Confidential

Risk Management

SEC Risk Appetite, Risk Equity Review for CSE

May 24th , 2005

LEHMAN BROTHERS

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BY LEHMAN BROTHERS HOLDINGS INC.

Agenda

- Risk Appetite
  - Risk Appetite Limit
  - Risk Appetite Usage and Measurement
    - Market Risk
    - Event Risk
    - Risk Aggregation
- Risk Equity
- Market Data
- Single-Transaction Limits

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Risk Management Integrated Framework

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Risk Management Integrated Framework

Risk Appetite is the revenue the Firm is "prepared to lose" in a year from market, event and counterparty credit risks.

Daily VaR

95% confidence

One day horizon

Market Risk

Pre-tax

Risk Appetite

95% confidence

One year horizon

Market Risk
Event Risk
Credit Risk

Pretax

Equity Requirement

99.5% confidence

One year or longer horizon

Market Risk
Event Risk
Credit Risk
Regulatory Capital
Operating Risk
Legal Risk
Corporate Assets

After Tax

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Risk Appetite

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Risk Appetite

Risk Appetite Limit

- We have established a framework for determining the most appropriate overall level of risk the Firm should be taking.
- The framework begins with the amount of revenue the Firm would make in a downturn and is designed to balance risk and return:
  - our aim is to deploy enough risk in our businesses to generate strong cross-cycle returns,
  - while at the same time limiting risk levels to ensure we meet our financial targets.
- We have defined this level of risk as our risk appetite, which represents the quantity the Firm is "prepared to lose" in a year from market and counterparty credit risk, as well as from stress events.
- In calculating our overall risk appetite, our goal is to maintain a minimally acceptable ROTE and compensation adequacy including maintaining sufficient headcount to protect the franchise for the long-term.
- The overall risk limit is driven by Risk Appetite which is approved by the Executive Committee on an annual basis and is reviewed quarterly for requisite changes.

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Risk Appetite

Risk Appetite Limit

- We start with our financial targets.
- We take into account a potential simultaneous slowdown in customer flow and banking activities (origination/advisory) which would negatively impact our financial targets since revenue shortfalls can also come from non-risk taking activities.
- Then we subject ourselves to two constraints:
  - maintaining a minimally acceptable annual ROTE
  - ensuring compensation adequacy including maintaining sufficient headcount to protect the franchise for the long-term.

Budget Revenue → Less →

- Potential revenue losses in customer flow and banking activities (origination/advisory)
- Revenues needed to
  - maintain a minimally acceptable annual ROTE
  - ensure compensation adequacy

= Risk Appetite Limit

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Risk Appetite

Risk Appetite Usage

- Risk appetite usage is measured on a globally consolidated basis and reported on a daily basis against our risk appetite limit.
- Risk appetite usage is composed of:
  - Market Risk
  - Event Risk
  - Counterparty Credit Risk

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Risk Appetite

Market Risk/VaR

- Market Risk measures the potential mark-to-market loss on all positions from adverse market moves.
  - We use historical simulations to determine what would have been the P&L impact on today's portfolio.
  - This approach allows us to avoid making assumptions about distributions, about diversification, about relative risk factor weightings.
  - We apply an exponential 10% per month decay factor weighting scheme to the data to emphasize more recent history.
  - Market risk is composed of linear, non-linear, and issue-specific risks.
  - Market Risk component in Risk Appetite is scaled from one-day VaR.

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Risk Appetite

Market Risk/VaR

- Linear risk
  - Linear risk is measured by calculating the sensitivities of all products to the relevant risk factors – the level and shape of the yield curves, credit spreads, basis, foreign exchange, etc. – and then simulating a walk-back through time to determine the P&L impact of changes in these relevant risk factors on the current portfolio.

$$[\text{Historical Time Series}] \times [\text{Sensitivity Vector}] = [\text{Simulated P \& L}]$$

$$\begin{array}{c} \begin{array}{cccc} \underline{\text{O/N}} & \underline{\text{1Yr}} & \cdots & \underline{\text{30Yr}} \end{array} \\ \begin{bmatrix} D_1 & D_1 & \cdots & D_1 \\ D_2 & D_2 & \cdots & D_2 \\ & & \cdots & \\ \vdots & \vdots & & \vdots \\ D_N & D_N & \cdots & D_N \end{bmatrix} \end{array} \times \begin{bmatrix} S_{O/N} \\ S_{1Yr} \\ \vdots \\ S_{30Yr} \end{bmatrix} = \begin{bmatrix} P\&L_1 \\ P\&L_2 \\ \vdots \\ P\&L_N \end{bmatrix}$$

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Risk Appetite

Market Risk/VaR

- Non-linear risk
  - Non-linear risk is computed based upon the stress matrices of P&L changes provided by the front-office pricing systems for various derivative products. The stress matrices of a portfolio are generated by stressing two major risk factors at a time and revaluing the whole portfolio. Then bi-linear interpolations are used to obtain nonlinear P&L vectors.

	Change in Underlying Benchmark Interest Rate									Historical Time Series		Simulated P&L
		-100bp	…	-10bp	-5bp	0	+5bp	+10bp	…	+100bp	Rates	Volatility	
Change in Volatility	+2.0	Simulated P&L Rates ↓ Vol ↑					Simulated P&L Rates ↑ Vol ↑				day1 day2 ⋮ day *N*	day1 day2 ⋮ day *N*	day1 day2 ⋮ day *N*
	+1.5												
	+1.0												
	+0.5												
	0					0							
	-0.5	Simulated P&L Rates ↓ Vol ↓					Simulated P&L Rates ↑ Vol ↓						
	-1.0												
	-1.5												
	-2.0												

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Risk Appetite

Market Risk/VaR

- Issue-specific risk
  - Issue-specific risk captures the idiosyncratic risk of individual issues. It is assumed to be normally distributed and independent of other risk factors.
  - For equity securities, issue-specific risk arises when there are insufficient historical data (<4 years).
    - The security is mapped to an appropriate index.
    - A regression is run for the 60-day historical data of the security and the proxy index.
    - The market component of the risk is obtained by applying the beta of the regression to the historical time series of the index.
    - The issue-specific component of the risk is estimated from the regression error.

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Risk Appetite

Market Risk/VaR

- Issue-specific risk
  - For fixed income securities, issue-specific arises in the cases of high grade and high yield securities where historical indices of credit spread and bond price are used in the historical simulation.
    - The dispersion of the constituent bonds in each index is used to estimate the issue-specific risks.
    - For each bond (*i*) in an index bucket, for example an HG bucket, we compute the tracing error of the spread change between two dates:

$$s^i_{t2} - s^i_{t1} = I_{t2} - I_{t1} + \varepsilon^i_{t2}$$

    - The standard error for all the bonds in the index bucket can be computed:

$$\delta_{t2} = \sqrt{\mathrm{Var}(\varepsilon^i_{t2})}$$

    - We repeat the above steps for a number of time periods. The average standard error is used to measure the issue-specific risk for the bonds in the index.

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Risk Appetite

Market Risk/VaR

- Government Bonds
  - The risk factors are par yields of different yield curves:
    - by currency and maturity
    - on-the-run treasuries, first off-the-run treasuries, constant maturities treasuries, on-the-run agencies, off-the-run agencies
    - Volatility for callable bond
  - In JGB market, there is a significant dispersion of yields around the splined yield curve for various reasons, such as preference towards high coupons, taxation, accounting, deliverability criteria and so on.
    - We divide the population of bonds into 16 groups:
      - super-long bonds (>10 year)
      - 15 pairs: 5 maturity buckets X 3 yield buckets (high, medium, low)
    - For each bond in each group, we measure the spread between its yield and the corresponding yield on the splined yield curve of the same maturity bucket. We assume that spread is normally distributed.
    - We can then estimate the variance of the spreads from historical data. The final P/L distribution of a portfolio of bonds can be estimated by convoluting the two components (yield curve and spread).

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Risk Appetite

Market Risk/VaR

- Interest Rate Derivatives
  - Risk factors include:
    - par yields of Libor curve at various maturity buckets
    - implied volatility
    - basis risk for basis swaps based on indices other than 3M Libor such as Fed Fund, Prime, CP, 1M Libor etc.
  - Non-linear risk is captured via revaluation stress matrices:
    - We stress the relevant yield curve by 11 parallel shifts of amounts ranging from –100bp to +100bp.
    - We stress the volatility level by 9 shifts of amounts ranging from –2 vols to +2 vols.
      - Above shifts are applied to pivotal vol points (e.g. 5y x 10y swaption). Regression is run to calibrate the beta weighting of the rest of the points on the vol surface.

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Risk Appetite

Market Risk/VaR

- Inflation Products
  - The main risk factor is the breakeven spread (ie nominal yield less real yield).
  - Market Data
    - For EUR denominated products, we use two French government bonds (Oatei 12 - referenced to Euro inflation) and Oati09 (referenced to French inflation) and an ITL 5-year breakeven swap time series.
    - For the USD denominated products, we use TIPS Jan 2010.

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Risk Appetite

Market Risk/VaR

- Residential Mortgages
  - The key risk factors are:
    - Interest Rates – 4 key rate durations (2yr, 5yr, 10yr, 30yr) are used with the appropriate benchmark curve (Swaps, Treasury or Agency)
    - IR Volatility – 5y x 10y swaption volatility is used
    - OAS – LIBOR OAS is the primary factor, with all products mapped to a number of time series:
      - FNMA and GNMA TBA, 30 yr and 15 yr mortgages ranging from 4.5% to 11
      - Strip Trust IO/PO of 5% to 8
      - CMOs use underlying collateral OAS multiplied by a convexity based factor of .75 to 1.25
      - Non-Agencies use TBA OAS + a non-agency spread
      - Sub Prime uses nominal credit spreads from HEL benchmarks
  - Non-linear Risk is estimated using stress matrix revaluation approach by shifting interest rate and volatility.
  - Prepayment risk is incorporated and is an integral part of the OAS and revaluation.

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Risk Appetite

Market Risk/VaR

- Commercial Mortgages
  - Main risk factors are interest risk and spread risk.
    - Conduit whole and large loans
      - The interest rate component is estimated from IR01s and changes in swap curves bucketed by maturity.
      - The spread component is estimated from the spread sensitivities and changes in the composite (based on recent securitizations) CMBS spread time series.
    - CMBS secondary securities
      - The interest rate component is estimated from IR01s and changes in swap curves bucketed by maturity.
      - The spread component is estimated from the spread sensitivities and changes in CMBS spread index curves bucketed by rating, maturity, fixed vs. floating.

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Risk Appetite

Market Risk/VaR

- Asset Backed Securities
  - Main risk factors are interest risk and spread risk.
    - The interest rate component is estimated from IR01s and changes in swap curves bucketed by maturity.
    - The spread component is estimated from the spread sensitivities and changes in ABS spread index curves bucketed by collateral type, rating, maturity, fixed vs. floating.

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Risk Appetite

Market Risk/VaR

- High Grade Credit Products
  - Main risk factors are interest rate and credit spread.
    - The interest rate risk component is estimated by multiplying the interest PV01 by the historical daily changes in the yields, bucketed by currency and maturity.
    - The systematic component of credit spread risk is estimated by multiplying the spread PV01 by the historical daily changes in index credit spreads, bucketed by currency, credit rating, industry, and maturity.
    - The issue specific component of the credit risk is estimated from the dispersion of the credit spreads of individual constituent bonds in an index bucket.

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Risk Appetite

Market Risk/VaR

- High Yield Credit Products
  - Risk factor is the bond prices.
    - The systematic component of the risk is estimated by applying the current market value of our positions to the historical daily percent changes in the price of high yield indices, bucketed by rating.
    - The Issue specific component is estimated from the dispersion of the bond prices of individual constituent bonds in an index bucket.
    - For high yield loans, we use the bond times series as a proxy, adjusted for the (generally lower) volatility of loans by the beta of the regression of loan historical time series against the bond time series.

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Risk Appetite

Market Risk/VaR

- Municipals
  - Muni Cash
    - Primarily risk factor is muni basis risk, i.e. muni bonds performance relatively to treasury.
    - Muni bonds are mapped into different rating and maturity. Treasury hedges are mapped to treasury curves.
  - Derivatives
    - Primarily risk factor is BMA basis risk, i.e. relative performance of BMA swap yields vs. Libor swap yields.
    - We use historical BMA swap rates , Libor swap rates to simulate daily P&L.
    - Non-linear risk is incorporated through stress matrices approach.

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Risk Appetite

Market Risk/VaR

- FX Products
  - Main risk factors are spot fx rates, interest rates, and spot fx volatilities for all currency pairs.
  - For the linear (non-option) positions, historical daily spot fx and interest rate changes are multiplied by the spot fx (delta) and interest rate (PV01) sensitivities.
  - For the options positions, non-linear risk is captured through stress matrices approach.

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Risk Appetite

Market Risk/VaR

- Equity Cash Products
  - Current MTM is directly multiplied by the percentage changes of historical stock prices.
  - For a stock with less than 4 years of historical prices, it is first mapped to a proxy index.
    - If there is at least 60 days of the stock price history available, regression is used to deduce the movements in the stock price by the movements in the proxy index.
      - The beta of the regression is used for the index component of the risk associated with the stock position.
      - The regression error is the issue-specific risk.
    - If less than 60 days of prices history is available, a default or manual value of beta and issue-specific risk are assigned.
    - Issue-specific risk is assumed to be independent of other risk factors and to have a normal distribution.

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Risk Appetite

Market Risk/VaR

- Equity Derivatives
  - Main risk factors are the price of the underlying asset and its volatility.
  - Non-linear risk is captured using stress matrix approach.

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Risk Appetite

Market Risk/VaR

- Convertibles
  - The risk of a convertible security can be approximated decomposing to an equity component and a fixed income component.
  - The equity component is estimated by a similar method for equity derivatives.
    - Currently for CB non-linear risk is estimated using Taylor Series Expansion rather than stress matrix.
  - The fixed income component is estimated using either the High Grade credit method or High Yield credit method, depending on the rating,. b

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Risk Appetite

Market Risk/VaR

- VaR
  - VaR is one component of Risk Appetite.
  - Granularity
    - Calculation is “bottom-up” from position or book level.
    - Slice and dice by trader, desk, risk factors, maturities, etc.
  - Scope – what’s not captured or not captured well
    - Correlation risk – currently developing stress measures
    - Skew – lack of market data
    - Tax risks for Muni Alt-tax swaps
    - Actual rate risk for actual rate muni swaps
    - Curve risk and basis risk (bonds vs. derivatives) for inflation products

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Risk Appetite

Market Risk/VaR

- VaR Reporting
  - daily reported to respective business and senior management
  - included in weekly risk package to Risk Committee and Executive Committee, which includes the CEO
  - monthly reviewed with SEC
  - quarterly reported in financial reports

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Risk Appetite

Event Risk

- Event risk measures stress and “gap risks” which go beyond potential market risk losses. We measure these risks using stress analyses which capture losses associated with
  - defaults for high yield
  - downgrades for high grade
  - property value losses on real estate
  - deal break risk for merger arbitrage strategies
  - defaults for sub-prime mortgage loans
  - dividend risk for equity derivatives
  - gap risk for fund derivatives

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Risk Appetite

Event Risk

- Default Risk for High Yield
  - Probability of default is based on rating agencies' historical transition matrix.
  - Loss upon default is estimated as market value less recovery.
  - Recovery rate is based on rating agencies' studies of historical recovery, or internal research information if available.
  - Defaults across different issuers are assumed independent.
  - The portfolio loss distribution is obtained using binomial probability distribution. The loss at the desired confidence level (95% for Risk Appetite purposes) is calculated.

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Risk Appetite

Event Risk

- Default Risk for High Yield – Binomial Probability Distribution

Bond	"ABC"	"XYZ"	"KLM"
Rating	Ba	B	Baa
Default Probability	1.23%	6.80%	0.14%
No Default Probability	98.77%	93.20%	99.86%
Position Market Value ($MM)	26.0	16.0	30.0
Exposure after 30% Recovery ($MM)	17.6	10.6	21.0

Establish every possible outcome with joint probabilities

Possible Combinations ($2^3 = 8$)	Loss Table			Number of Bonds Default	Portfolio Exposure ($MM)	Joint Probability
1	17.6	10.6	21.0	3	49.0	0.00012%
2	17.6	10.6	-	2	28.0	0.08352%
3	17.6	-	21.0	2	38.6	0.00180%
4	-	10.6	21.0	2	31.6	0.00940%
5	17.6	-	-	1	17.6	1.14478%
6	-	10.6	-	1	10.6	8.70988%
7	-	-	21.0	1	21.0	0.12988%
8	-	-	-	0	0.0	91.92476%

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Risk Appetite

Event Risk

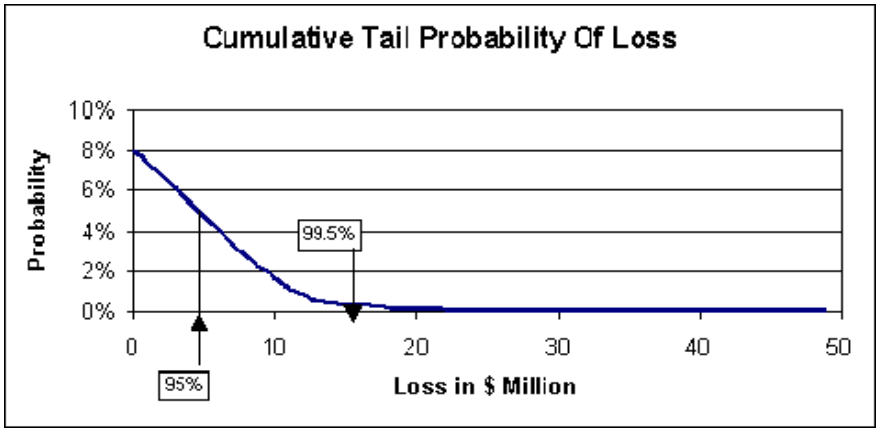
- Default Risk for High Yield – Binomial Probability Distribution

Exposure Sorted in Descending Order

Portfolio Exposure ($MM)	Joint Probability	Cumulative Probability
49.0	0.00012%	100.00000%
38.5	0.00160%	99.99988%
31.5	0.00940%	99.99828%
28.0	0.03352%	99.98888%
21.0	0.12888%	99.95536%
17.5	1.14476%	99.77648%
10.5	6.70896%	98.33172%
0.0	91.32476%	91.32476%

99.5% CI (0.5% Tail)

95% CI (5% Tail)



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Risk Appetite

Event Risk

- Downgrade Risk for High Grade
  - One letter rating downgrade is considered.
  - Probability of downgrade is based on rating agencies' historical transition matrix.
  - Loss upon downgrade is estimated as the P/L impact due to the widening of the spread.
  - Downgrade events across different issuers are assumed independent.
  - Portfolio loss distribution as well as at the desired confidence level is calculated similarly as in High Yield default risk.

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Risk Appetite

Event Risk

- Property Value Losses on Real Estate
  - For real estate and related loans, we measure the capital value loss due to real estate downturns .
  - We use a "historical simulation" approach to determine the P/L impact of shocks in the real estate market on today's portfolio.
    - Revalue each property to simulate P&L impact (only loss amounts are taken) => P&L vector:

$$\begin{bmatrix}\text{Market Value}\\ \text{of Property}\end{bmatrix} \times \begin{bmatrix}\text{Historical Time Series of}\\ \text{Property Value Changes}\end{bmatrix} - \begin{bmatrix}\text{Senior Debt}\\ \text{if applicable}\end{bmatrix} - \begin{bmatrix}\text{Lehman Loan}\\ \text{MTM Basis}\end{bmatrix} = \begin{bmatrix}\text{Simulated P \& L for each loan}\end{bmatrix}$$

    - Aggregate losses across property types within a region => P&L vector
    - Aggregate across regions using assuming zero correlation across different regions using a procedure similar to High Yield defaults => Joint probability distribution => Loss at the desired confidence level

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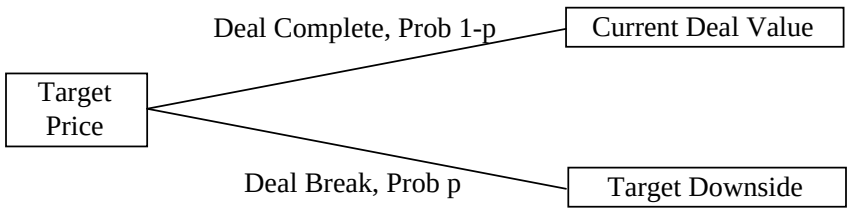
Risk Appetite

Event Risk

- Deal Break Risk for Merger Arbitrage Strategies
  - If deal breaks, target and acquirer are assumed to experience the reverse of percentage price movements at deal announcement.
  - Probability of deal break is estimated by assuming that current target price is the expected value of deal complete value and deal break value.



$$S_{Target} = (1-p) \times current_deal_value + pS_{Target}(1 - initial_premium) \;\; => p$$

  - Events across different M&A deals are assumed independent.
  - Portfolio loss distribution as well as at the desired confidence level is calculated similarly as in High Yield default risk.

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Risk Appetite

Event Risk

- Defaults for Sub-prime Mortgage Loans
  - We approximate a credit stress by assuming a 25% reduction in market value in the non-rated retained exposures.
  - For whole loans we assume 4% of the capital structure would be equivalent to the non-rated portion.
  - We believe this is conservative since the majority of the non-rated portion is typically securitized in a NIM transaction the month following the initial securitization. Any residual from the NIM transaction is carried at zero basis until it begins to receive cash.

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Risk Appetite

Event Risk

- Dividend Risk for Equity Derivatives
  - For equity options, the key event risk arises from the discrepancy between the actual dividend and the assumed dividend in the option pricing model.
  - The P/L impact of a 75% discrepency (for options on single stocks) or a 25% discrepency (for options on baskets) in the assumed dividend is calculated as the event risk.

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Risk Appetite

Event Risk

- Gap Risk for Fund Derivatives
  - Main risk is due to NAVs of funds gapping down.
  - Currently we use the following two-scenario macro gap stress to estimate the this risk.
    - In the first scenario, for each trade, we apply a 20% down shock to the equity component and we estimate the stressed note NAV. The loss on the trade is estimated as Max (0, Bond Floor - Stressed NAV).
    - In the second scenario, we first apply a 10% down shock. The trade may partly de-lever out of equity into swap units and then we further apply a 20% shock. The sum of these two losses is the stress loss for this scenario.
    - We take the greater of the two stress losses above as the gap risk for this trade.
    - The portfolio gap risk is estimated as the sum of the losses over all trades.

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Risk Appetite

Counterparty Credit Risk

- Counterparty Credit Risk measures the potential loss the Firm can suffer due to forward settlements, financing and derivative transactions with our customers.

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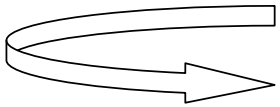
Risk Appetite

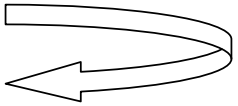
Aggregation

- We allow for the benefit of diversification in aggregating risk across businesses while recognizing correlations exist across risk categories within businesses:



Diversification

- Within Market Risk across businesses and divisions
- Diversification benefits arise from businesses functioning as part of a larger unit
  - Trading desks => Regional businesses
  - Regional businesses => Global businesses
  - Global businesses => Divisions
  - Divisions => Firm



Correlation

Within businesses across the risk categories

- Correlation exists across
  - Different types of events
  - Defaults of different counterparts
- Correlation also exists across
  - Market risk
  - Event risk
  - Counterparty Credit risk

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Risk Appetite

Market Risk Aggregation

- The simulated P&Ls for all products from all risk factors, including linear and non-linear, are simply added up across each historical date, yielding a P&L distribution due to market factors.
  - Correlation/diversification is naturally captured in the historical market data. No assumptions are made.

Regional businesses => Global businesses

Interest Rate Products America Total Simulated P & L	+	Interest Rate Products Europe Total Simulated P & L	+	Interest Rate Products Asia Total Simulated P & L	=	Total Interest Rate Products Simulated P & L
day 1 [·]		day 1 [·]		day 1 [·]		day 1 [·]
day 2 [·]		day 2 [·]		day 2 [·]		day 2 [·]
· [·]		· [·]		· [·]		· [·]
	+		+		=	
· [·]		· [·]		· [·]		· [·]
· [·]		· [·]		· [·]		· [·]
day N [·]		day N [·]		day N [·]		day N [·]

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Risk Appetite

Market Risk Aggregation

- Issue-specific risks are assumed normally distributed and independent of the simulated P&L and independent of each other.
  - It can be combined with the simulated P&L component by convoluting the two probability distributions.

Simulated P&L Distribution | **Issue Specific Risk - Discretized** | **Total Risk**

$$
\begin{array}{r}
\text{day 1} \\
\text{day 2} \\
\text{day 3} \\
\vdots \\
\text{day N-1} \\
\text{day N-1}
\end{array}
\begin{pmatrix}
P\&L_1 & p_1 \\
P\&L_2 & p_2 \\
P\&L_3 & p_3 \\
\dots & \dots \\
P\&L_{N-1} & p_{N-1} \\
P\&L_N & p_N
\end{pmatrix}
\otimes
\begin{pmatrix}
s_1 & q_1 \\
s_2 & q_2 \\
s_3 & q_3 \\
\dots & \dots \\
s_{M-1} & q_{M-1} \\
s_M & q_M
\end{pmatrix}
\Rightarrow
\begin{pmatrix}
P\&L_1 + s_1 & p_1 * q_1 \\
P\&L_1 + s_2 & p_1 * q_2 \\
\vdots & \vdots \\
P\&L_1 + s_M & p_1 * q_M \\
\vdots & \vdots \\
P\&L_N + s_1 & p_N * q_1 \\
P\&L_N + s_2 & p_N * q_2 \\
\vdots & \vdots \\
P\&L_N + s_M & p_1 * q_M
\end{pmatrix}
$$

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Risk Appetite

Event Risk and Credit Risk Aggregation

- Events for different businesses are assumed independent across different businesses.
  - Aggregation is obtained by convoluting the probability distributions from each businesses.

- Counterparty defaults are assumed independent across different counterparts.
  - Aggregation is obtained by binomial probability distribution.

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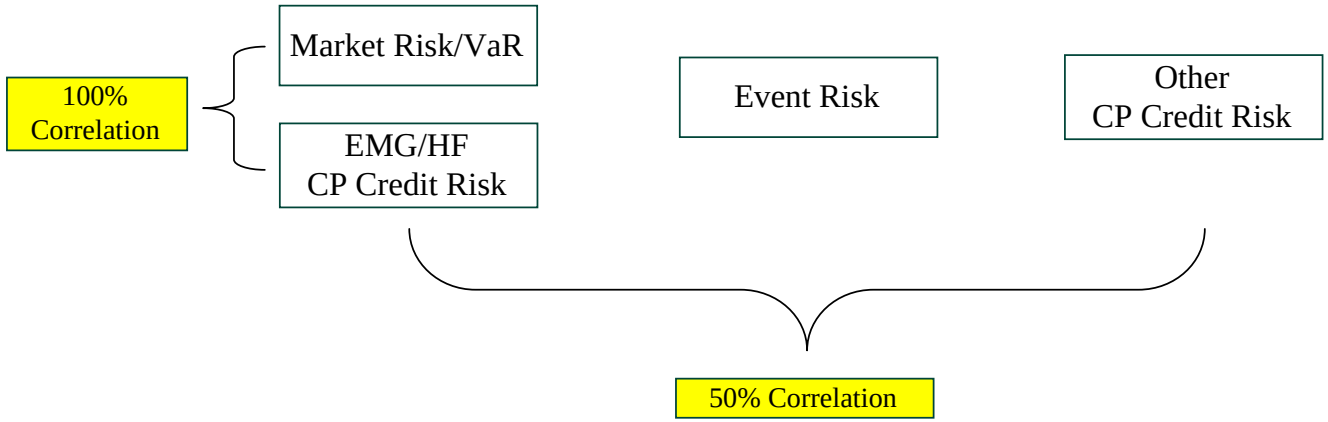
Risk Appetite

Aggregation of Market, Event, and Credit Risk



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Risk Appetite

Risk Appetite Reporting

- Risk Appetite is calculated and reported daily. It is
  - published on LehmanLive
  - communicated to trading desks
  - communicated to divisional business heads, CAO, CRO, CFO, and other key Finance Control personnel with daily recap and comments
  - included in weekly risk package to Risk Committee and Executive Committee, which includes the CEO

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Risk Appetite

Risk Appetite Report

	95% Annual Risk ($Millions)				
	Usage				Limit
	2/28/2005				
	Americas	Europe	Asia	Global	
FIXED INCOME					
IR Products	255	128	103	328	300
Liquid Market Prop	87	29		107	100
High Grade Including Pipeline & Commitments	151	109	52	200	475
CDO	24	59	9	65	100
Structured Finance	56	8	11	56	100
Real Estate	314	161	99	411	500
Mortgage Trading	370			370	350
Firm Financing	58	16		68	100
High Yield Including Pipeline & Commitments	214	83	81	291	500
Municipals	193			193	200
Foreign Exchange	53	94	48	172	175
Fixed Income Corporate	16	5	6	19	160
Firm Relationship Loans - FID Share	16	10		20	25
TOTAL FIXED INCOME	**843**	**354**	**251**	**1,089**	**1,500**
EQUITIES					
Cash Products	19	39	10	49	120
Convertibles	90	39		103	150
Volatility	70	88	122	182	225
Portfolio	33	22	7	42	75
Proprietary	53	32	0	63	90
Relative Value	2	9	0	9	35
Yield Enhancement		18		18	20
Equity Financing	6	2	1	9	35
Equity Corporate*	37	113	6	130	35
Firm Relationship Loans - Equities Share	16	10		20	20
TOTAL EQUITIES	**217**	**182**	**127**	**352**	**450**
WAM	**266**	**6**		**268**	**325**
INVESTMENT BANKING**	**24**	**12**	**12**	**31**	**50**
RISK ARBITRAGE	**234**	**89**	**46**	**278**	**450**
TOTAL COMPANY	**1,096**	**424**	**330**	**1,411**	**2,100**

*Equity Corporate includes syndicate positions.
**IBD includes IBD's share of high yield loan holds.

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Risk Appetite

Risk Limits

- Risk Appetite Limits
  - the overall limit is driven by Risk Appetite which is approved by the Executive Committee.
  - limits are set by Risk Management in conjunction with the business heads.
  - limits are cascaded down to the divisions and businesses.
- VaR Limits
  - the overall VaR limit is a function of the Market Risk component of Risk Appetite.
  - limits set by Risk Management in conjunction with business heads.
  - limits are cascaded down to the divisions and businesses.

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Risk Equity

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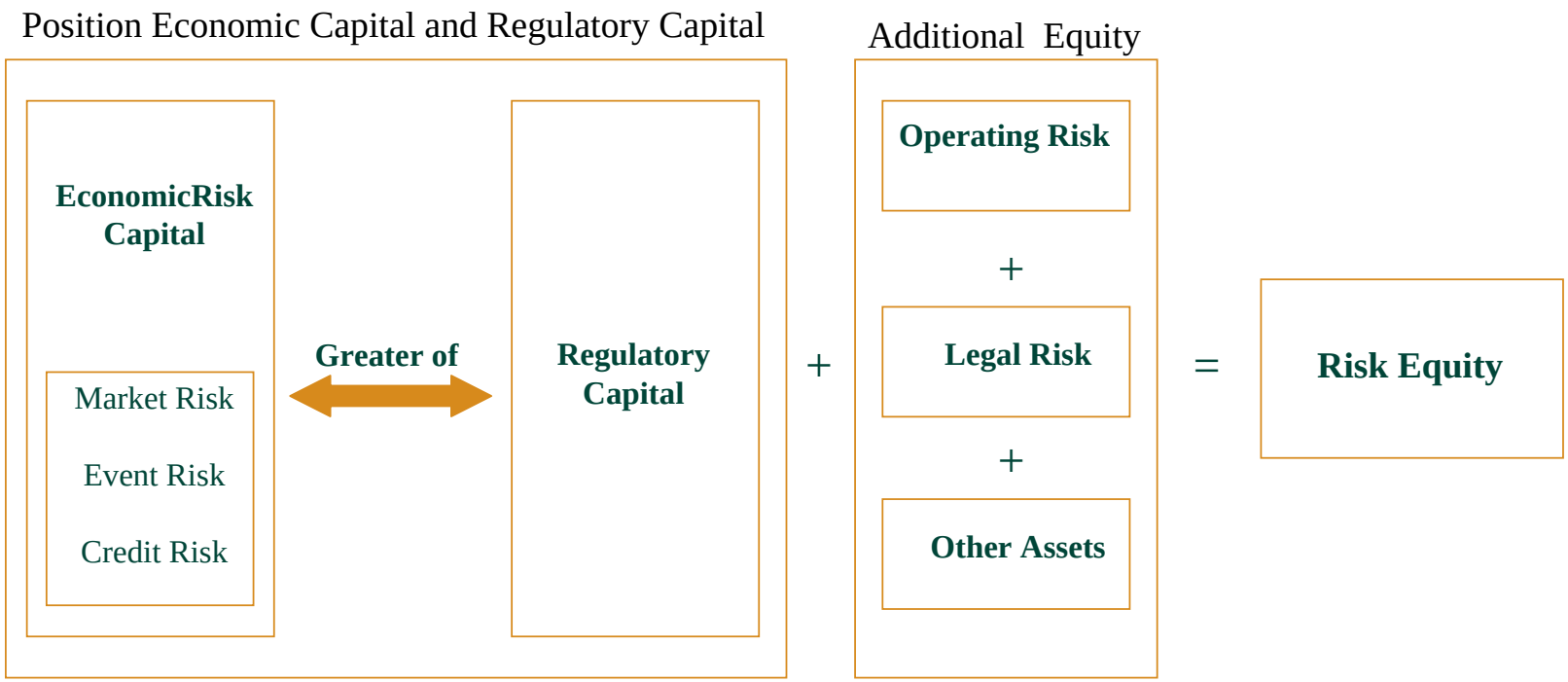
Risk Equity

Risk Equity

The equity capital the Firm requires is the economic capital required to protect the Firm against market, event, counterparty credit and operating/legal risks augmented by regulatory capital – the capital required by businesses operating in regulated entities.



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Risk Equity

Economic Risk Capital

- Market, event, and counterparty credit risks are calculated using the same methodology as in Risk Appetite.
  - A higher confidence level is used (99.5%).
  - A longer horizon is used for measuring real estate event risk (2-year) and longer for counterparty credit risk..
  - The potential revenue losses are tax-affected.

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Risk Equity

Regulatory Capital

- The Firm is required to hold Regulatory Capital (in the form of both debt and equity) against our positions in our regulated entities
  - Where Regulatory Equity exceeds risk-based equity, the Firm must maintain that higher level of equity
  - As a result, the model determines the amount of Regulatory Equity required for each product and defines position equity as the greater of risk-based equity and Regulatory Equity

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Risk Equity

Other Required Capital

- Operating Risk measures the risk of each business beyond potential gains and losses on positions
  - This form of risk exists (and requires incremental equity) when there is a potential that the revenue of a business fall below its operating expenses and produces losses
  - Conversely, if revenues exceed costs even when stressed downward, the business creates a surplus which can help offset position-related losses and, therefore, reduce its equity requirement in the current model
- To estimate Operating Risk (and distinguish it from Position Risk), the model identifies all of the "flow" revenues associated with each business and stresses revenues down consistent with historical market disruptions and 1-year downturns in these revenues
- For this purpose, revenues include M&A, origination fees and other revenues from customer flow
  - Once stressed downward, these reduced revenues are applied against each business' augmented expense base; operating expenses are reduced to reflect reductions in compensation and variable and fixed NPE
- The net result may be an after-tax loss or an after-tax gain; losses are added to the equity requirements of the business while gains reduce the equity requirement of a business

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Risk Equity

Other Required Capital

Corporate Assets

- Certain assets are shared assets of the Firm and are held at the corporate level
- These assets include deferred taxes, fixed assets and receivables
  - The model defines the equity required to support these assets and allocates that equity to the businesses according to their respective uses of the underlying assets
  - Except for partnerships (that can be identified by business), the driver for this allocation is headcount

Legal Risk

- This risk category is meant to capture other events which expose the Firm to losses
- These other risks arise from the legal environment in which the Firm operates and include such matters as: sales practice, investor suitability, fraudulent trading, employment practices, regulatory actions and underwriting and advisory liability
- The determination of the amount of equity required to cover the loss from the occurrence of these events was based on a review of these events (within the Firm and in the market) and the available insurance coverage
- The amount is split evenly between Fixed Income, Equities and Banking

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Market Data

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Market Data

Market Data

- Data are from both internal (mostly fixed income) and external sources (mostly equities).
- Equity price data (~15,000 times series) are pulled and cached daily from vendor FAME.
- All other data are stored in LehmanRisk's central depository HMD (historical market database) (~6,000 time series used in VaR calculations).
- Dedicated resources and shared responsibilities to control the data.

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Market Data

Data Sources

Source	Connection Method	Type of Data Used	Int/Ext
DRI / IDC / Muller / FT -Extel pricing	Via vendor FAME	• Equity Prices	Ext
Bloomberg	Via Lehman's Finesse Real Time Interface	• Non-US Fixed Income • Treasury/Swap/Libor Yields • FX Spot rates • Commercial Papers • Fed Funds	Ext
Cost of Carry	Via internal FAME DB	• On-the-runs Repo Rates	Int
Murex	Via internal FAME DB	• FX Spot Rates • FX Interest Rates • FX Volatilities (by USD/CCY_pair)	Int
Point	Via Stored Procedures & FTP-ed Flat Files	• HG Corporate Spreads • HY Data (Europe) • EMG Yields and Spreads	Int
GMD	OBDC	• USD Treasury Yields • Basis Spreads • Deposits, Swap Yields • Swaption Vols	Int
GEM	Stored Procedures & Flat Files	• USD Treasury Par-Fitted Yields (CMT) • UST On-the-run, Off-the-run Yields • JGB Par-Fitted Yields	Int
Muni Index Group	Stored Procedures	• Municipal Index Data	Int
User Provided Flat Files	Flat File Loaders	• EMG Implied Vols • JGB Bonds Short end of the curve • Equity Index Implied Vols	Int

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Market Data

Data Control

- Resources and Organizational Procedures
  - Data Quality Control Group (DQCG). Consisting of one person from quantitative risk management and one person from risk technology, this group is in charge of data quality and daily maintenance of TS.
  - Designated Risk Managers (DRM). All market data have owners. These owners are Risk Managers in charge of particular TS. DQCG resolves all issues regarding particular TS with its DRM.
  - When data are initially loaded into HMD, DQCG checks interface, loads market data from the sources, and provides needed data cleaning. Final TS are approved by DRM and loaded into HMD.
  - DQCG constantly monitors quality of market data and takes actions to fix all problems with market data. If issue with TS is complicated DRM participates in analysis of the problem and approves needed changes to maps or non trivial data fixes.

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Market Data

Data Control

- Control Methods and Tools
  - cross-checking multiple data sources, e.g. Murex vs. Bloomberg FX data
  - audit trail of data change – who/what/when/why change etc
  - daily missing data report for un-updated time series
  - periodic graphing, inspection, and analysis of selected time series

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Single Transaction Limits

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Single Transaction Limits

Single Transaction Limits

- The Firm operates under a comprehensive regime of limits for risk which relate to the aggregate portfolio of transactions.
- The Single Transaction Limit framework is designed to limit our exposure to a single transaction even if it can be accommodated within these aggregate limits.
- We want to limit the maximum loss we could incur to any one name in order to avoid negative publicity and incur decreased confidence in the Firm's risk controls.
- Executive Committee approval is required where transactions could exceed these limits.

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Single Transaction Limits

Setting Single Transaction Limits

- Setting limits for single exposure requires deciding
  - loss tolerance to a single transaction => potential quarterly loss threshold at $200 million
  - confidence level (probability) => 99.5%, consistent with our risk equity model and equates to a catastrophic loss
  - how to measure the potential loss => based on our risk methodologies discussed earlier
    - Fixed Income transactions
      - interest rate risk, spread risk, specific risk, downgrade or default risks
    - Equity transactions
      - the risk that the market price of the underlying will fall as a block trade or syndicate position is unwound. It is driven by the volatility of the underlying stock and by its liquidity, which determines how fast a block trade or syndicate position is unwound

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