Review of CME Group's Credit Default Swap Margin Model and Financial Safeguards for CDS Clearing

April 18, 2009

Executive Summary

Risk Management Consulting Services, Inc. ("RMCS") was engaged by CME Clearing, the clearing division of CME Group, Inc. ("CME Group"), to review the CME Group model for margining credit default swaps ("CDSs") and to comment on the company's financial safeguards available to cover any CDS clearing member default-related losses in excess of margin. Specifically, RMCS was engaged to review the CDS margin model and financial safeguards package at a broad level. In addition, RMCS was retained to review and assess the extensive empirical testing and evaluation of the margin model undertaken by CME Clearing and Risk Resources LLC.

The major conclusions from our review are as follows:

(1) CME Group's approach to determining CDS portfolio margin is conceptually sound and has several practical advantages vis-à-vis alternative approaches considered by CME Group.

(2) Margin requirements on CDS portfolios calculated in CME Group's margin model are based on a generally conservative set of assumptions.

(3) CME Group's back-testing efforts indicate that the proposed margin generally delivers in excess of the 99% coverage objective that CME Clearing has set as its principal control objective.

(4) Additional financial safeguards are available to absorb losses that may result if a clearing member defaults at a time when its net obligation to CME Clearing across its house and/or aggregate customer-segregated accounts exceeds its margin.

(5) CME Group's proposed integration of CDS clearing into its existing financial safeguards is reasonable and consistent with the safety and soundness of CME Clearing.

(6) Catastrophic "jumps to default" by reference entities underlying single-name CDSs may precipitate margin coverage shortfalls on portfolios with highly concentrated exposures to the defaulting reference name(s). Nevertheless, we do not consider a lack of 100% margin coverage of all such possible jump-to-default losses to be a significant flaw in either the CDS margin model or the clearing risk management process more generally.

The next section of this Executive Summary summarizes CME Clearing's risk management process as background for understanding CME Group's proposed CDS margin model. Following that introductory discussion, we briefly explain each of the above conclusions, which are substantiated in more detail in the Report that follows.

Background on CME Clearing Risk Management Mechanisms

At present, virtually all CDSs are bilateral contracts negotiated over-the-counter ("OTC") between protection buyers and sellers. Unlike exchange-traded derivatives that are cleared and settled by a central counterparty ("CCP"), CDSs thus expose users to the credit risk of each of their counterparties. To manage those counterparty exposures, market participants have to date typically relied primarily on netting and collateral requirements.

The CME Group CDS clearing initiative provides a CCP facility for credit default swaps by integrating CDSs into the existing CME Clearing House. To manage its CCP risk exposures, CME Clearing will utilize the same risk management principles on which it has relied for many decades to clear futures and options.

CME Clearing requires all trades to be guaranteed by a clearing member. Twice daily, all clearing members must settle any net mark-to-market payment obligations arising from losses in their house or customer accounts. To cover potential losses between mark-to-market periods, CME Clearing imposes margin requirements on clearing members. In turn, clearing members must collect margin from their customers.[i] If a customer's account declines in value by more than the customer's margin on deposit with its clearing member, the clearing member demands cash to cover the loss and additional margin to collateralize the customer's ongoing exposure. If the customer defaults to the clearing member, the clearing member must cover the corresponding obligation to CME Clearing.

A default by a customer on a required margin or mark-to-market payment to its clearing member does not necessarily mean CME Clearing incurs any losses, which would put the capital resources of *non*-defaulting firms at risk. Before that happens, the clearing member must default, which occurs if the clearing member lacks the financial resources to cover its margin and/or mark-to-market obligations to CME Clearing on either its customer-segregated accounts or its house account.

In the event of a clearing member default arising from a customer default, CME Clearing may apply all customer-segregated margin and any profits or margin in the defaulting member's house account to offset losses in its customer-segregated accounts. So, CME Clearing is only exposed to losses on customer defaults if all of the following occur at the same time: (i) one or more customers default to a clearing member; (ii) the clearing member lacks the financial resources to cover its defaulted customer obligations or its house account obligation to CME Clearing; and (iii) the net obligation of the clearing member to CME Clearing across all customers and its house account exceeds the clearing member's total margin and surplus mark-to-market profits.[ii]

In the eventuality that a clearing member default coincides with a margin shortfall, CME Group has additional financial resources that can be used to cover such a loss that presently total approximately $6.6 billion[iii] consisting of about $50mn in surplus CME Group funds, $1.75bn in security deposits[iv] paid in by clearing members,[v] and $4.8bn in contingent assessment powers on clearing members. In addition, the CME Group has a secured line of credit of $600 million (renewed in October 2008) on which CME Clearing can draw to cover same-day cash shortfalls in consequence of a clearing member default.[vi]

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[i] Customer margin requirements imposed by clearing members may be higher than clearing member margin requirements imposed by CME Clearing.

[ii] If a clearing member defaults as a result of losses in its house account, CME Clearing may not apply customer-segregated funds to those losses. Non-defaulting customer accounts are simply transferred to other non-defaulting clearing members. So, CME Clearing is exposed to losses on house account defaults any time the clearing member lacks the financial resources to cover its own house account obligations to CME Clearing and the resulting losses exceed house account margin.

[iii] As of December 31, 2008. *See* CME Group, Inc., *Securities and Exchange Commission Form 10-K* (March 2, 2009).

[iv] Security Deposits are also sometimes referenced collectively as either a clearing default fund or guaranty fund.

[v] Participants in the CME Group's CDS clearing venture will be required to post security deposits based on the level of their clearing activity.

[vi] This Report is limited to a review of CDS margin calculations. We have not independently examined the adequacy of the additional financial resources available to CME Group to cover default-related losses in excess of margin or the CME Clearing's systems for assessing the sufficiency of those resources.

Our Major Conclusions

(1) CME Clearing's multifactor model approach to determining CDS portfolio margin requirements is conceptually sound and has several practical advantages vis-à-vis alternative approaches considered by CME Group.

CME Clearing's margin model determines margin requirements for CDS portfolios, not individual CDS positions. This approach appropriately recognizes the offsetting nature of long and short exposures in the same trading account.

In the CME Group model, portfolio margin is assessed based on a factor model designed to capture the possibility of large CDS price movements, as well as potential illiquidity and other characteristics of a CDS portfolio that may be relevant in the event CME Clearing must liquidate or hedge such a portfolio following a clearing member default. The model calculates a CDS portfolio's exposure to risk factors that capture overall CDS price movements and to risk factors that describe idiosyncratic price movements or compensate for specific features of CDS portfolios.

The use of multifactor models to describe likely price movements is well-accepted and well-documented in the asset pricing literature and in practice. In the context of margin determination, the multifactor model approach also has the critical virtues of replicability and transparency. Both of these attributes are particularly important given the two-tiered margining system in which CME Clearing assesses margin requirements on clearing members and members in turn assess margin on their customers.

The alternative CDS margin modeling approaches considered by CME Clearing included Monte Carlo simulation, value at risk, volatility-based margin, and rules-based margin. Among these, CME Clearing gave the most consideration to Monte Carlo simulation, which, like the factor model approach, has ample precedent in the literature and in practical valuation and risk measurement applications. But unlike the factor model approach, Monte Carlo simulation cannot be replicated, recalculated, or applied to customer accounts by clearing members to the same degree as the factor model approach.

(2) Margin requirements on CDS portfolios calculated in the CME Group margin model are based on a generally conservative set of assumptions.

The total margin required on a CDS portfolio under the CME Group model is the sum of scenario-based portfolio losses arising from seven component risk factors. Because the model sums margin requirements across risk factors, it offers the protection that would result if those risk factors were perfectly correlated (*e.g.*, if the extreme outcomes on all factors were to occur simultaneously). The margin model thus will err on the side of conservatism, especially during normal market conditions.

(3) CME Clearing back-testing efforts indicate that the proposed margin model generally delivers in excess of the 99% coverage objective that CME Group has set as its principal risk control objective.

CME Group has stated that the CDS margin model should cover at least 99% of all potential changes in CDS portfolio values over the time it would take CME Clearing to hedge or liquidate the open positions of a defaulting clearing member. On that basis and assuming a one-day liquidation horizon,[vii] the CME Group model has delivered the 99% or better target coverage on the test portfolios CME Clearing has examined.

[vii] CME Clearing has also examined coverage for certain portfolios over multi-day liquidation horizons to evaluate potential situations in which the open positions of a defaulting clearing member cannot be quickly hedged or liquidated.

Specifically, CME Clearing reviewed more than 1,000 test portfolios – some randomly generated, and some specifically constructed to reflect particular trading strategies. CME Clearing also analyzed several single-name CDSs on reference entities that experienced known credit deteriorations in 2008. Margin requirements on test portfolios were then compared to historical simulations of absolute profits and losses ("P&L")[viii] from April 2008 through December 2008 (the "evaluation period").[ix]

To assess whether the test portfolios provide the desired 99% coverage, CME Clearing examined "portfolio-day" coverage – *i.e.,* the percentage of total portfolio days in which any test portfolio would have exposed CME Clearing to a loss in excess of margin over a presumptive one-day exposure horizon. For the random portfolios, margin was adequate to cover absolute P&L on 99.99% of the portfolio-days analyzed. For the non-random portfolios, absolute P&L never exceeded margin requirements. For the single-name protection sales, about 99.8% of all portfolio-days were covered by margin. The CME Clearing margin model thus delivered even more than CME Clearing's desired coverage protection on the test portfolios examined over the evaluation period.

(4) If a clearing member defaults at a time when its net obligation to CME Clearing across its house and/or aggregate customer-segregated accounts exceeds its margin, additional financial safeguards are available to absorb such losses.

If margin is insufficient to cover a clearing member's open obligations to CME Clearing following a default, CME Group has an extensive set of further financial resources on which it can draw to cover default-related losses. As noted earlier, the financial resources available to CME Group presently total about $6.6 billion, and that total will increase based on the additional contributions resulting from CDS clearing activity. CME Group estimates that this amount of risk capital is sufficient to cover CME Clearing's potential exposure to a worst-case default by its largest net debtor in the CDS clearing arena.

CME Group reviews the adequacy of its financial safeguards package at least quarterly, moreover, and will collect additional risk capital from members when necessary (either to cover any incremental risks that result from CDS clearing or as changes in existing clearing risk exposures dictate).

(5) CME Group's proposed integration of CDS clearing into the existing financial safeguards is reasonable and consistent with the safety and soundness of CME Clearing.

The correlations of CDS returns with returns on certain other major asset classes cleared by CME Clearing are relatively low. As such, CME Group's plan to integrate CDSs into its existing financial safeguards package offers greater safety for each unit of risk capital, and will require less new risk capital than if CME Group's CDS clearing initiative were backed by a stand-alone guaranty fund with contribution requirements unique to CDS clearing.

[viii] Because a simulated profit on any given portfolio is offset by identical losses in some other trading account(s), CME Clearing essentially also treats profits as potential losses. Absolute P&L thus is the absolute value of the portfolio's profit *or* loss on a given day.

[ix] Estimation of the factors used in CME Clearing's CDS margin model is based on data from March 2, 2007 to March 31, 2008.

(6) Catastrophic "jumps to default" by reference entities underlying single-name CDSs may precipitate margin coverage shortfalls on portfolios with highly concentrated exposures to the defaulting reference name(s). Nevertheless, we do not consider a lack of 100% margin coverage of all such possible jump-to-default losses to be a significant flaw in either the CDS margin model or the clearing risk management process more generally.

Unexpected "jumps to default" by reference entities underlying single-name CDSs can cause sudden and extreme declines in CDS prices. Although often large in principle, such price changes are often more limited in practice because CDS prices typically decline in advance of a default. Expected recoveries, moreover, can be significant.

In CME Clearing's evaluations of the margin model for single-name protection sales, a limited number of margin shortfalls occur for reference entities that experienced rapid credit deteriorations or discrete jumps to default during the evaluation period. Yet, neither we nor CME Clearing consider the failure of the margin model to cover fully all potential jumps to default as a significant flaw of the CDS margin model. Our reasons include the following:

- Given the additional financial safeguards available to CME Clearing to cover losses in excess of margin, the CME's risk management objective for its margin model is not 100% coverage – which would require 100% collateral for all positions, and is a commercial and practical impossibility. Instead, CME Clearing's CDS margin model is intended to provide 99% coverage, and the margin coverage shortfalls for single-name portfolios that CME Clearing examined satisfy this criterion.

- It is unlikely that both customer and clearing member portfolios would be strongly exposed to a single name. Most real-world portfolios – especially those of clearing members – are diversified across many reference names, as well as across industries and other factor exposures. The *portfolio* margin is therefore adequate even when a single name jumps to default, as CME Clearing found in its back-tests of portfolios. If a clearing member did amass a large, concentrated single-name exposure in its house or aggregate net customer accounts, that exposure would almost certainly be noticed by clearing house risk monitoring systems and management personnel. Large single-name exposures might be more likely in individual customer accounts, but clearing members would surely monitor such exposures, as well, and are free to charge additional margin.

- Following a default by a clearing member in its customer accounts, the customer positions are netted across all futures and options as well as CDSs. Even if the CDS portfolio of a single customer was concentrated in a single defaulting reference entity, the overall customer portfolio of the clearing member will be much less concentrated. A single-name jump to default could cause failures if it coincided with large losses on all other net positions cleared by the defaulting clearing member. But the relatively low historical correlations between CDSs and many of the products CME Clearing currently clears suggests that this scenario is unlikely.

- Concentrated exposures to indices are more likely than concentrated exposures to single-name portfolios. An index is, however, diversified across reference names by design, which helps ensure that index spreads do not generally jump to default in the same manner as spreads on individual reference names. The lack of any observed shortfalls in CME Clearing's back-tests of numerous index trading strategies supports this conclusion.

- CME Clearing has risk management processes in place in addition to its margin and other financial safeguards that facilitate monitoring, surveillance, and (near) real-time risk control. Although we

have not reviewed those processes in the course of our current review, CME Clearing's risk management systems are time-tested over a variety of economic conditions and products.

Although we find that the CME Clearing's CDS margin model achieves its goals, our Report concludes with some small suggestions on how potential modifications based on monitoring the model's operational performance might result in even greater safety, some additional efficiency (*i.e.,* achieving the same safety with less margin), and greater pricing transparency.

I. Introduction

A. Scope and Methodology

Risk Management Consulting Services, Inc. ("RMCS") was engaged by CME Clearing, the clearing division of CME Group, Inc. ("CME Group"), to review the CME Group model for margining credit default swaps ("CDSs") and to comment on the company's financial safeguards available to cover any CDS clearing member default-related losses in excess of margin. Specifically, RMCS was engaged to review the CDS margin model and financial safeguards package at a broad level. In addition, RMCS was retained to review and assess the extensive empirical testing and evaluation of the margin model undertaken by CME Clearing and Risk Resources LLC.[1]

This review was undertaken by RMCS (www.rmcsinc.com) in cooperation with Compass Lexecon (www.compasslexecon.com). The primary members of the review team were as follows:

- *Christopher L. Culp, Ph.D.* – Director of RMCS, Senior Advisor to Compass Lexecon, and Adjunct Professor of Finance at The University of Chicago's Booth School of Business
- *John H. Cochrane, Ph.D.* – Myron S. Scholes Professor of Finance, The University of Chicago Booth School of Business
- *Andrea M. P. Neves, M.A., M.S.* – President, Seven Consulting, Inc.
- *Hal S. Sider, Ph.D.* – Senior Vice President, Compass Lexecon

Questions or requests for further information on this Report or on the CME Clearing margin model should be directed to CME Clearing, and not to RMCS, Compass Lexecon, or the above individuals.

B. Structure of the Report

This Report summarizes the major findings of our review and analysis of CME Clearing's CDS margin model.[2] Section II of this Report begins with a review of credit default swaps and the means by which counterparty credit risks were managed on such CDSs through 2008. In Section III, we review the background underlying recent initiatives to create central counterparty ("CCP") clearing for CDSs in general and CME Group's CDS clearing initiative in particular. Section IV summarizes our evaluation of CME Clearing's CDS margin model. In Section V, we review the financial safeguards in place at CME Clearing to cover any default-related losses in excess of margin. Section VI concludes.

[1] We do not distinguish between CME Clearing and Risk Resources personnel or analyses in this Report.

[2] Portions of our review were performed in conjunction with the CME Clearing's regulatory approval process for its CDS clearing initiative and thus are confidential. Nevertheless, all of the significant conclusions from that more detailed review are summarized here.

II. Credit Default Swaps and Counterparty Exposure Management Through 2008

A. Credit Default Swaps

A credit default swap ("CDS") is a derivatives contract in which a credit protection buyer makes a fixed payment periodically to a credit protection seller in exchange for a specified contingent payout following a default event on the asset(s) underlying the CDS. At present, virtually all CDSs are negotiated over-the-counter ("OTC"). In other words, CDSs are bilateral contracts between the protection buyer and seller that can be customized along any dimensions to meet the needs of the particular counterparties in any given transaction.

Single-name corporate CDSs are based on corporate securities issuers known as "reference names" or "reference entities." Such single-name corporate CDSs provide buyers with protection in the event of a default on any eligible corporate debt security issued by the reference entity. Single-name CDSs can also be based on specific reference assets, such as sovereign debt obligations or asset-backed securities. In addition, numerous portfolio CDS products exist, ranging from CDS index products to funded and tranched CDS transactions.[3] CME Clearing currently plans to clear only CDSs and indexes based on corporate securities.

Credit events that trigger contingent payments from protection sellers to buyers in a typical single-name corporate CDS include the bankruptcy or insolvency of the reference entity, a failure of the reference entity to make a scheduled principal or interest payment on its debt securities, or a failure of the reference entity to meet contractually required payment obligations on other OTC derivatives such as interest rate swaps. Upon the occurrence of such a credit event, the protection seller either makes a cash payment to the protection buyer (equal to the par amount of the security less the expected recovery) or the protection seller pays cash to the buyer equal to the par amount of the CDS in exchange for receiving an eligible security issued by the defaulting reference entity. Until recently, the vast majority of single-name CDSs has been settled in the latter manner, known as physical settlement.[4]

CDSs are analogous to credit insurance and can be used either to hedge the default risk of a security or to take a position on the credit risk of the underlying reference entity.[5] The price paid by a protection buyer in a CDS – analogous to premium paid in an insurance contract – is called the CDS spread. CDS spreads are quoted on an annualized basis and typically payable quarterly. CDSs also specify the duration or tenor of the protection, with the most common tenors being 1, 3, 5, 7 and 10 years.

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[3] Funded, tranched CDS transactions are known more popularly as synthetic collateralized debt obligations.

[4] Physical settlement of CDSs (which requires the protection buyer to deliver the defaulted security) has posed some problems for the industry, especially when the amount of protection sold through CDSs exceeds the amount of bonds issued by the reference name. To help address this problem, the International Swaps and Derivatives Association ("ISDA") has developed protocols that allow CDS participants to convert physically settled CDSs to cash-settled CDSs following a default. The expected recovery rate used to settle CDSs in such instances is determined through an auction of the underlying defaulted reference securities administered by Markit/Creditex.

[5] Unlike traditional credit insurance, the credit protection purchaser in a CDS contract is not required to have an "insurable interest" in the underlying reference asset.

Although CDSs were introduced in the early 1990s and are often (wrongly) considered exotic new financial instruments,[6] they are perhaps best understood as natural extensions of previously existing contracts for managing credit-related risks. For example, CDS contracts are very similar to financial guaranties in which insurance companies agree to guarantee principal and interest payments on some underlying debt security. Since the 1970s, such financial guaranties have been an integral part of public finance and municipal bond markets.[7]

Despite the significant attention and focus on problems affecting the performance of CDS markets in recent months, it is also generally recognized that CDSs can play an important and efficiency enhancing risk-diversification function.[8]

B. CDS Transaction Negotiation and Trade Processing

Nearly all CDS transactions are negotiated through derivatives dealers. Such dealers are typically internationally active financial institutions such as commercial and investment banks. In a typical CDS transaction, the dealer acts as a principal and not merely a broker or an agent. CDS users thus are exposed to the credit risk of their dealer counterparties.

Inter-dealer brokers ("IDBs") also play an important role in the CDS market. The major IDBs help dealers (and sometimes end users) identify multiple bids and offers and reduce the costs of searching for and identifying counterparties for complex transactions. Various IDBs also provide ancillary services to CDS dealers, including trade affirmation, connectivity with other market participants, data collection, and valuation tools.

Centralized information about live CDS quotes and *ex post* transaction prices is lacking. Bids, offers, and acceptances are usually communicated via phone, e-mail, and instant messaging. Various quotation services provide indicative quotes for generic CDS transactions, but such quotes are often lagged and do not represent actual bids and offers at which dealers are willing to transact on a particular deal. After-the-fact transaction prices, moreover, are generally only reported to data vendors on an ad hoc basis.

Operationally, the processing of CDS transactions today involves a variety of services and providers. The major steps in a CDS transaction include the following:

- *Negotiation and Execution*: The parties set the terms of the transaction.

- *Trade Capture*: The parties each record the terms of the trade.

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[6] For example, *The Economist* (April 12, 2007) referred to credit derivatives as "exotic instruments," and Reuters notes that CDS are "opaque and highly complex instruments whose market value can often only be estimated by computer models." (Reuters, "ECB Supports Central Counterparties for CDS," November 3, 2008).

[7] Despite the problems encountered by several major "monoline" financial guarantors in 2008, financial guaranties continue to play an important role in certain bond markets.

[8] *See, e.g.,* U.S. Government Accountability Office, *Credit Derivatives: Confirmation Backlogs Increased Dealers' Operational Risks, But Were Successfully Addressed After Joint Regulatory Action*, GAO Report to Congressional Requesters GAO-07-716 (June 2007), p. 5., and Congressional testimony of the Director of the Securities and Exchange Commission's Division of Trading and Markets (Congressional Hearings, "House Agriculture Committee Holds Hearing on the Role of Credit Derivatives in the U.S. Economy," October 15, 2008, p. 7.)

- *Trade Confirmation*: The parties verify the key economic terms of the trade and establish an official record of the trade.

- *Servicing*: Either the CDS counterparties or a third party services the transaction. Servicing includes settling funds payments and processing payments and securities deliveries following credit events.

C. Bilateral Counterparty Credit Exposure Management

Unlike exchange-traded derivatives cleared and settled by a CCP, CDSs – like most other OTC derivatives – expose their users to the specific credit risks of their counterparties. As a result, a CDS trader cannot simply offset a single-name CDS protection purchase (sale) with an offsetting protection sale (purchase) with a different counterparty. Although such a transaction would hedge the trader's exposure to the credit risk of the underlying reference asset, the trader would face counterparty risk to both its original trading counterparty and its hedge counterparty.

To manage their counterparty credit exposures to date, market participants have typically relied primarily on bilateral netting and/or collateral.

(1) Bilateral Netting

Most CDSs are negotiated under ISDA Master Agreements that provide for bilateral cash flow netting and netting in the event of a counterparty default. For cash-settled CDSs or physically settled CDSs that are cash-settled following a default (through the ISDA/Markit/Creditex auction process), bilateral netting can significantly reduce the actual credit exposures between two counterparties.

A significant proportion of reported CDS activity is tracked through the Depository Trust and Clearing Corp. ("DTCC") Deriv/Serv system, used by many dealers to confirm trades. DTCC also operates a Trade Information Warehouse that maintains an official record of CDS contracts confirmed by DTCC. CLS Bank International provides settlement services for contracts processed in the DTCC Trade Information Warehouse. Although DTCC and CLS Bank do not guarantee performance on CDS transactions per se, they do enhance the efficiency of netting bilateral CDS credit payments.

The ISDA Master Agreements also facilitate cross-product netting, so that two counterparties with significant bilateral OTC derivatives exposures can net across derivatives based on different underlying asset classes (*e.g.,* interest rate swaps and CDSs).

(2) Collateral

CDSs documented under the ISDA Master Agreements typically include a Credit Support Annex ("CSA") that articulates specific collateral requirements for the CDS protection seller and possibly the protection buyer.[9] Although collateral requirements can vary substantially across counterparties and transactions, the collateral that a counterparty must post is usually a function of its perceived credit worthiness and the size of the potential credit exposure on the transaction.

Unlike exchange-traded futures and options margin, collateral on CDSs negotiated under ISDA Master Agreements is not marked-to-market twice-daily. On most CDS transactions negotiated OTC under the

[9] Protection buyers must sometimes post collateral or other credit enhancements to guarantee their fixed spread payments over time in the event that the spread declines. On pay-as-you-go ("PAUG") CDSs, moreover, protection buyers may owe funds to the protection seller in addition to the periodic CDS spread that must also be collateralized.

ISDA Master Agreements and CSA, additional collateral is usually callable only following the downgrade of a counterparty, a significant increase in the mark-to-market credit exposure of the "in-the-money" counterparty, or both. In those situations, the "out-of-the-money" counterparty receives a collateral call from the in-the-money counterparty.

Given the non-transparent and decentralized nature of the OTC market, however, significant disagreements can occur about collateral posting requirements, often arising from disputes over the prices used to calculate current mark-to-market CDS values. Because collateral calls in the OTC market are less frequent and are often triggered by events such as credit downgrades, moreover, they can be much larger than typical exchange margin calls. As a result, collateral shortfalls on OTC credit default swaps can be much larger than on CCP-cleared products subject to twice-daily margining. In extreme situations, large OTC collateral calls from multiple counterparties at the same time can precipitate a liquidity crisis, as we saw in 2008.

D. The Move Toward Central Counterparty Clearing

In March 2008, the President's Working Group on Financial Markets ("PWG") established several policy objectives for OTC derivatives with "a primary focus on credit default swaps."[10] These objectives were restated on November 14, 2008, at which time the Treasury Department issued a press release indicating that "the PWG's top near-term OTC derivatives priority is to oversee the successful implementation of [CCP] services for credit default swaps."[11] Two of the rationales provided by the PWG were the need to consolidate and manage CDS credit exposures multilaterally (rather than bilaterally) and the need for greater transparency in CDS markets.

(1) Consolidation of Credit Risk at the CCP

The separation of price and credit risks has long been recognized as a significant benefit of organized futures exchanges and CCPs.[12] By interspersing a single counterparty between all buyers and sellers, a CCP system can help market participants realize the following potentially significant benefits:

- A CCP can increase market liquidity by reducing market participants' concerns about counterparty default risk and the time-consuming and costly process by which market participants must evaluate and monitor those risks. Concerns about a potential firm's default can also can lead to a "run" in which the counterparties of a dealer perceived to be at risk of default rush to unwind their positions. The existence of CCP clearing reduces such concerns because the clearing house assumes such default risks.

- CCP clearing facilitates the monitoring of market participants' aggregate activity, enabling both regulators and the clearing house to evaluate more effectively the risks faced by individual market

[10] President's Working Group on Financial Markets, *Policy Objectives for the OTC Derivatives Market* (November 14, 2008). (hereinafter "PWG Report") The PWG consists of representatives from the Department of the Treasury, Board of Governors of the Federal Reserve System, the Securities and Exchange Commission, the Commodity Futures Trading Commission and the Office of the Comptroller of the Currency.

[11] U.S. Treasury Department, *Press Release* (November 14, 2008), p. 1. For a similar more recent such proposal, *see* T. Geithner, *Written Testimony Before the House Financial Services Committee* (March 26, 2009).

[12] *See, e.g.,* L. G. Telser, "Why There are Organized Futures Markets," *Journal of Law and Economics* 24(1) (April 1981).

participants, as well as any systemic risks.

- Procedures established by CCPs facilitate the expeditious and orderly resolution of claims following a default by a market participant. When transactions are bilateral, by contrast, a bankruptcy filing by one of the parties may result in collateral being frozen for an extended period of time. CCPs typically have well-established procedures for quickly liquidating positions held by defaulting participants.

- CCP clearing encourages the standardization of contract terms. This lowers the cost of negotiating a contract and again may enhance market liquidity. Standardization also often facilitates the ability of firms that hold portfolios of contracts to offset existing positions. This further promotes liquidity by reducing the collateral a customer needs to maintain for a portfolio of positions.

(2) Transparency of Pricing and Collateral Requirements at CCPs

The lack of transparency in CDS pricing is a problem well-recognized by market participants. Credit Suisse, for example, notes: "Given that the majority of credit derivatives transactions are negotiated over the phone and through email message traffic, collecting standardized market data that is both timely and reliable has been a challenge."[13]

During 2007 and 2008, the lack of pricing transparency (and, in some cases, a lack of liquidity) contributed to disputes among CDS market participants about the valuation of CDS positions for the purpose of enforcing or disputing collateral calls. Such disputes can be disruptive, time-consuming, and costly, and can expose market participants to potentially significant and unexpected liquidity shocks.

By contrast, CCP clearing facilitates the establishment of consistent and transparent collateral (*i.e.,* margin) requirements. CCPs establish standard procedures for marking contract prices to market and reduce operational risks by establishing efficient mechanisms for monitoring and ensuring compliance with margin requirements. The aggregation of pricing information in the clearing house also enhances financial safeguards by reducing disputes about collateral valuation. Similarly, clearing house-mandated standardization of contract terms facilitates the establishment of collateral requirements by reducing the scope of idiosyncratic contract terms. In addition, increased liquidity resulting from the reduction in counterparty risk associated with the CCP framework improves the reliability of pricing information used in the establishment of collateral requirements.

(3) Recent Problems in CDS Markets

The absence of CCP clearing does not necessarily imply that OTC markets fail to provide adequate financial safeguards. On the contrary, it is widely recognized that OTC derivatives participants can in some markets successfully manage their credit risks and in those cases may sometimes prefer to keep their transactions over-the-counter. If, for example, dealers are well-capitalized and have access to ample liquidity, the risks of "runs" resulting from possible dealer defaults or liquidity crises arising from unexpected collateral calls are relatively low. Similarly, OTC markets will be more likely to successfully manage credit risks if rating agencies are successful in evaluating the creditworthiness of their customers.[14]

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[13] Credit Suisse, *Financial Exchanges and Market Structure* (September 29, 2008).

[14] *See* R. Kroszner, "Can the Financial Markets Privately Regulate Risk?" *Journal of Money, Credit and Banking* 31 (1999). In certain circumstances, moreover, OTC market participants may have specialized information

Nevertheless, the credit market disruptions during 2007 and 2008 have reminded us that swap dealers are *not* always seen as sufficiently well-capitalized to stave off runs and liquidity crises. As such, CCP clearing services may help address problems in administering financial safeguards for CDS transactions by: (i) mutualizing credit risks and reducing the likelihood of systemic problems resulting from the failure of a major dealer; (ii) creating transparent rules for moving collateral and improving the monitoring and enforcement of collateral requirements; (iii) improving the efficiency of collateral collection and other aspects of CDS clearing operations;[15] and (iv) applying consistent valuation and pricing to collateral.

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that facilitates their evaluation of risks associated with specialized instruments. These issues are addressed in C. Pirrong, "Rocket Science, Default Risk and the Organization of Derivatives Markets," SSRN Working Paper (April 2006).

[15] For example, the GAO and others noted difficulties in processing CDS trades, including backlogs of unconfirmed CDS trades. See GAO Report, *op. cit*.

III. The CME Group Central Counterparty Clearing Initiative for CDSs

In response to the PWG's recommendations and similar concerns amongst market participants about counterparty credit risk management for bilateral OTC CDS transactions, CME Group, working with Citadel, announced its intention to provide CCP clearing services for certain CDS contracts. CME Group's initiative to clear and provide CCP services for certain CDSs is designed to extend its existing clearing house processes, controls, and safeguards into the CDS product space. In other words, in lieu of creating a new standalone facility, the CME will fold CDSs into the existing CME Clearing.

Initially, CME Clearing will clear the major indices on North American and European corporate reference entities (including the CDX and iTraxx families of indices), single-name CDSs based on the constituent reference entities underlying those indices, and selected additional single-name CDSs on corporate reference names. CME Clearing does *not* plan at this time to clear CDSs based on sovereign debt, asset-backed securities, or the full range of single-name CDS, nor does CME Clearing plan in the near term to clear tranched CDS products.

To allow for multilatteral netting, CME Clearing has standardized the fixed spreads or coupons of its cleared CDS products. Specifically, any single-name CDS (regardless of the contractual spread) will be decomposed into two component CDSs: one with a 100bp coupon, and the other with a 500bp coupon.

A. CME Clearing Risk Management

CME Clearing has been providing CCP clearing and settlement services to numerous futures and options markets for over a century, during which time neither CME Clearing nor any of its clearing members have incurred any credit losses arising from a clearing member default. To preserve the safety and soundness of CME Clearing, CME Clearing relies on a multi-pronged system of risk management principles, practices, and controls.

One key feature of the risk management process is the reliance by CME Clearing on a clearing-member-centric structure. Although any eligible market participants have access to the CCP services provided by CME Clearing, only authorized clearing members have a *direct* credit relationship to CME Clearing. Specifically, all customer transactions must be guaranteed by a clearing member, and that clearing member is liable to CME Clearing for any outstanding mark-to-market payment obligations the end customer cannot satisfy. Clearing members, in turn, are subject to membership requirements, ongoing credit surveillance and monitoring, and capital adequacy requirements. In this manner, CME Clearing ensures that its only direct credit exposure is to those clearing members that it has the authority to oversee and monitor.

A second feature of CME Clearing risk management is the prudential margin system. Initial margin must be posted as a performance bond for any newly established positions, and all open positions must satisfy minimum maintenance margin requirements. Non-clearing-member customers are required to post margin with their clearing members as a performance bond, and clearing members in turn are required to post margin with the Clearing House for both their customer and house clearing accounts.

A third and related feature of CME Clearing risk management is the twice-daily mark-to-market and resettlement process. Twice each day, open positions are marked to current market prices, and losses

on any trading accounts must be paid in cash. In this manner, CME Clearing ensures that its exposure to the risk of a clearing member default is generally limited to the time between mark-to-market periods.[16]

If the financial resources of a clearing member are inadequate to cover any unsettled customer payment obligations, the clearing member is in default with CME Clearing. CME Clearing then nets all positions in the customer-segregated accounts (including both CDS and non-CDS products). Any gains and excess collateral in the defaulting clearing member's house account (plus certain other resources of the clearing member) can also be applied to cover the remaining loss in the customer accounts. If a large loss in excess of margin occurs in a defaulting clearing member's house account, by contrast, customer funds may not be applied to cover any open obligations. Instead, the customer accounts are transferred to other non-defaulting clearing members.[17]

If a clearing member defaults with unsettled obligations and open positions (after netting), CME Clearing as the CCP essentially inherits those open positions, and, if practicable, generally will endeavor to hedge any OTC exposures as desired, and to liquidate OTC and open futures positions in a timely and non-destabilizing manner. Any resulting losses in excess of margin are absorbed by CME Group's financial safeguards package, which includes about $50mn of surplus funds, $1.75bn of paid-in security deposits contributed to CME Clearing by clearing members, and approximately $4.8bn in assessment rights on non-defaulting clearing members for post-default top-up contributions to cover any remaining losses. In other words, CME Group has approximately $6.6bn of risk capital available to absorb clearing member default-related losses in excess of margin.[18] In addition, CME Group has a secured line of credit of $600 million (renewed in October 2008) on which CME Clearing can draw to cover any short-term (*e.g.,* same-day) cash shortfalls precipitated by a clearing member default.

B. Motivations for Integrating CDSs into the Existing Clearing House

We understand that the decision by CME Clearing to integrate CDSs into the established current clearing framework was made after careful consideration of the risks and nature of CDSs. That integration reflects the following CME Group business objectives:

- *Open Structure:* Membership in the CME Group CDS clearing initiative will available to dealers and qualified buy-side participants (*i.e.,* any market participants that meet "eligible contract participant" criteria). The CDS clearing initiative will use the existing clearing member structure, in which all non-clearing-member customer transactions are guaranteed and cleared by a CDS clearing member.[19]

- *Transparent:* CDS clearing will be a transparent process. In particular, the margin calculation methodology and the pricing sources used by CME Clearing to calculate twice-daily pays and collects

[16] In practice, CME Clearing's exposure to losses can be longer than the time between resettlements if the open positions of a defaulting member cannot rapidly be hedged or liquidated.

[17] Customer funds are segregated away from house account funds. In the event that a clearing member defaults as a result of problems in its house account, customer-segregated accounts can be moved relatively quickly and easily to the segregated accounts of non-defaulting members.

[18] As of December 31, 2008. *See* CME Group, Inc., *Securities and Exchange Commission Form 10-K* (March 2, 2009).

[19] The criteria required for clearing CDS include historic operational and risk management capabilities of clearing CDS in addition to $300 million net capital requirements.

will be visible to market participants.

- *Capital-Efficient:* Members of the CDS clearing initiative are protected by CME Clearing's approximately $6.6bn of risk capital (in excess of margin) to cover losses that might arise from a clearing member default. Especially given the relatively low correlations of CDS products with many other futures and options cleared by CME Clearing, the CME Group approach is intended to provide CDS clearing members with the same capital efficiencies currently available under the company's existing financial safeguards program – *viz.,* requiring clearing members to post a single security deposit and pledge a single contingent commitment to CME Clearing for all cleared products is more efficient than a series of stand-alone requirements, provided the cleared products do not have perfectly correlated downside exposures.

- *Regulatory Certainty:* CDSs will be cleared by CME Clearing in its capacity as a CFTC Designated Clearing Organization. As such, CME Group's cleared CDSs will be subject to CFTC oversight and regulation, which includes customer funds segregation and a specifically crafted set of regulations concerning the resolution of clearing member defaults under U.S. bankruptcy laws. In addition, customers will be afforded the same CFTC regulations and customer protection safeguards now available to end users of other futures and futures options.[20]

In light of the above, we consider CME Group's planned integration of CDS clearing into the existing CME Clearing risk management framework and financial safeguards package as reasonable, efficient, and consistent with the safety and soundness of CME Clearing.

[20] CDS segregation status is currently pending a CFTC approval of a 4d order.

IV. Assessment of the CME Clearing CDS Margin Model

All risk measurement models have fundamentally the same objective – *viz.,* to measure potential losses arising from possible future economic scenarios in order to achieve some target risk profile. Some risk measurement models are based on discrete scenario analyses, whereas others are based on a more formal probabilistic approach in which scenarios (*e.g.,* future prices) are drawn from probability distributions. Parametric models examine future possible portfolio values as if they were drawn from a named probability density function (*e.g.,* the normal distribution), whereas non-parametric models examine future portfolio values using historical data as the basis for possible future portfolio values.

No particular risk measurement approach is *a priori* better than another. All financial models are approximations of reality, after all, and none is perfectly predictive. Risk exposure estimates are driven primarily by the underlying assumptions (and any associated parameter estimates related to those assumptions) about the evolution over time of prices and other economically relevant variables. For an identical set of such assumptions, differences in calculation methodologies should be minor, and the choice of one computational approach relative to another is primarily an implementation issue.

Accordingly, our assessment of the CME Clearing model has focused on three broad questions:

- Does the model make sense conceptually?
- Does the model generate risk coverage estimates that are consistent with the CME Group's desired risk coverage objectives?
- Does the model make sense from a practical standpoint and implementation perspective, especially *vis-à-vis* alternative models?

A. Conceptual Assessment of the Multifactor Model Framework

CME Clearing's CDS margin model is a type of factor-based margin model in which margin requirements for portfolios are computed based on several macro and micro risk factors that can influence the values of single-name and index CDS positions. Specifically, the CME Clearing model computes margin for these risk factors and then sums these components to get a total portfolio margin requirement.[21]

Factor models are common in financial economics and are often used to explain and characterize returns across different assets in terms of common risk factors (*a.k.a.* state variables).[22] Factors can be anything that explain or are thought to generate returns. Linear factor models estimated using historical data are especially pervasive in the financial asset pricing and valuation literature.[23]

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[21] As noted earlier, CME Clearing's CDS margin model is intended to be transparent to CDS clearing members. Although we do not discuss the details of the model here, such details are available to CME Clearing CDS clearing members.

[22] *See, e.g.,* J. H. Cochrane, *Asset Pricing* rev. ed. (Princeton University Press, 2005).

[23] *See*, *e.g.,* J. Y. Campbell, A. W. Lo, and A. C. MacKinlay, *The Econometrics of Financial Markets* (Princeton University Press, 1996), D. Duffie, *Dynamic Asset Pricing Theory* 3d ed (Princeton University Press, 2001), Cochrane, *op. cit.,* and K. J. Singleton, *Empirical Dynamic Asset Pricing: Model Specification and Econometric Assessment* (Princeton University Press, 2006).

In general, the variation in price changes of most fixed income securities and derivatives[24] can be explained by three pervasive factors – the level of prices/rates, the relation between prices/rates at different maturities, and a credit and/or liquidity risk adjustment.[25,26] In this sense, the macro factors in the CME Clearing margin model have ample precedent in the finance literature to substantiate their use as core determinants of margin requirements.

The CME Clearing CDS multifactor model also accounts for instrument- and sector-specific risks, including illiquidity and discrete jumps to default. Margin for these considerations is based both on the probability of price changes and also the potential illiquidity of both CDSs and the reference securities underlying CDSs. Because those risks are not necessarily reflected in the macro factors in the existing CME Clearing margin model, the model also includes several micro risk factors.

B. CME Clearing Margin Coverage Analyses

CME Clearing's primary risk control objective for its CDS margin model is to provide coverage for at least 99% of potential changes in CDS portfolio values over the time it would take the clearing house to hedge or liquidate any still-open positions assumed by CME Clearing from a defaulting clearing member. To test how the CDS margin model would have performed for various portfolios under actual market conditions relative to that criterion, CME Clearing compared margin requirements to profits and losses on three types of test portfolios: (i) randomly generated portfolios; (ii) non-random portfolios; and (iii) concentrated single-name CDS protection sales on reference entities that experienced credit deteriorations in 2008.

To assess whether the test portfolios achieved CME Clearing's desired 99% coverage level, we primarily focused on "portfolio-day" coverage as evaluated by CME Clearing over a nine-month period during 2008.[27] Specifically we examined CME Clearing's estimates of absolute profits and losses ("P&L")[28] to margin requirements by portfolio and by day during the 2008 evaluation period. Because marking to market and resettlement occurs twice daily, CME Clearing's tests of its margin model focus on a one-day exposure horizon.[29]

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[24] Selling credit protection in a CDS is synthetically equivalent to buying the underlying bond. In this sense, CDSs are correlated to the underlying credit sensitivities of the referenced fixed-income securities.

[25] *See, e.g.,* Cochrane, *op. cit.,* D. Brigo and F. Mercurio, *Interest Rate Models* (Springer, 2001), and D. Duffie and K. J. Singleton, *Credit Risk: Pricing, Measurement, and Management* (Princeton University Press, 2003).

[26] In the context discussed here, the impact of liquidity and default risk refers to liquidity and default risk premia *generally* (as opposed to the liquidity and default risks that may idiosyncratically affect any specific financial instrument).

[27] The margin requirements used over this evaluation period were based on a one-year historical time period. Notably, the period over which the margin model parameters were estimated was less volatile than the evaluation period.

[28] Because a simulated profit on any given portfolio is offset by identical losses in some other trading account(s), the CME essentially also treats profits as potential losses. Absolute P&L thus is the absolute value of the portfolio's profit *or* loss on a given day.

[29] CME Clearing also analyzed the adequacy of margin over multi-day exposure horizons to address scenarios in which open positions assumed by the clearing house from defaulting clearing members would take several days to hedge or liquidate. The results of these tests show predictably larger swings in P&Ls, but for the most part the margin model still covers the desired proportion of those swings.

For the random portfolios analyzed by CME Clearing, the margin was adequate to cover absolute P&L on all but one portfolio-day, which implies adequate coverage on 99.99% of total portfolio-days analyzed. In this sense, the margin model is considerably more conservative than its stated 99% objective.

CME Clearing also examined a variety of non-random portfolios designed to reflect particular exposures or trading strategies, including a variety of portfolios specified by regulators. None of these non-random strategic portfolios experienced any margin shortfall during the evaluation period.

Finally, CME Clearing also analyzed a number of single-name protection sales for selected reference entities that experienced adverse credit events during the evaluation period. For 1-year protection sales on the single-name reference entities considered, 99.8% of the portfolio-days in the evaluation period were adequately margined. The portfolio-day coverage was also 99.8% for 5-year single-name protection sales. As this suggests, no shortfall was observed for a large majority of the default events. Nevertheless, shortfalls were identified in a handful of instances. The largest such shortfall for the single-name protection sales examined was 144.7% of margin (*i.e.,* the simulated loss was about $245 for every $100 of margin required).

C. Alternative Approaches Considered by CME Clearing

CME Clearing considered six alternatives to the multifactor methodology margin approach that was ultimately adopted. Two of the other methodologies considered – value-at-risk ("VaR") and Monte Carlo simulation – merit further discussion.

The proposed CME Clearing multifactor margin model is actually very similar conceptually to VaR.[30] In general, VaR is the potential loss of value in a portfolio over a specific period of time and corresponding to a specific probability threshold. The CME Clearing margin model essentially calculates *factor-specific* VaRs – *i.e.,* potential losses in portfolio value over a specific period of time and corresponding to specified probabilities on a factor-by-factor basis – and then sums these factor-specific VaRs to get a total margin requirement. In other words, instead of weighting the risk contributions of each factor by a historical covariance matrix (as would be expected in a traditional factor-based variance/covariance VaR model), the CME Clearing model *sums* the factor-specific contributions to margin (VaRs) – *i.e.,* the model assumes that near-worst-case losses on each of the seven risk factors are perfectly correlated within a portfolio.

CME Clearing also considered adopting a Monte Carlo approach for margin estimation. In general, a Monte Carlo margining methodology would simulate changes in CDS spreads and/or underlying bond prices using some presumed model of price behavior and parameter estimates to represent the evolution of prices over time.[31] Although Monte Carlo methods are useful and frequently employed for valuing fixed income securities and their derivatives, CME Clearing rejected this approach for margin

[30] Some erroneously consider VaR to be synonymous with an assumption that changes in portfolio value are distributed normally. Such "parametric normal" VaR estimation methods, however, are only one possible means by which VaR can be measured. More generally, VaR can be computed for any named probability density function or empirical distribution. *See, e.g.,* C. L. Culp, M. H. Miller, and A. M. P. Neves, "Value at Risk: Uses and Abuses," *Journal of Applied Corporate Finance* 10(4) (Winter 1998) and G. A. Holton, *Value at Risk: Theory and Practice* (Academic Press, 2003).

[31] The literature on the use of Monte Carlo methods to value risky debt is voluminous. *See, e.g.,* Brigo and Mercurio, *op. cit.,* P. Glasserman, *Monte Carlo Methods in Financial Engineering* (Springer, 2004), and D. L. McLeish, *Monte Carlo Simulation and Finance* (Wiley, 2005).

determination on the basis that a Monte Carlo model lacks transparency and is too much of a "black box" for market participants.

We concur. Because Monte Carlo is a numerical simulation approach, any given computation of portfolio risk may differ from any other given computation. Although a large number of simulations based on the same underlying stochastic process(-es) should yield results that are *on average* the same, the behavior of the tails of the simulated distributions generated in two different implementations may not be – especially for stochastic processes that include parameters like discrete jumps to default.

Further, Monte Carlo methods are highly dependent on the underlying stochastic process(-es) presumed to describe the evolution of prices, rates, and/or state variables over time. Even for traditional financial instruments like bonds, the literature exhibits little consensus about which stochastic process is "the right one" to use.[32] The Monte Carlo approach is also very computationally intensive. Together with its "black box" rather than "rules-of-the-game" nature, this makes it hard for market participants to structure their portfolios and provision for future liquidity needs.

Unlike a Monte Carlo approach, the CME Clearing approach is (and is intended to be) transparent and replicable by individual CDS clearing members. Market participants can perform margin calculations on their own with only a small amount of information from CME Clearing.

In principle, a factor model and a Monte Carlo approach should yield very similar estimated risk exposures if the two approaches are based on common underlying return-generating processes with similar parameter estimates. In other words, either approach makes sense as a matter of pure theory. But in practice, we agree with CME Clearing that a Monte Carlo approach would lack transparency, create potential inconsistencies in actual clearing member margin calculations, and impose greater burdens on clearing members than a factor model approach.

D. Margining Jump-to-Default Risk

A distinguishing risk characteristic of CDSs and a correspondingly unique feature of CME Clearing's proposed CDS margining methodology relates to "jump-to-default" risk – *i.e.,* the possibility that a portfolio with large net sales of protection on a single underlying reference entity could experience significant losses over a very short period of time following an unexpected event of default by the reference entity. CME Clearing's proposed margining methodology for jump-to-default risk is based on the historical occurrence of extreme multi-day movements in CDS spreads/prices. Unfortunately, few such events exist in the historical record (even taking into account the credit crisis). In that sense, it is not surprising that the historical data do not necessarily generate estimates of *ex ante* jump-to-default risk that cover unprecedented events like the Lehman bankruptcy filing and the subsequent collapse in Lehman bond prices relative to post-bankruptcy/pre-CDS-auction recovery rate expectations.

Conceptually, jump-to-default risk exposures can never be *fully* covered without requiring clearing members to collateralize any large net sales of protection completely. The ostensible benefit of total jump-to-default risk coverage, of course, is the assurance of the safety and soundness of CME Clearing and the integrity of the clearing process. Yet, those benefits must be weighed carefully against certain costs of using a margin system to achieve those ends.

[32] *See, e.g.,* Brigo and Mercurio, *op. cit.*

(1) When is CME Clearing Exposed to Jump-to-Default Risk?

CME Clearing stands to incur a loss related to a jump-to-default scenario only in very isolated circumstances. A clearing firm may, after all, default to CME Clearing without the clearing house incurring a "loss." As more fully articulated below, a loss to CME Clearing is defined as a clearing firm's unmet obligation, where the unmet obligation is in excess of the clearing firm's eligible resources available to CME Clearing (*i.e.,* collateral, the defaulting firm's security deposit, etc).

Because CFTC funds segregation requirements do not permit the comingling of house and customer monies, if a clearing member default occurs as a result of a deficit in the house account, customer accounts are simply transferred to other non-defaulting clearing members. Alternatively, if a clearing member defaults because of the failure of one or more customers to meet their obligations to the clearing member, any positions in the accounts of non-defaulting customers can be netted against the positions of the defaulting customer. In other words, CME Clearing is exposed to jump-to-default losses primarily if certain events occur simultaneously:

- The reference entity experiences an unexpected catastrophic jump to default that occurs over a relatively short period of time; *and*
- The clearing member's net obligation to CME Clearing cannot be satisfied using other resources at the clearing member's disposal, as described by the following scenarios:
    - For defaults in the house account, total net trading profits and margin on *all cleared products in the house account* is less than the net CDS loss (inclusive of CDS margin).
    - For defaults in the customer-segregated accounts, total net trading profits and margin on *all customer accounts* is less than the net customer CDS loss (inclusive of CDS margin).

The above are most likely to occur in situations where the CDS clearing member has a significant concentration of net protection sales on specific reference names either in its house account or in its *aggregated* customer-segregated accounts. But mere concentration in CDSs is not enough. In order for the CDS jump to default to cause a clearing member default, it must also be true that the clearing member lacks sufficient customer or house margin *in non-CDS products* to cover the net CDS loss. The clearing member thus remains the first line of defense, and the clearing house is not exposed to default-related losses as long as the clearing member's financial resources are sufficient to cover its obligations to CME Clearing.

Although it is impossible to predict what the net positions in either the house or customer-segregated accounts will look like at any particular CDS clearing member, the generally low correlations in price changes across various products cleared by CME Clearing with CDS products suggest that large clearing members with diverse customer and house trading activities are unlikely to experience significant losses on their CDS positions at the same time that large losses occur on non-CDS positions. Table 1, for example, shows correlations in daily percentage price on the CDX.IG and CDX.HY with other significant CME Group-cleared products from January 2007 through March 2008. Many of the correlations are near zero. Table 2 indicates that extending the sample period through the end of December 2008 does not significantly change the results. Even the relatively high CDX correlations with other products – *e.g.,* CDX and S&P500 – never exceed 75%.

(2) Margin vs. Mutualized Risk Capital

No CCP margin system of which we are aware (for any product) has a stated goal of achieving 100% risk coverage for all potential catastrophic events. A "fully collateralized" CDS protection sale, moreover, already exists in the market in the form of another product – *viz.,* a corporate bond.

Margin represents a prepayment by a clearing member of *its own* potential obligations to CME Clearing. For low frequency, high severity losses, however, it is generally more efficient to rely at least partially on *mutualized* commitments of members (*i.e.,* obligations of non-defaulting members to guarantee unsatisfied obligations of a defaulting member). We discuss these mutualized risk capital facilities existent at CME Clearing in more detail in Section V.

Viewed in another way, the mutualized financial safeguards provided by CME Clearing can be seen as a "default insurance mutual" in which all clearing members deposit some capital up front (*i.e.,* the security deposit requirement) and agree to provide additional capital later if necessary (*i.e.,* the contingent assessment obligation) in return for CME Clearing providing each member with the equivalent of "insurance" that their obligations will be covered should they default. Margin, in turn, is the equivalent of a pre-funded deductible that differs for each member based on their actual risk exposures.

A requirement that protection sellers fully collateralize jump-to-default risk is tantamount to disregarding the member-mutualized risk capital layer that exists precisely to absorb such losses in excess of margin. As long as default probabilities and/or portfolio exposures remain imperfectly correlated across clearing members, a structure with no risk mutualization could be highly capital-inefficient.

(3) Risk Management and Risk Control Apart from the Margin System

The CDS margin model is just one component in the overall risk management infrastructure and process relied on by CME Clearing to manage the clearing house's exposure to clearing member default risk. Although our review did not involve a formal examination of this process, we note that CME Clearing has the right to request additional intraday or "super" margin from any clearing member between scheduled mark-to-market resettlement periods. CME Clearing also enjoys other discretionary risk control powers, such as the capacity to limit clearing members' CDS transaction volume to mitigate burgeoning risk exposures.[33] Prudential risk management practices such as these can significantly enhance CME Clearing's capacity to mitigate the clearing house's dynamic credit exposure to a defaulting clearing member.

Whereas margin and the CME Group's financial safeguards help reduce the *size* of CME Clearing's risk exposure to a clearing member default without regard to the likelihood that such a default may occur, CME Clearing also has a well-established process and longstanding track record of success in prudential and effective day-to-day risk monitoring and surveillance intended to help reduce the *likelihood* that a clearing member will default with open and unsatisfied obligations that give rise to clearing house losses. This risk management process includes strict clearing membership requirements and capital adequacy standards, ongoing clearing member credit surveillance, daily updated historical observations of trends in data, and near-live position and concentration monitoring. CME Group rules also allow for CME Clearing to require the clearing firm to retain additional margins at the account level. All of these risk management tools will be applied to CDS clearing members even more conservatively than they are applied to current clearing members of existing futures and options products.

[33] Rule 8-F. An amendment to this rule is pending that would further clarify CME Clearing's powers with respect to CDS clearing.

V. CME Group Financial Safeguards for CDS Clearing

A. Lamfalussy Largest Net Debtor Analysis

The traditional analysis of financial safeguard adequacy is based on the 1990 report by the Bank for International Settlements known as the "Lamfalussy Report." Specifically, the Lamfalussy Report requires the following minimum standards for any cross-border and multi-currency netting scheme:[34]

1. Netting schemes should have a well-founded legal basis under all relevant jurisdictions.
2. Netting scheme participants should have a clear understanding of the impact of the particular scheme on each of the financial risks affected by the netting process.
3. Multilateral netting systems should have clearly-defined procedures for the management of credit risks and liquidity risks which specify the respective responsibilities of the netting provider and the participants. These procedures should also ensure that all parties have both the incentives and the capabilities to manage and contain each of the risks they bear and that limits are placed on the maximum level of credit exposure that can be produced by each participant.
4. Multilateral netting systems should, at a minimum, be capable of ensuring the timely completion of daily settlements in the event of an inability to settle by the participant with the largest single net-debit position.
5. Multilateral netting systems should have objective and publicly-disclosed criteria for admission, which permit fair and open access.
6. All netting schemes should ensure the operational reliability of technical systems and the availability of back-up facilities capable of completing daily processing requirements.

The fourth Lamfalussy requirement is known as the "largest net debtor test" and has become the standard quantitative means by which the financial integrity of a clearing house is assessed by third parties.

CME Clearing routinely performs stress tests on its existing clearing products that facilitate estimation of stress-tested largest net debtor positions (plus presumptive "collateral damage"). CME Clearing then ensures that the financial resources available to cover any clearing member default-related losses in excess of margin are at least equal to the estimated potential default-related losses of the largest net debtor *plus collateral damage*. In other words, we understand that CME Clearing routinely evaluates the adequacy of its financial resources to ensure that its coverage is even more conservative than the Lamfalussy largest net debtor coverage requirement.

Any independent quantitative evaluation of financial safeguards for CDS-related clearing, however, is complicated by two over-riding factors based on the fact that CDS-related clearing is not yet operational. Namely, we do not know future CDS clearing volume and hence cannot forecast the amount of collateral that will be on deposit. Nor do we know what the portfolios of clearing members will look like, and hence cannot estimate largest net debtor positions.[35] CME Clearing loss exposure estimates are similarly handicapped.

Importantly, however, CME Clearing plans to re-compute the stress-tested largest net debtor exposure at least quarterly once the CDS clearing mechanism is operational and as additional data is gathered on

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[34] The list reproduced here is directly quoted from the *Report of the Committee on Interbank Netting Schemes of the Central Banks of the Group of Ten Countries* (Bank for International Settlements, November 1990), pp. 3-4.

[35] For these reasons, we have not independently validated CME Clearing's stress test exposure estimate.

trading and clearing behavior by members. We understand that financial safeguards and required security deposit contributions will also be re-assessed as the underlying data permits a more realistic analysis of the risks of CDS clearing. Initially, we understand that CME Clearing plans to assess security deposit shortly after migration of the OTC books to CME Clearing.

In addition to the foregoing, it is worth noting that – contrary to conventional wisdom following the credit crisis – CDS price changes are actually not particularly volatile compared to other futures contracts.[36] Table 3 shows the volatility, minimum, and maximum one-day percentage price changes in a number of the major contracts currently cleared by the CME – as well as the CDX.IG and CDX.HY indices – from January 2007 through March 2008. Table 4 shows similar statistics for the entire 2007 – 2008 sample period. In both samples, the CDX.IG is actually the *least* volatile product on the table. Nor is the volatility of the CDX.HY remarkable, especially when compared to the more volatile contracts like crude oil, natural gas, and equities.

Also worth noting is that CME Clearing already clears single-stock futures. And for a given company, the equity should be more volatile and have a larger potential downside tail risk than even the most deeply subordinated debt of that same company because equity is more junior than any debt security in a corporation's capital structure.

B. Contingent vs. Paid-in Risk Capital

Some have expressed concerns that the amount of paid-in financial capital backing CME Clearing is too low relative to CME Clearing's contingent assessment powers. Although we have not undertaken an independent empirical analysis of the adequacy of CME Group's financial safeguards for the reason noted earlier (*i.e.,* inability to model clearing volume until the CME Group facility goes live), contingent capital has long been used by insurance companies, reinsurance companies, and other corporations as an alternative to raising paid-in risk capital.[37]

Whether or not risk capital is paid-in or contingent usually matters primarily for liquidity risk management. Paid-in capital can be used to cover losses immediately, whereas payments arising from contingent assessment rights can take time to collect. CME Group's financial safeguards, however, include not only its $1.75 billion in paid-in security deposits, but also $600 million in secured lines of credit from a bank syndicate (renewed as of October 2008) that guarantee CME Clearing access to liquidity on the same day as a default.

Specifically, following a clearing member default, CME Clearing can draw on its $600mn liquidity facility on the same day to cover any immediate cash obligations of the clearing house that cannot be satisfied with margin deposits. The collateral pledged to cover that $600mn liquidity facility includes either the assets of the defaulting clearing member or assets from CME Clearing's security deposit fund. CME Clearing could, if necessary, liquidate additional security deposits in order to generate cash.

Contingent assessments would presumably be slightly more time-consuming to collect, and are subject to clearing member credit risk. But that credit risk is already taken into account in determining clearing member default fund contribution requirements and is implicitly reflected in CME Clearing's largest net debtor analysis. In particular, we understand that the CME's largest net debtor loss calculations assume

[36] In a jump-to-default scenario, volatility is significantly less important than the location and size of the "tails" of the loss distribution. Nevertheless, volatility may be a reasonable proxy for "normal" market risk.

[37] *See, e.g.,* C. L. Culp, Structured Finance and Insurance (Wiley, 2006).

that the defaulting clearing member will not be able to meet any contingent assessments by CME Clearing.

Summary and Conclusions

This Report reflects our current understanding of CME Clearing's proposed CDS margin model and our assessment of that model and the diagnostic review of that model by CME Clearing. In summary, we believe the conceptual approach adopted by CME Clearing is, in principle, sound. And based on the tests we have reviewed that CME Clearing has performed, we believe that the CDS margin model achieves CME Group's stated 99% risk coverage objectives.

We are confident, moreover, that the integration of the model into CME Clearing's existing risk management process (including clearing membership requirements, ongoing member credit surveillance, position and exposure monitoring, intra-day margin assessment authority, etc.) will add an additional layer of safety to the model itself, especially in light of CME Clearing's extensive and successful track record in managing its clearing risks.

Nevertheless, no margining system is perfect, and CME Clearing's model is no exception. Especially given the relatively nascent state of the empirical literature on CDS pricing, CME Clearing will need to monitor the effectiveness and robustness of the CDS margin model on an ongoing basis, as well as stay current on the empirical and theoretical CDS pricing literature. And CME Clearing management has indicated every intention of doing so.

One area on which CME Clearing personnel plan to concentrate on an ongoing basis is the regular re-evaluation of the factors underlying the CDS margin model to determine whether new factors might be appropriate additions to the model. Even for the current risk factors in the margin model, alternative factor estimation methods[38] and factor structures[39] may eventually prove superior to the current approach as more data becomes available and as market conditions change.

The current approach in which margin from each factor is summed (*i.e.,* presuming perfect correlation of all factors), moreover, should be regularly reexamined both to avoid potential over-margining and to increase the precision of the relationship between margin and risk. Although conservatism is admirable, too much conservatism can be misleading. If by assuming less than perfect correlation across factors less margin is required, one can then increase the margin for particular factors. In this way, it may be possible to increase the safety of the system for a given amount of margin.

More generally, our Report focuses only on the adequacy and safety of the margin system, not its efficiency. But efficiency – requiring the least margin for a given desired level of safety – is important for the success of CME Group's clearing initiative and for the fullest possible realization of the public benefits of central clearing. If substantially more margin and collateral are required by the CME Clearing than in OTC markets, it will be hard to attract customers to central clearing.

For all these reasons, periodic re-evaluation of the factor structure and the factors themselves thus will be critical on an ongoing basis.

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[38] For example, as reliable bid/offer CDS spread data and price impact estimates becomes more widely available over time, CME Clearing might undertake a re-assessment of its liquidity risk factor based on new empirical estimates of potential CDS liquidation costs.

[39] The factors that generally describe fixed-income term structures may not be optimal over time to describe the behavior of the CDS curve (which, unlike traditional fixed- or floating-rate debt, does not have a funding (*e.g.,* LIBOR) component). If new and better factors are identified to describe the variation in CDS spreads, the CME can change the definitions of one or more of the factors in its current model without abandoning its fundamental margining approach.

Finally, one of the most significant advantages of CCP clearing for CDSs is the reliance by the CCP on a single set of prices to facilitate automatic marking to market, resettlement, and margining. Costly, time-consuming, and disruptive disputes over collateral calls – as we saw in 2008 – can thus be virtually eliminated. But fully realizing that benefit requires diligent attention to the underlying pricing source being used for marking to market and margin calculations. This challenge is not, of course, unique to CDSs. CME Clearing often must determine settlement prices on contracts with relatively low liquidity and limited transaction volume.

Although CME Clearing has a number of data sources available from which actual transaction prices of some CDSs can be obtained, many CDSs (and their underlying cash bonds) do not trade with any regularity. As such, the CME Clearing model relies on the theoretical pricing model of JPMorgan and the theoretical mark-to-model prices provided to CME Clearing by its data vendors.[40] Yet, model prices may deviate significantly from actual transaction prices.

For the CDS products CME Group currently plans to clear, the theoretical prices on which the CME Clearing plans to rely are based on generally straightforward methodologies. But if CME Group ever decides to clear tranched CDS products, additional attention may need to be paid to the underlying pricing model and data inputs. Even for plain vanilla non-tranched single-name CDS and index products, CME Clearing should continue to monitor and compare theoretical versus actual transaction prices (when both are available) from its data vendors.

[40] The actual techniques for computing and reporting model prices, hybrid actual/model prices, and indication-of-interest prices depend on the particular pricing source and data vendor.

Table 1: Correlations in 1-Day Percentage Price Changes

01/01/07 – 3/31/08

	CDX.IG	CDX.HY	Aust Doll	Euro Curr	JP Yen	Euro-dollar	US 10-yr Note	US 30-yr Bond	Corn	Crude Oil	Live Cattle	Nat Gas	S&P 500
CDX.IG	1.00	0.78	0.31	-0.04	-0.42	-0.13	-0.51	-0.43	0.05	-0.02	0.09	-0.04	0.69
CDX.HY		1.00	0.26	-0.01	-0.41	-0.16	-0.41	-0.36	0.06	-0.02	0.08	0.00	0.69
Australian Dollar			1.00	0.53	-0.30	-0.14	-0.38	-0.28	0.19	0.32	0.12	0.01	0.38
Euro Currency				1.00	0.22	-0.07	0.04	0.05	0.15	0.28	0.03	0.08	0.02
JP Yen					1.00	0.15	0.49	0.45	-0.08	-0.05	-0.15	0.04	-0.47
Eurodollar						1.00	0.27	0.21	-0.04	-0.05	-0.08	-0.02	-0.22
US 10yr Note							1.00	0.85	-0.20	-0.14	-0.04	0.00	-0.52
US 30yr Bond								1.00	-0.18	-0.06	-0.02	0.03	-0.39
Corn									1.00	0.30	0.00	0.16	0.08
Crude Oil										1.00	0.11	0.37	0.08
LiveCattle											1.00	-0.13	0.05
Nat Gas												1.00	0.04
S&P 500													1.00

Table 2: Correlations in 1-Day Percentage Price Changes

01/01/07 – 12/31/08

	CDX.IG	CDX.HY	Aust Doll	Euro Curr	JP Yen	Euro-dollar	US 10-yr Note	US 30-yr Bond	Corn	Crude Oil	Live Cattle	Nat Gas	S&P 500
CDX.IG	1.00	0.50	0.13	0.00	-0.25	-0.01	-0.24	-0.21	0.10	0.01	0.04	0.00	0.43
CDX.HY		1.00	0.31	0.10	-0.41	-0.06	-0.29	-0.30	0.13	0.17	0.13	0.01	0.71
Australian Dollar			1.00	0.57	-0.36	-0.10	-0.22	-0.23	0.37	0.45	0.16	0.16	0.41
Euro Currency				1.00	0.08	-0.03	0.06	0.05	0.33	0.42	0.09	0.21	0.09
JP Yen					1.00	0.10	0.53	0.49	-0.11	-0.11	-0.12	-0.01	-0.53
Eurodollar						1.00	0.18	0.16	-0.05	-0.06	0.03	0.00	-0.06
US 10yr Note							1.00	0.84	-0.15	-0.13	-0.08	-0.01	-0.39
US 30yr Bond								1.00	-0.18	-0.17	-0.11	-0.01	-0.36
Corn									1.00	0.40	0.19	0.22	0.16
Crude Oil										1.00	0.14	0.39	0.24
LiveCattle											1.00	0.04	0.15
Nat Gas												1.00	0.04
S&P 500													1.00

Table 3: 1-Day Historical Percentage Price Changes

01/1/2007 – 3/31/2008

	Std Dev	*Min*	*Max*
CDX.IG	0.18%	-0.81%	1.03%
CDX.HY	0.56%	-4.21%	2.00%
Australian Dol	0.77%	-4.43%	1.89%
Euro Currency	0.44%	-1.28%	1.44%
JP Yen	0.74%	-3.36%	3.33%
Eurodollar	0.43%	-1.49%	1.51%
US 10yr Note	0.41%	-1.34%	1.42%
US 30yr Bond	0.57%	-2.03%	1.63%
Corn	2.17%	-5.43%	8.05%
Crude Oil	1.90%	-5.49%	5.48%
LiveCattle	1.18%	-5.08%	5.16%
Nat Gas	2.98%	-13.84%	11.58%
S&P 500	1.12%	-3.95%	4.26%

Table 4: 1-Day Historical Percentage Price Changes

01/1/2007 – 12/31/2008

	Std Dev	*Min*	*Max*
CDX.IG	0.44%	-5.39%	5.56%
CDX.HY	0.70%	-4.21%	2.57%
Australian Dol	1.30%	-9.50%	6.21%
Euro Currency	0.70%	-3.18%	3.00%
JP Yen	0.83%	-3.93%	4.53%
Eurodollar	0.52%	-2.66%	2.86%
US 10yr Note	0.54%	-2.83%	1.84%
US 30yr Bond	0.70%	-3.00%	3.02%
Corn	2.60%	-7.41%	9.60%
Crude Oil	2.77%	-10.27%	14.27%
LiveCattle	1.46%	-7.07%	6.78%
Nat Gas	3.03%	-13.84%	11.58%
S&P 500	2.01%	-9.88%	14.11%