Risk Management Assessment

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Lehman Brothers Holding Inc. (Lehman)

Risk management is a core competency and a critical rating driver for the securities industry. Risk characteristics are difficult for these firms to communicate to investors in a timely and transparent fashion, particularly given the highly dynamic environment in which they operate.

Moody's ratings have always directly reflected a judgment on management's risk control culture and capabilities, particularly for financial institutions. However, the Risk Management Assessments (RMAs) for individual firms expand this judgment by evaluating the quality of a firm's risk management within a given sector's framework. The RMA essentially does this by positioning such management in relation to benchmarks and best practices.

The relative positioning of a firm in the industry's continuum of risk management practices may have a direct impact on its rating – an impact that is conditional on the other fundamental strengths or weaknesses of the firm. We expect that the RMAs will continue to add transparency to the overall rating process.

Conclusions

We view risk management at Lehman as a significant credit strength for the issuer that supports its current A1, stable rating. However, the opacity of the firm's risk disclosures and the general reluctance of securities firms to provide guidance on their risk exposures remain a hurdle to higher ratings in the sector..

Key Positive Attributes

- Historically, the firm has demonstrated its capacity for efficient risk- taking, as indicated by the statistical analysis of its earnings over time[1]
- The firm demonstrates a very disciplined and holistic approach to setting risk appetite, starting with setting overall financial targets and minimum achievable objectives. This approach has resulted in a coherent set of limits and a conservative risk philosophy
- A strong culture of individual excellence is thriving, combined with team-playing at all levels of the firm. The avoidance of the "star" system for traders enables management to go beyond the quantitative aspects of risk management and to ask about the intent of trades on the books

[1] See Appendix 1 for more details

- The risk system is integrated across businesses, which mostly derives from organic growth. This uniformity of analysis and design gives the firm an advantage in terms of aggregation and break-down of risks -- both of which are keys to the effective risk-taking activities
- The firm relies on a strong "second-level" governance structure with a set of committees; this structure addresses ex-post position risk as well as anticipatory commitment and transaction risks.
- Finally, there is an extended array of risk measures. Risk managers use a mix of overall qualitative assessments with sophisticated quantitative metrics that are either statistically based or nonparametric in nature (such as scenarios and stress-tests)

Areas of Concern:

- The firm exhibits a willingness to take big concentrated positions in illiquid investments. The total notional amount of off-balance sheet commitments and contingencies represents 303% of the firm's tangible equity as of November 30, 2005. Although the notional amount does not provide an indication of the risks contained in these positions (in particular because of hedging and selling down of positions), this percentage is the second highest in the group of five major US broker-dealers after Merrill Lynch. It reflects Lehman's aggressive approach to .generate revenues from new sources
- Lehman has started a belated effort to break into the top ranks of hedge funds service providers. This effort could potentially tempt management to assume more operational exposures in risk mitigation when dealing with second-tier hedge funds. (The recent example of Lehman's suit against the Wood River Fund in Superior Court of California in San Francisco although not a prime brokerage failure is an illustration of issues lurking in hedge funds relationships)
- The firm still suffers from a relative lack of diversification outside of the mortgage/fixed-income and credit-trading area. Although in the past, the firm's fixed income business has been resilient through rising and declining interest rates environments, this concentration could potentially compound losses in some scenarios involving rapidly increasing interest rates and lower US house prices.
- The public risk disclosures are of poor quality and very limited in scope. Opacity of risk disclosures is a common issue of all firms in the securities industry, but Lehman is clearly among the most laconic firms on the topic, with only four pages dedicated to describing risk in its 2005 annual report.* Risk opacity, particularly with respect to tail risks, represents a hurdle to higher ratings for many firms in this industry.
- The lack of an integrated operational-risk framework is a barrier to assessing and addressing gaps in the firm's processes . However Moody's recognizes that operational risk has become a priority for implementation at Lehman in line with the Advanced Measurement Approach (AMA) requirements of the new CSE regulation[2]
- Lehman does not have a dedicated Risk Committee of the board. This is a trait shared by all 5 major US securities firms and a clear gap compared to most large banks. Moody's views this as an overall weakness in the risk management framework for the industry

**Examples of important gaps include the absence of synchronous depiction of VaR and positional net revenues, as well as the absence of discussion of scenarios, or economic capital by business. The firm only started to release its daily trading revenues numbers in the 2003 annual report. Before that, management was only disclosing weekly results, which typically show a much smaller frequency of losses and contain less information on the risk profile of the firm. The granularity of this disclosure is the least among the five US broker-dealers because Lehman does not provide any details on the size of losses.*

[2] For more details on the Consolidated Supervised Entity (CSE) regime, please refer to Moody's Methodology for Risk Management Assessments: The Global Securities Firms Industry, April 2005

Analysis

KEY FACTORS IN THE ANALYSIS OF RISK GOVERNANCE

Risk Philosophy

Lehman Brothers prides itself on a very holistic and conservative view of risk-taking in all its businesses. In a way, this has been empirically verified by the firm's very low public profile in all of the serious compliance scandals involving banks and other financial institutions (such as those involving Enron, Parmalat, or Worldcom). Lehman has been able to consistently avoid appearing in the headlines while side-stepping excessive volatility in its trading results. Management succeeded in achieving this despite a higher concentration than all other investment banks in the fixed income and mortgage areas.

Protecting the franchise is at the heart of the broker-dealer's risk culture. From the top down, the focus of the firm is on achievable returns balanced among all the risks and uncertainties attached to each business, and the means by which this balance enables risk-takers to deploy their risk appetites in the most efficient way.

An obvious example is in the mortgage area – a place where management has shrewdly upgraded the value chain by starting to originate its own mortgages. This situation enables the firm to fine-tune its origination pipeline in order to match the current level of securitization margins. Lehman has thus transformed a position-taking business (trying to fit what was originated by others into the securitization economics) into a spread business -- one where its executives control both the input (mortgages) and the output (the securitization process). This conservative risk philosophy is buttressed by a number of internal control procedures that enforce strict discipline. These processes include the daily mark-to-market of all positions and the use of a market-based transfer price for all relationship loans, as well as a very well-defined matrix of committees to address trades at all stages of their life cycle.

One area that distinguishes Lehman from its competitors is the degree to which its employees are rewarded with stock and options. Over time, this has resulted in employee ownership of around 30%. Such a large participation in the capital in the firm, accompanied by restrictive vesting and selling conditions, reinforces the alignment of the firm's top-level employees along the longer-term view of profitability and the accompanying safeguards to reputation.

Committees and Their Relationship with the Board

The board of directors of Lehman is very focused on risks. Board members take part in risk seminars on a regular basis. This attitude permeates the composition of the committee structure. At the highest level of executive management, the Risk Committee of the firm reviews all exposures, position concentrations, and risk-taking activities. The committee consists of the members of the Executive Committee of the firm, the chief risk officer, and the chief financial officer. It meets weekly and discusses significant existing positions and commitments.

The CEO also chairs a weekly capital markets meeting, which helps to frame and reassess the risk views of the firm in light of the global financial environment. This contextual element is thus incorporated at the highest level of management of the firm. Moody's views this positively because it enables the risk "narrative" to be consistent from the top down. Yet another relevant executive body is the Operating Exposures Committee, which is chaired by the firm's chief legal officer, and is tasked with addressing franchise and control issues in all activities where risks or potential exposures exist.

A newly established Operational Risk Committee attended by senior management in the key businesses and support functions of the firm is in charge of monitoring the implementation of the operational risk framework and the resolution of current operational issues.

Within the business units there are a number of specific committees such as: the transaction-oriented committees that focus on specific types of risk-taking at different stages of their life cycle; the commitment committees address issues on proposed debt and equity offerings, financing transactions, or underwriting proposals; loan-related committees review and approve any lending-type transactions as an underwriter, as an investor, or as a liquidity-commitment provider. Finally, specialized committees, such as the New Products Committee or the Complex Structured Finance Committee, apply discipline to those specific risks attached to innovations and/or added complexity to existing types of transactions.

Organization of Risk Function and Risk Framework

The global risk management function is integrated globally, reporting to the Chief Risk Officer, and it is independent from trading (as would be expected from a best-in-class institution). The Chief Risk Officer reports directly to the Chief Administrative Officer, who is a member of the Executive Committee. The risk managers across the world report in a matrix form to the regional heads of the trading departments and to the global heads of the risk management division.

The diversity of professional backgrounds in the risk-management organization mirrors the new roles that these associates play in the dynamics of the firm's businesses. Far from mere nay-sayers, risk managers are constantly evolving their roles as providers of richer information and closer guidance while enforcing a disciplined approach to controls. There are differences between the mindsets in each area of expertise (market vs. credit or operations), but risk managers -- by necessity -- are placed at the intersection of market research and deal analysis. Clearly, intellectual stimulation is a ever-growing benefit of the job.

Lehman manages this "knowledge network" by mixing different types of people within the organization. As a result, the risk organization comprises three types of people: "quants," or individuals with advanced degrees in maths or physics; ex-traders wishing to broaden their horizons; and ex-bankers with experience in lending and complex deals.

Risk Appetite and Risk Limits

The risk-appetite framework of Lehman is both more formalized and more holistic than most others in the industry. The framework relates a) the acceptable amount that management is ready to lose in one year from *all* sources of risk to b) the sustainable revenue-generation power of the firm, stressed for downturn events. The risk-appetite framework also incorporates key constraints around minimally acceptable financial objectives over a cross-cycle period. This definition of Lehman's risk appetite is quantified and is approved by the Executive Committee on an annual basis. It is at the center of management's approach to the allocation of risk-taking capacity through a comprehensive set of limits.

Risk-appetite usage is measured on a globally consolidated basis and is reported daily against the risk-appetite limits. In order to calculate this usage, the firm employs measures for market, credit, and event risks, combining them in a very conservative fashion. The event-risk parameters incorporate the potential impact of economic downturns on asset prices (such as house prices), as well as possible gaps in the assumptions used in the normal course of trading businesses (such as jump to default type moves instead of credit quality deterioration accompanied by spread moves).

The main statistically based risk limits constrain risk-taking at the portfolio level, and they are closely integrated with the overall risk framework of the firm. They basically consist of VaR and risk-appetite limits. As a second line of defense, non-statistical risk limits put constraints on the size of single transactions, and also on the amount of credit exposure to any counterpart or country, as well as on the total concentration in asset classes, industries, or credit sectors.

KEY FACTORS IN THE ANALYSIS OF RISK MANAGEMENT

Risk Culture, Control Environment, and Decision-making

The main message from the senior executives starts from the simple premise that bad things will happen. Starting from this assumption, the risk culture is based on accountability and then on the rapid elevation of potential problems all the way up to the Executive Committee, if justified. If employees keep a problem to themselves, it becomes theirs; if it is shared, it is Lehman's to solve. In order to facilitate sharing information, the control environment is built on two key principles:

1. Control functions should be interconnected and integrated as much as possible
2. The role of these functions is not to enforce rules, but to understand what could hurt the firm and respond accordingly.

Risk-takers should want to talk to risk managers because they respect their advice -- not because they have to. It goes without saying that risk managers can earn the respect of the traders only if they are of the same caliber. As a result, a large proportion of employees in the risk management organization are ex-traders or from other types of risk-taking backgrounds.

The risk-management group has a multifaceted mandate within the organization: (a) it develops policies and procedures; (b) it sets measures and limits; and (c), it monitors limit usage and validates valuation models. In their capacity, risk managers work proactively with the risk takers of the firm. Their role is particularly influential at the beginning stage of

a new, large transaction in order to determine if Lehman should go ahead with it. The role of the risk organization in these discussions is to make sure that the least risky structure of the deal is executed and that risk mitigants are in place.

Other independent support functions, such as finance and product control, add support to the risk management effort by creating a robust internal-control framework. These professionals particularly ensure the integrity of the daily mark-to market and P&L processes, which are key inputs to the implementation of the risk management decision-making.

Asset- Liquidity Risk Management

Less liquid assets are those that require a higher proportion of long-term funding on balance sheet (equity and long-term debt). These assets are typically difficult to sell (if at all) in a reasonable amount of time without large losses to their theoretical value. They include financial assets kept in inventory -- such as bank loans, CDOs, high-yield securities, and principal investments -- as well as non-financial assets such as goodwill, joint ventures, and other assets.

The disclosures around these assets are not standardized across securities firms. Moody's attempts to quantify the coverage of less liquid assets with long-term sources of funding through its cash-capital methodology[3]. The ratio of cash capital over liquid-adjusted net assets is monitored on a regular basis as a key indicator of these firms' liquidity- and capital-adequacy profiles. Despite the secular increase in less liquid assets on Lehman's balance sheet, Moody's believes that the firm maintains, strong capital and liquidity positions.

In addition, the longer holding horizons of illiquid positions are incorporated in the framework for the risk appetite and risk equity limits, which are established using a one-year time frame. These illiquid positions might trigger specific actions and adjustments in addition to the regular risk monitoring and measurement process. These actions include some, or all, of the following:

- Inventory turnover and position-concentration reports
- Implementation of age limits for inventory on the balance sheet, with associated penalties
- A valuation adjustment for liquidity to reduce the asset value
- Liquidity reserves for valuation uncertainties
- Implementation of relative-value trades or hedges

One area of concern for all broker-dealers and banks active in the capital markets is the potential for term mismatch between the repo (liabilities) and the reverse repo (assets) books. The first approximation commonly used is that these two books are overnight transactions; hence, they are very liquid and basically wash out to a very small net position ("matched book"). This assumption is only partially true, however, because firms have been extending more aggressive term repos to various counterparties – a choice that could conceivably prevent the firm from accessing the cash immediately.

The funding profile of Lehman is robust because of its emphasis on long-term debt to provide a cushion to the life of its assets. (This is reviewed in more details in Moody's Liquidity Risk Assessments - LRA).

Hedge Fund Relationships

Despite its advertised ambitions in the prime-brokerage space, Lehman has not managed to break into the top tier of providers of hedge-fund capital-market services. As a result, the firm might choose to engage in riskier strategies in order to secure sufficient growth to justify the infrastructure expenses. Despite the strong corporate controls extending to the hedge funds related activities, the recent mishap with the Wood River Fund shows how even a well-oiled risk management process can slip up in the most basic way, failing to put in place the right risk mitigants, particularly those involving operational exposures.

[3] See "2005 US Securities Industry Outlook", Moody's Investors Service,, February 2005 for details of the cash capital calculation

Lehman Brothers vs. Wood River Fund
On October 3, 2005, Lehman filed a suit in California Superior Court in San Francisco against a mid-size hedge fund, Wood River Capital Management, alleging that it was the victim of a fraudulent stock scheme perpetrated by the fund in September. Lehman started providing brokerage services to the $500MM AUM fund in June 2005. In August, Wood River asked Lehman to purchase 800,000 shares of a small high-tech stock, Endwave (ticker: ENWV), a maker of radio-frequency components based in Sunnyvale, CA. Wood River was supposed to repurchase the shares from Lehman later on with a transaction fee. On September 22, Lehman arranged for the purchase at $26 per share from the Merrill Lynch account of Wood River for delivery on Sept. 27. As Wood River became incommunicado and failed to repurchase the shares from Lehman, the broker-dealer was left holding the stock at the same time that its price plunged. Lehman liquidated its position starting on September 29 in a declining environment and heavy selling volume and suffered a loss that it is trying to recover through its suit against the fund.
Source: "Wood River Fund Holds Big Stake in Telecom Whose Stock has Fallen", The Wall Street Journal (October 10, 2005), "Lehman: Burned by a Hedge Fund?", BusinessWeek OnLine (October 10, 2005)

It is important to recognize that Lehman had declined providing prime brokerage services to this particular hedge fund. The firm was acting as an agent in the above transaction and was providing services on the basis of a standard cash equity brokerage account. Although we cannot read too much into one isolated fraud event, the circumstances surrounding the known facts of the case demonstrate the daily challenges of the risk-management process when confronted with the motivation for business growth.

A couple of things seem to have gone awry in this particular case:

1. It does not appear that Lehman performed full due diligence on the fund, despite warning signals emanating from the fund's business practices. Examples of red flags include (a) a lack of regulatory filings for its equity positions, and (b) previous lawsuits brought by CSFB and the fund's landlord for defaulting on its debts.
2. Lehman did not require over-collateralization of the shares and, as a result, bore the full market risk of the position.

These are pretty basic mistakes for a quality organization such as Lehman. Although one could argue that the loss will hardly make a blip on the firm's financial results, the blows to reputation could hurt. Moody's remains closely attentive to these types of exceptions to the risk- management process and how the consequences are handled by the organization.

In the case of Lehman, following this incident, the firm has tightened its controls around account openings and bolstered education efforts for the sales force.

Off- Balance Sheet Risks, Commitments, and Contingencies
Commitments and contingencies are not reported on the balance sheet. (They are mostly disclosed in note 10 of the 2005 annual report.) The disclosure is heterogeneous (as is the case for all firms in the industry) and does not really provide any useful indication of the risk levels or loss potential in these activities. In fact, two pieces of information are missing from the vast majority of firms' disclosures:

1. The size of the actual unexpected loss potential in a stressed scenario (i.e., equivalently how much economic capital is allocated to these risks). Much uncertainty is associated with the development of losses under the various types of guarantees and representations made by the firm. Nevertheless, we remain convinced that the development of stress scenarios can be very useful in quantifying certain risks embedded in these agreements. A very important side benefit of the construction of scenarios is that their very design can help determine a course of action should these events occur.
2. Is the loss exposure from all these contingencies already included in the risk systems and the risk measures of the firm?

In the table below, we try to provide more transparency to these risks for Lehman:

Table 1: Lehman's Commitments and Contingencies (Excluding Litigation and Derivatives)

Type of commitment / contingency	Total notional exposure ($)	1 year growth	Disclosed risk of loss exposure ($)	Main risks	Moody's estimation of risk level
Lending commitments (excluding repurchase agreements)	$27.9 billion	+34%	None	Credit and funding	Medium. Mostly hedged with credit derivatives. Loss exposure included in firm's credit risk calculation
Mortgages commitments	$9.4 billion	-27%	None	Credit and funding	High but loss exposure included in the overall credit risk calculation
Liquidity provider contracts	$6.0 billion	-18%	None for munis, full amount for other	Market and funding	Low. Liquidity call can only be triggered in limited cases and is supported by investment grade assets
Guaranteed return contracts	$3.2 billion	+10%	$3.2 billion	Market	Medium
Letters of credit	$2.6 billion	+52%	None	Funding	Low
Private equity/other	$0.9 billion	+28%	None	Market	High
Total (gross)	$50 billion	+6%	ND		

Source: Lehman 2005 annual report

The total notional of commitments/guarantees represented 303% of the firm's tangible common equity as of November 30, 2005, which is the second highest percentage among the five major US broker-dealers. One must recognize that the gross amount of exposure (total notional at risk before hedging or selling down) is not a good measure of the actual risks embedded in these commitments. However the total size of commitments in part reflects the tolerance of the firm towards potentially illiquid positions.

Operational Risk Management and Compliance Processes

Lehman has established widely communicated policies specifying standards of ethical business practices and compliance procedures with regulatory rules and guidelines. These policies include a code of conduct, a firm mission statement, and rules for personal investments and political contributions. Lehman is subject to regulatory supervision from a wide-ranging set of regulators globally, including the SEC, the CFTC, NYSE, NASD, the FSA (UK), and the FSA (Japan). Teams of compliance officers are responsible for ensuring that all regulatory rules are adhered to, and for responses to inquiries by the regulators across the whole spectrum of its businesses. In addition, a firm-wide compliance coordinating office acts as a "chaperon" for the communications between equity research and investment banking.

Moody's believes that Lehman currently lacks a fully integated framework and organization to implement a holistic operational risk-management approach. It does not appear that operational losses have been tracked regularly or that Key Risk Indicators (KRIs) are currently used to inform the evaluation of business managers in addition to purely financial metrics.

Although Lehman is late in the implementation phase of operational risk compared to some other securities firms, it has made considerable progress in the past year. The recently established Operational Risk Committee monitors the status of the framework implementation as well as the current operational risk issues. The efforts are multi-pronged, including systematic loss data gathering, a mapping of operational risks by transaction process flow and the development of a operational VaR model and of a set of Key Risk Indicators (KRI's). Operational risk factors are already used to inform and develop the audit department's risk-based planning approach, in order to determine which areas of the firm to review.

Lehman is still behind the curve compared with the efforts of large international banks. These institutions have been implementing a truly comprehensive framework of operational risk measurement and management for a number of years in order to comply with Basel II capital-adequacy demands (this regime was officially released in 2001, with the goal of implementation by January 1, 2007). We expect that the new CSE regulation will have a similar impact on broker-dealers and should result in much more formalized and quantitative approaches to operational risk management. In fact,

Lehman intends to be compliant with the AMA (Advanced Measurement Approach) method of the CSE as soon as all requirements are met

Significant theoretical and practical progress has been made recently on the quantitative front (improvement in completeness of loss databases, new models for correlation of operational risk events) and we expect investment banks to catch up quickly with the best-practice banks for the measurement of economic capital related to operational risk.

Contingency planning is a major aspect of the proactive handling of operational risk. Lehman is probably one of the firms most aware of the issues because it was completely displaced after the September 11 terrorist attacks on the World Trade Center in New York. The firm is currently testing real-time solutions for contingency situations --solutions such as a long-term displacement of traders in order to better identify the issues of trading from remote locations (such as from the trader's home). The view of the firm, which is shared by Moody's, is that problems of this scale will represent grave threats to the integrity of the whole financial system and cannot be solved independently by any individual Wall Street firm. Such a disaster requires cooperative industry effort, including active participation by the regulators.

KEY FACTORS IN THE ANALYSIS OF RISK QUANTIFICATION

Evaluating the Risk Measures Toolbox

Market Risk: Lehman employs a historical-simulation approach for its VaR calculation. In the process, the firm uses more than 20,000 separate time series of individual asset prices for its risk measurements, which enables it to incorporate a large amount of specific risk in the metrics before any diversification is taken into account. The look-back period for the VaR calculation encompasses the previous four years of data, which is longer than most other financial institutions employing the same type of methodology.

Credit Risk: This is measured on a portfolio basis, using a common source of data for all counterparties. The firm employs both current credit and maximum potential exposure to quantify market-dependent credit exposures of derivatives and contingent contracts.

Event-risk measures losses associated with gaps in the normal conditions (defined as the ones prevailing in financial markets most of the time). The event-risk metric enables management to quantitatively assess what losses could result from a real estate crisis or from sudden jumps to default of high-yield positions.

In addition to the day-to-day measures of market risk, the firm regularly runs historical and hypothetical stress scenarios to evaluate the impact of abnormal market conditions without the ability to hedge or modify existing positions.

Moody's believes that VaR has many flaws that disqualify it as being a sole statistical measure of risk-taking. We are strong proponents of so-called coherent risk measures[4]. These provide more information about losses in the tails of the distribution, and they also avoid some deficiencies inherent in the VaR measure.

Risk/Reward Measurement – Aggregation and Decomposition of Risk Measures

Lehman uses an overall risk-appetite measure (the amount of business loss it could sustain in a stress environment while being able to fulfill its compensation obligation and generate acceptable return on equity) to drive its limits allocation.. It enables senior executives to measure financial performance against a well-defined, quantified maximum-loss objective. This measure is further allocated to the various businesses of the firm, which use this yardstick to control the risk appetites and determine their relative performances against it.

Because of the high level of technological integration, risk aggregation is built directly into the capacities of the risk systems and it is not an after-the-fact thought process. Aggregation of risk measures can be achieved by legal entity, by type of trade/product, or by counterparty. Aggregation by legal entity is important for compliance with the new regulatory capital rules in various geographies. It is also helpful for tax purposes because it demonstrates that profits attributed to each legal entity are done so on the basis of an objective criterion. The historical-simulation methodology for the calculation of VaR automatically incorporates correlations by design and allows aggregation and attribution of market risks on a portfolio basis. For credit and event risks, management makes various conservative correlation assumptions.

[4] See Appendix 4 for a discussion of VaR vs. coherent risk measures

Distribution of Trading Revenues

The shape of the distributions of trading net revenues is an indicator of the trading risk profile of the firm. (The histogram of daily trading revenues for 2005 and 2004 is disclosed by the firm in its annual report on page 64.) The analysis of daily trading revenues for Lehman, however, is obscured by two changes that the firm made in its reporting:

1. Lehman only started disclosing daily trading revenues in its 2003 annual report. Previously, it only disclosed weekly revenues. These have a very different statistical distribution and hence cannot be compared to daily results.
2. The firm also changed the granularity of its reporting between the 2003 and the 2004 annual reports. It stopped providing a break-down of losses and now only furnishes the aggregate number of losing days, without any indication of the size of the loss. Lehman also changed the scale it uses for reporting positive trading days.

As a result of this lack of standardization, the year-on-year comparison of daily trading revenues supplies only minimal information on risk-appetite shifts in the firm's trading operations.

The table below compares the daily trading net revenues for the years 2002 to 2005 and is provided for reference only.

Table 2: Distribution of net daily trading revenues for Lehman Brothers ($MM)

Net Revenues	<(0)	(0) – 60	>60
2002	7.9%	90.1%	2.0%
2003	2.0%	94.8%	3.2%
2004	2.8%	91.3%	5.9%
2005	2.0%	92.0%	6.0%

Note: Some numbers used to build the table above were visually estimated from the corresponding graphs in the annual reports. As a result, the percentages in the table might differ slightly from the results one would obtain using the exact day count. Moody's believes that the conclusions drawn would remain valid with the exact numbers.

Despite the lack of granularity of the data, the predominance of large gains (higher than $60M) compared to losses is an empirical confirmation that the firm has been efficient in selecting positively skewed bets. Of course, nothing guarantees that this winning run will continue in the future.

KEY FACTORS IN THE ANALYSIS OF RISK INFRASTRUCTURE AND INTELLIGENCE

Technology Issues

The risk-technology department has a dual reporting line to the information technology division and to the global risk management organization (through the quantitative risk management department). Risk technology mirrors the departmental and regional structure of the risk division.

Similar to the situation at Goldman Sachs, the nature of the firm's business provides Lehman with two advantages regarding its technology infrastructure:

1. Lehman does not have a significant presence in the retail-investor segment, which limits the number and types of software applications it uses
2. The firm has grown mostly through organic expansion, which limits the number of legacy systems it has to deal with.

The risk-system architecture of the firm is based on a "hub and spoke" model. In this environment, each front end system is used as the repository of the data (both internal positions and external feeds) required by the particular business. A centralized system contains historical time series and the analytical modules which are, in turn, shared with the front-end applications. These applications are implemented based on the computation needs of each desk. The central system aggregates all risk exposures -- both market and credit -- that are also reconciled to the general ledger. The client application enables users to drill down into the risk components of positions.

Modeling of Complex and Structured Trades

Model risk can be defined as the potential difference between a) the price derived from the model used to mark positions in the firm's accounts and b) the price at which the instrument actually trades in the market. In that sense, it does not really matter if the price traded in the market is the theoretically correct one as long as enough parties agree to transact on that basis.

Model risk is a growing area of concern, given the development of ever more complex derivatives and the vertiginous growth of new areas of trading, such as credit derivatives and CDOs/CLOs. There are many practical stand-alone issues with valuation models, ranging from the selection of the underlying generating process of the risk factors all the way down to the implementation of the computer code. These pitfalls are well-known, and sophisticated financial institutions have multiple processes to vet their models.

Moody's does not believe that it is possible to reasonably quantify the extent of model risk within the firm, given the enormous amount of assumptions and parameters used across all trading desks. We are focused on understanding how financial firms approach these issues, however, and how they avoid model obsolescence from changes in market behaviors or availability of hedging instruments.

At Lehman, the models are developed by the dedicated quantitative-research groups attached to each business. Risk management gets involved in the development process early on, and these experts independently validate multiple aspects of the models, from the theoretical framework to the appropriate amount of reserves for model risk. Controllers verify the model's input parameters and output prices on an on-going basis.

Finally, the model control committees ensure the application of best practices for the scheduling and prioritizing of model reviews. Although these steps in themselves do not guarantee that all losses due to model errors can be avoided, it provides confidence that losses will be manageable.

Lehman has recently issued a new policy on complex structured transactions that is fashioned on the recent regulatory guidance[5] published by the major US regulators. Most of these transactions are routed through the main committee-approval process. However, management has also created specific committees at the level of the main business units to review trades that would not typically fall within the purview of the main committees. Transactions above the threshold levels, as well as deals presenting material franchise or reputation exposures, are still routed to the executive committee for review and approval

Risk Intelligence, Reporting, and External Disclosure

Lehman maintains a full schedule of risk reports at various levels of the firm, starting with daily reports at the regional/business unit manager all the way up to the CEO and quarterly presentations to the board of directors. The information reported internally mixes quantitative metrics with qualitative comments in order to create a context-sensitive view of risks.

Commitments are reported upon in the same manner as firm positions in the books of the firm. The best information from the most sophisticated systems is useless, however, if the people interpreting it do not have the skills or knowledge to question and challenge the results. In order to obtain the maximum value from risk reports, the firm relies on risk personnel and senior managers who know the specifics of the various markets (most risk managers have been traders at some points), and they have experienced different cycles.

This sensitivity to the context of markets and trades is the most important attribute of an efficient risk infrastructure. Unfortunately, it is completely lost in the external disclosures of the firm (as is the case with almost all financial

[5] "Interagency Statement on Sound Practices Concerning Complex Structured Finance Activities", May 2004

institutions). External risk disclosures are in line with the firm's competitors,' and as such, they are lacking specific content. Quantitative market risk information is limited to the Value-at-Risk (VaR) disclosure[6] and the histogram of P&L gains and losses. There are three main problems with this kind of disclosure:

a. Actual gains and losses are not directly compared to VaR through time on the same graph, which would at least give the reader a sense of how well the two are connected
b. The real trading gains and losses include intra-day P&L from customer flow and changes in positions that tilt the comparison because only positional P&L (i.e., gains and losses, assuming that positions have not changed from one day to the next) is relevant for back-testing against VaR.
c. VaR is cut at a 95% or 99% threshold and thus completely misses the large losses meaningful for the franchise as a whole

Without a more complete indicator of risk appetite --such as economic capital -- VaR merely serves as a substitute metric for investors. As shown on table 2 in Appendix 3, trading VaR is typically 2 orders of magnitude lower than the capital at risk of the firms (i.e. VaR represents roughly 1% of the equity of the firm) and regular trading revenues also represent a large multiple of VaR.. Based on this measure of risk only, the firm might at times seem to produce risk-adjusted returns that largely exceed expectation or go against intuition (i.e., VaR goes down while P&L goes up). Average value at risk for the quarter, in other words, does not provide any valuable information on the actual risks taken by the firm. VaR is clearly an insufficient proxy for the total bundle of risks taken by the firm in the normal course of business.

In the future, we would welcome more complete disclosures on the model of what we recommended in the industry RMA.[7] This would include the disclosure of an economic capital number for each of the businesses at Lehman as an indicator of risk appetite, as well as the results of the key stress tests. In addition, the disclosure of regulatory capital computed using the new SEC CSE regulation will serve as a clearer indicator of the total risk appetite.of the firm and allow for a comparison with banks under the Basel II regulatory regime.

[6] See Appendix 3 for a comparative table of the industry's VaR disclosures

[7] "Moody's Methodology for Risk Management Assessments: The Global Securities Firms Industry", April 2005

Appendix 1

EFFICIENCY OF RISK TAKING IN THE SECURITIES INDUSTRY

	Average Quarterly Earnings ($000's)	Volatility of earnings (detrended) ($000's)	**Efficiency ratio**
BSC	392,434	85,629	**4.6**
GS	1,306,792	411,861	**3.2**
LEH	692,083	240,456	**2.9**
MS	1,553,417	622,602	**2.5**
MER	1,156,208	752,686	**1.5**

Note:
- Moody's calculations based on 24 quarterly data points between 1Q00 and 4Q05.
- Earnings are pre-tax profits after extraordinary items
- Volatility is calculated after fitting the actual results to a linear trend and considering the residuals (i.e. actual earnings – fitted earnings)
- Efficiency ratio equals average quarterly earnings divided by volatility of quarterly residual earnings

The higher the number in the "Efficiency ratio" column, the better the firm's ability to convert its risk-taking activities into earnings. At a given level of earnings, the lower the volatility of earnings the higher the ratio and reciprocally, at a given level of volatility, the higher the absolute level of earnings, the higher the ratio. Conceptually there are 2 ways for a firm to improve its ratio:
- Keep volatility of earnings constant and increase its average quarterly earnings (for example by lowering its costs)
- Keep its average quarterly earnings constant while lowering the risk of its position (for example by optimizing the selection of its asset base.)

Appendix 2

BENCHMARKING OF THE KEY RISK ATTRIBUTES OF SECURITIES FIRMS

	Bear Stearns	**Goldman Sachs**	**Lehman**	**Merrill Lynch**	**Morgan Stanley**
Risk governance from Board	Mostly delegated	Mostly delegated	Mostly delegated	Mostly retained	Mostly retained
Risk appetite	Bottom-up limits aggregation	Integrated bottom up	Integrated top-down	Bottom-up limits aggregation	Bottom-up limits aggregation
Control environment	Partnership	Partnership	Partnership	Corporate	Corporate
Risk organization	Desk centric	Distributed	Distributed	Centralized	Distributed
Risk model	Control and report	Control and advisory	Control and advisory	Control and report	Control and report
Risk infrastructure	Central aggregation	Central computation	Central aggregation	Central aggregation	Central computation
Risk knowledge	Distributed	Distributed	Centralized	Centralized	Centralized
Risk measures	Less sophisticated	More sophisticated	More sophisticated	Less sophisticated	More sophisticated
Compliance	Decentralized	Distributed	Decentralized	Decentralized	Distributed
Integration of risk disciplines/firm-wide enterprise risk model	Basic	Medium	Advanced	Basic	Medium
Models	Risk Management	Front office	Front Office	Risk Management	Risk Management
Economic Capital	Basic	Medium	Medium	Medium	Advanced
Development of Operational risk	Medium	Advanced	Medium	Medium	Medium

Appendix 3

BENCHMARKING OF VAR DISCLOSURES

Table 1: Trading Value at Risk Disclosures

Value-At-Risk as reported by SEC registrants	Reported average daily VaR year 2005	Year 2005 diversifictn benefit %	Reported average daily VaR year 2004	Year 2004 diversifictn benefit %	YOY increase in average VaR	Confidence interval	Holding period days	Methodology
Bear Stearns	20.5	22%	15.8	25%	+29.7%	95%	1	Mix HS & Covar
Goldman Sachs	70.0	39%	67.0	38%	+4.5%	95%	1	HS
Lehman Brothers	31.4	23%	26.8	22%	+17.2%	95%	1	HS
Merrill Lynch	38.0	40%	28.0	55%	+35.7%	95%	1	HS
Morgan Stanley	85.0	41%	73.0	43%	+16.4%	99%	1	Mix HS & MCS

Notes:

- HS = Historical Simulation
- MCS = Monte-Carlo Simulation
- Covar = Parametric Approach (Variance/Covarance)
- Diversification benefit in % measured as total average VaR divided by sum of VaRs by risk factors minus one

Table 2: Regulatory Value-at-Risk in relation to other metrics of the firm

	US$m VaR to Basel Regulatory Standard		Regulatory VaR as % of Tier I capital		Trading Revenue /Regulatory VaR	
	FY2005	FY2004	FY2005	FY2004	FY2005	FY2004
Bear Stearns [b, c, d]	95.7	70.6	89 bp	79 bp	40 x	51 x
Goldman Sachs [b, c, d]	371.1	299.6	133 bp	119 bp	42 x	40 x
Lehman Brothers [b, c, d]	160.1	124.8	102 bp	92 bp	46 x	42 x
Merrill Lynch [b, c]	178.9	152.0	60 bp	62 bp	20 x	15 x
Morgan Stanley [b, c, d]	268.8	253.0	101 bp	97 bp	27 x	22 x
YOY % increase	**+19.4%**		**+1.2%**		**+15.4%**	

Notes:

- Reported VaR figures converted to 99% confidence levels and 10-day holding periods. The greater of reporting period end VaR and reporting period average VaR is used for the Basel VaR number equivalent
- Where Tier I capital figures are not available, we used tangible common equity plus preference capital
- Trading revenue figure used is the principal transactions results on the books other than the private equity / venture capital / long- term holdings portfolios.
- Regulatory VaR as % of Tier I capital reported in basis points (bp). One hundred basis points equal 1%
- Trading revenue divided by VaR is reported as a multiple of VaR. For example 40 x means that trading revenues are 40 times the size of regulatory VaR.

Appendix 4

VALUE-AT-RISK AND COHERENT RISK MEASURES

A risk measure can be viewed as a function of the distribution of portfolio value X, which is summarized into a single number, $\rho(X)$.
Coherent risk measures meet the following properties[8]:

- Subadditivity: $\rho(X+Y) \leq \rho(X) + \rho(Y)$
- Positive homogeneity: for any $\lambda>0$, $\rho(\lambda X) = \rho\lambda(X)$
- Monotonicity: $X \leq Y \Rightarrow \rho(X) \leq \rho(Y)$
- Translation invariance: For all real α: $\rho(X+\alpha r) = \rho(X) - \alpha$

These properties ensure that a measure is fair, robust, and relevant:

- Sub-additivity guarantees that the risk measure of an aggregate portfolio will be less then or equal to the sum of the risk for the sub-portfolios.
- Positive homogeneity ensures that the measure scales risks appropriately/For example, the risk measure for half a portfolio would be half the risk measure of the total portfolio.

(Risk measures that satisfy both conditions (sub-additivity and homogeneity) fully capture the benefits of diversification)

- Monotonicity ensures that measure ranks portfolios according to their risks. If portfolio A generates at least as high a payoff as portfolio B for every possible state of nature, then portfolio A should have the same or less risk.
- Translation invariance ensures that the risk of a portfolio will be reduced in proportion to the amount of the added risk-free investment.

Value-at-Risk (VaR) defined as the maximum expected loss over a given horizon at a predetermined confidence interval is not a coherent risk measure, as it does not meet the sub-additivity property. It is possible to find examples of short option positions that can create large losses with a low probability and hence have low VaR, yet combine to create portfolios with larger VaR. Only when portfolios' returns are elliptically distributed does VaR meet the sub-additivity property. (The normal distribution is a special case of the set of elliptical distributions).

There is a large set of coherent risk measures to choose from. One in particular exists because its simplicity and closeness to VaR has gained traction in the financial community: the expected shortfall. ***The expected shortfall is defined as the unweighted average of all losses beyond a threshold quantile (reciprocally a confidence interval).***

If this quantile is chosen as the one used to define the VaR level (for example: 95%), then the expected shortfall is simply the expected loss once the VaR threshold is pierced (i.e., the ES quantifies the loss in the tail in the distribution). The ratio of expected shortfall over VaR gives a good indication of the fatness of the tail of the loss distribution and hence provides a transparent risk indicator for firms that have roughly the same VaR levels. If the loss distribution is normal, the ratio of ES/VaR at the 99.5% confidence interval is only 1.12. However, for the extreme value distribution, which has a much fatter tail, this same ratio is: 1.33.

The expected shortfall is not a new concept and has been used by the insurance industry to price policies for a number of years.The calculation of expected shortfall is a fairly straightforward extension of VaR since it can be approximated as the simple average of VaR measures at different threshold levels. As a result any VaR computation routine can be easily reprogrammed to produce an expected shortfall number in addition to the usual VaR output.

[8] For further details, see Artzner P. et. al. (1999) 'Coherent Measures of Risk', Mathematical Finance, vol.9, July, pp. 203-228.

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