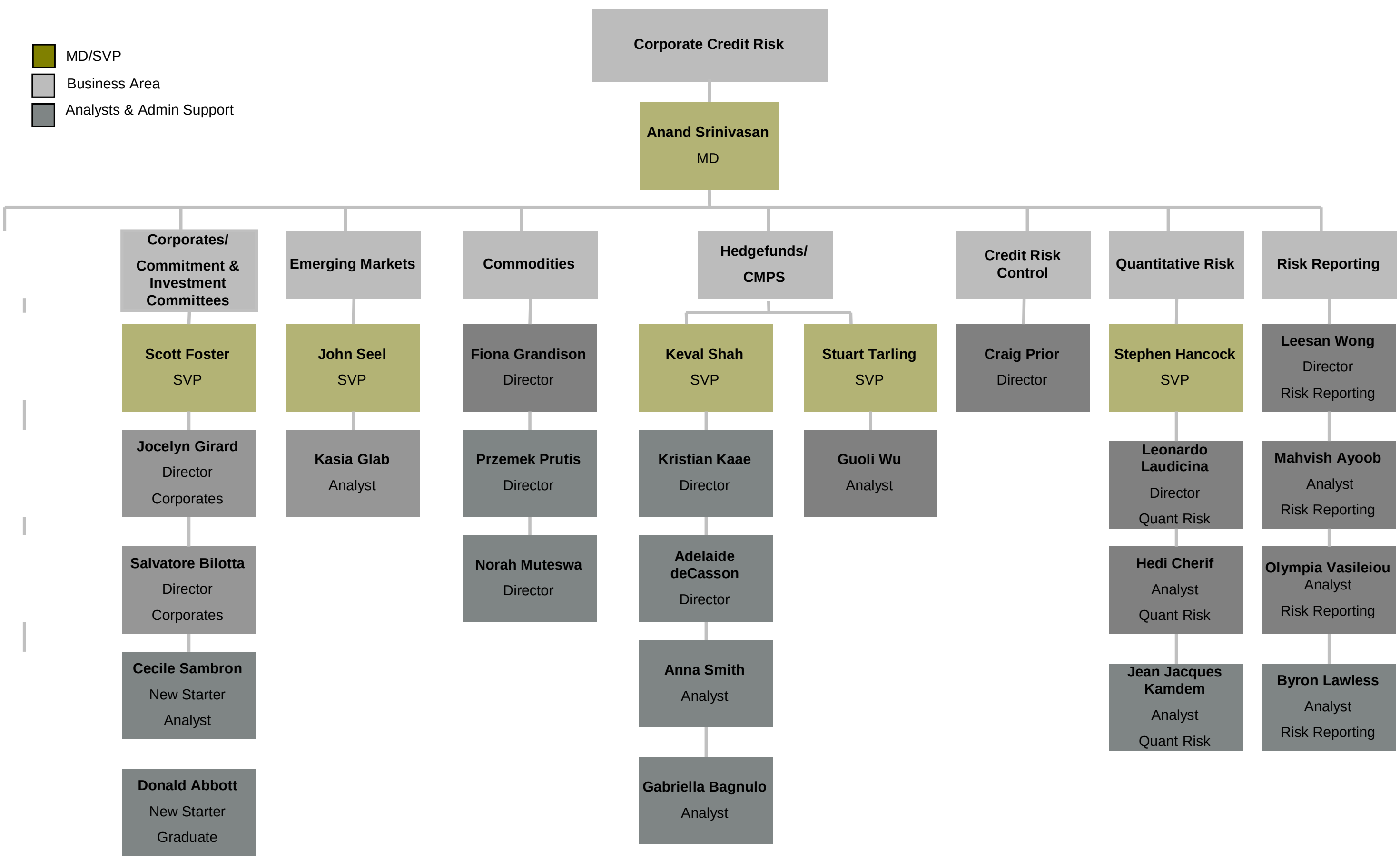
## 5.5 Appendix E – European Risk Organisation Chart

### a) European Market Risk Organisation Chart



## 5.6 Appendix E – European Risk Organisation Chart

### b) European Credit Risk Organisation Chart



## 5.7 Appendix F – Market Risk Management Limit Policy

Refer to Lehman Brothers Market Risk Management Limit Policy, as held by the Market Risk Management team.