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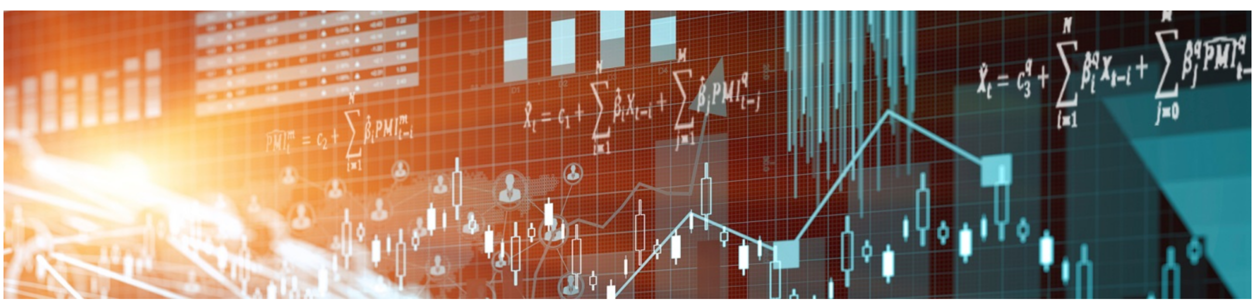
Using Speed and Credit Limits to Address the Procyclicality of Initial Margin at Central Counterparties



by Nikil Chande and Nicholas Labelle St-Pierre

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Using Speed and Credit Limits to Address the Procyclicality of Initial Margin at Central Counterparties

by

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Abstract

This paper proposes a practical approach to address the procyclicality of initial margin at central counterparties (CCPs) that can work even in periods of extreme stress. The approach allows CCPs to limit the speed of margin increases resulting from spikes in market volatility. To maintain the desired level of risk protection, the model covers, through loss-sharing arrangements, a chosen number of the largest shares of the margin increases that are deemed procyclical. To facilitate adoption of this approach, we allow loss sharing to be capped through the allocation of bilateral credit limits. We undertake an empirical exercise to demonstrate that, even with conservative assumptions, the proposed approach can generate significant margin relief without generating losses that cannot be absorbed by clearing members.

Bank topics: Financial markets; Financial stability; Financial system regulation and policies; Payment clearing and settlement systems
JEL codes: G, G1, G18

Résumé

Dans cette étude, les auteurs proposent un modèle pragmatique pour atténuer la procyclicité des marges initiales prescrites par les contreparties centrales, même en périodes de tensions excessives. Le modèle permet aux contreparties centrales de limiter la vitesse d'augmentation des marges résultant de brusques poussées de la volatilité du marché. Afin de maintenir le niveau de protection désiré contre le risque, le modèle permet de couvrir, par le moyen d'accords de partage des pertes, une partie des plus fortes hausses de marges réputées procycliques. En vue de faciliter l'adoption du modèle, les auteurs restreignent le partage des pertes par l'imposition de limites de crédit bilatérales. Les auteurs entreprennent un exercice empirique pour démontrer que, même avec des hypothèses prudentes, l'approche proposée peut générer un allègement de marges important sans générer de pertes que les membres compensateurs ne peuvent absorber.

Sujets : Marchés financiers; Stabilité financière; Réglementation et politiques relatives au système financier; Systèmes de compensation et de règlement des paiements
Codes JEL : G, G1, G18

1 Introduction

In response to the financial crisis, there has been a regulatory push to enhance financial stability through increased use of central counterparties (CCPs). For example, a major policy initiative adopted by the G20 is to promote the use of central clearing for standardized over-the-counter (OTC) derivatives.[1] CCPs help to promote well-functioning markets and reduce systemic risk through a number of channels (Chande, Labelle and Tuer 2010). CCPs mitigate counterparty risk assumed by market participants and reduce the uncertainty associated with their network of exposures, especially during times of stress. CCPs also introduce robust default-management processes, so that, in the event of a default by a market participant, other institutions are less likely to be affected. Overall, CCPs have great potential to reduce systemic risk and reinforce financial stability by addressing some of the deficiencies in the existing bilateral infrastructure.

At the same time, the increased prominence of CCPs means their risk-management practices have a greater potential for procyclical effects. Procyclicality refers to "changes in risk-management requirements or practices that are positively correlated with business- or credit-cycle fluctuations and that may cause or exacerbate financial instability" (CPSS and IOSCO 2012).[2] For example, in times of stress when market volatility tends to be increasing and market liquidity tends to be decreasing, collateral requirements and haircuts on collateral can rise dramatically, precisely at a time when market participants may be less able to fund additional collateral. In response, stressed participants may need to quickly deleverage or face the prospect of defaulting on the calls for additional collateral. This can result in a negative feedback effect that worsens the financial market stress, resulting again in further calls for collateral that may be even more difficult to fund (Brunnermeier and Pedersen 2009).

Risk management by CCPs relies heavily on calculating margin collateral and collecting it from their members to cover the exposures that CCPs face as a result of their members' activity. These margin calculations are typically based on historical price observations, and thus margin requirements imposed on a CCP's members can increase abruptly in times of stress (Murphy, Vasios and Vause 2014; Park and Abruzzo 2016). This paper proposes an approach to mitigate the procyclical impact of large, sudden calls for additional initial margin collateral by CCPs that can result when there are rapid increases in market volatility. This approach is based on two distinct ideas that can be applied independently:

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[1] This and other reform commitments were made in September 2009 at the G20's Pittsburgh Summit (Group of 20 2009). For a description of how these reforms can strengthen the infrastructure of OTC derivatives markets, see Wilkins and Woodman (2010).

[2] Procyclicality in the financial system is discussed in a number of reports in the Bank of Canada's *Financial System Review* (Bank of Canada 2009).

(i) providing temporary initial margin relief by imposing a limit on the speed of margin requirement increases while maintaining an expected level of risk protection by using loss-sharing arrangements (or loss mutualization); and

(ii) introducing bilateral credit limits to cap potential losses that members of a CCP may incur as a result of participation in this loss-mutualization scheme.

This paper uses daily portfolio data from January 2003 through March 2011 to show that the proposed approach can generate significant initial margin relief for a CCP's members, without causing losses that the members are unable to absorb. An important caveat is that the results depend on historical portfolio data that might have been different had the proposed approach already been in place.

Section 2 explains the motivation for implementing the proposed methodology, including the potential costs of mitigating procyclicality with traditional through-the-cycle methods. Section 3 describes the Countercyclical Margin (CCM) model, which involves using speed limits and loss mutualization to deal with excessively large and rapid margin increases. This section also describes how the model can be supplemented by imposing certain restrictions on loss-sharing arrangements through bilateral credit limits. Section 4 explores empirically the potential implications of the CCM model using simulations, and Section 5 concludes.

2 Context

2.1 Relationship between CCPs and procyclicality

The introduction of CCPs has been proposed as part of the solution to address procyclicality arising in bilateral arrangements (Cecchetti, Gyntelberg and Hollanders 2009; CGFS 2010). For instance, by mitigating concerns about counterparty credit risk during periods of stress, CCPs can encourage trading in markets that might otherwise become illiquid. As well, since collateral is required from every clearing member, the potential increase in collateral requirements in a stress event would be smaller than if no collateral had been initially collected, which can be the case in the bilateral market. In addition, because of the netting efficiencies associated with CCPs, a participant in the system will have a smaller number of outstanding contracts; therefore, an increase in collateral requirements would affect fewer total outstanding contracts compared with if these were traded bilaterally (Chande, Labelle and Tuer 2010).

Because of the benefits associated with the introduction of CCPs, the Longworth Report (CGFS 2010) recommended considering their use for standardized derivatives transactions and also for securities financing transactions (repo and securities-lending transactions). However, the Longworth Report also recommended a review of the policies and risk-management practices of CCPs for procyclical impacts. Implicitly, the report raises the point that, although CCPs can help reduce procyclicality, they could also destabilize financial markets by increasing collateral requirements too rapidly in times of stress.

In determining the appropriate level of initial margin, there are three potentially competing objectives, which can be summarized as follows:

(i) *risk mitigation:* ensuring that a minimum level of expected risk protection is achieved through the collection of collateral;

(ii) *cost efficiency:* avoiding unnecessarily high collateral costs; and

(iii) *financial stability:* avoiding the destabilizing effect of large and rapid calls for collateral.

These three objectives are strongly interrelated. For instance, to reduce the prospect of destabilizing margin calls, CCPs can maintain a higher overall level of margin and thus of risk mitigation. But this would impose higher collateral costs for CCP participants. On the other hand, lower overall levels of margin would reduce collateral costs but, to maintain a given level of expected risk mitigation, CCPs would need to rapidly increase margins during times of stress. These large and rapid increases can be destabilizing to CCP participants and financial markets. In addition, if a CCP were to keep its margin too low for too long, this could create an incentive for institutions to increase leverage.

International best practice clearly states the importance of addressing the procyclical nature of a CCP's margining practices, but only to the extent that is feasible and safe, as emphasized in the *Principles for Financial Market Infrastructures*:

> A CCP should appropriately address procyclicality in its margin arrangements.… To the extent practicable and prudent, a CCP should adopt forward-looking and relatively stable and conservative margin requirements that are specifically designed to limit the need for destabilising, procyclical changes. (CPSS and IOSCO 2012, 53)

2.2 Existing approaches to mitigating CCP procyclicality

To mitigate procyclical impacts of CCPs on the financial system, the Longworth Report recommends examining the imposition of minimum constant through-the-cycle margins and haircuts, with a possible countercyclical add-on, or margin-smoothing methodologies.[3] A through-the-cycle approach sets margins at a relatively stable level across the business cycle, which can help to prevent an accumulation of excessive leverage during booms and disruptive deleveraging during times of stress.

One strategy to address margin procyclicality is to use a *margin floor*, which is a minimum level of initial margin that each clearing member must maintain.[4] A margin floor can help prevent a buildup of excessive leverage during the expansionary phase of the cycle because, even as volatility falls, members must continue to pledge the minimum level of collateral. The trade-off is a higher cost of collateral during periods of low volatility but smaller increases in required collateral in times of stress.

Another approach is to increase initial margin requirements by a certain fixed amount as calculated by the risk model.[5] This approach is often called a *margin buffer*. To deal with procyclicality, the buffer needs to be released during times of stress. Authorities could release it at their discretion or according to a prescriptive rule when it would help to alleviate pressure to meet excessively large increases in margin requirements.

Margin-smoothing methodologies also attempt to provide a more stable level of initial margin through the cycle. One way to accomplish this is to consider a different asset-price distribution beyond the normal distribution. Using a historical distribution and considering multiple economic cycles (or a longer "look-back period") is a smoothing method that can help stabilize margin levels throughout the cycle. Margin can also be smoothed by assigning a minimum weight to price observations in the look-back period that occur during times of stress. Other weighting schemes can be used when estimating volatility—such as the exponentially weighted moving average (EWMA)—to change the relative weights given to past price observations and thus smooth the resulting margin requirements.

To help demonstrate key trade-offs in designing a margining approach to deal with procyclicality, **Chart 1** shows daily initial margin requirements for a selected portfolio, based on three margin methodologies, from January 2003 through March 2011. The portfolio remains constant through the entire period. It was selected from a set of client and firm portfolios provided by the Canadian Derivatives Clearing Corporation (CDCC)

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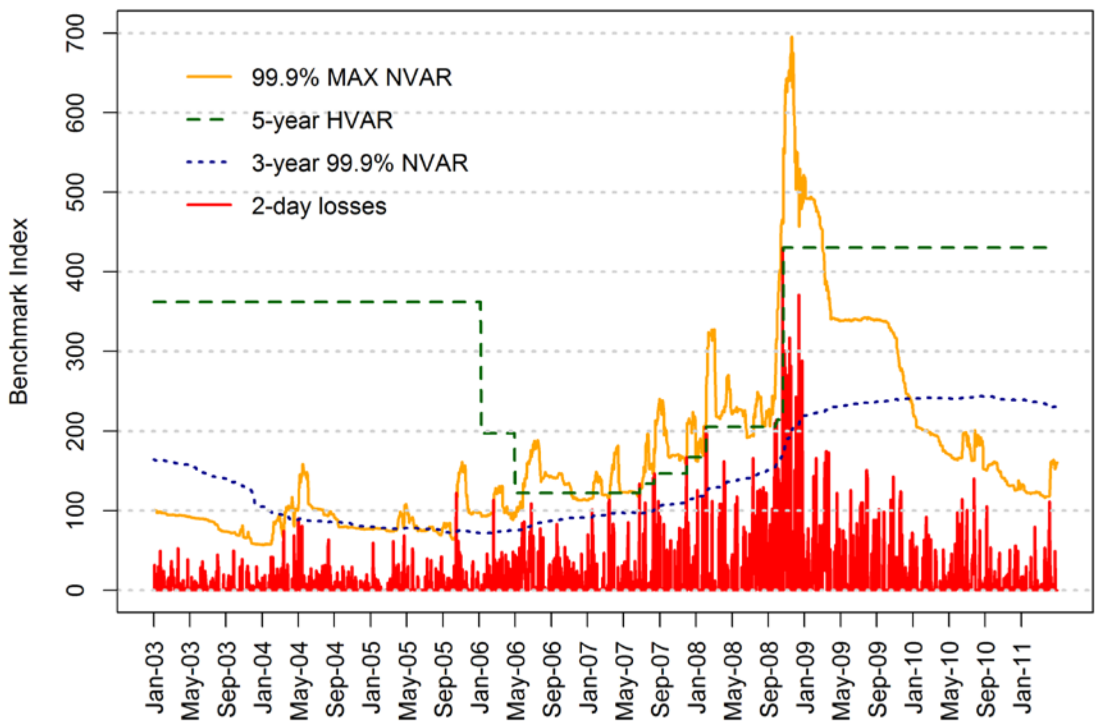
3 In addition to the Longworth Report (CGFS 2010), see Longworth (2010).

4 This minimum can be expressed at the contract level (in dollar terms or relative to the current value of the contract) or at the portfolio level. For instance, the minimum margin required for a given portfolio could be set at the level prescribed by a three-year historical value-at-risk (VaR) model.

5 This fixed amount could be expressed at the contract level (in dollar terms or relative to the current value of the contract) or at the portfolio level. For instance, the add-on could be 5 per cent of the margin requirement prescribed by the risk model at the portfolio level.

for the three most-traded futures contracts on the Montreal Exchange: SXF, CGB and BAX.[6]

Chart 1: Margin requirements of selected portfolio



The margin methodologies shown in Chart 1 are as follows:

- The *benchmark margin methodology* ("99.9% MAX NVAR") sets an initial margin requirement on day *t* equal to the largest requirement over the past 20, 90 and 260 days, using a normal value-at-risk (VaR) model with a 99.9 per cent confidence interval and two-day liquidation period.
- The *five-year historical VaR* ("5-year HVAR") sets the initial margin requirement for the morning on day *t* as the worst two-day loss of the portfolio over the past five years.
- The *three-year normal VaR* ("3-year 99.9% NVAR") sets the initial margin requirement for the morning on day *t* at three standard deviations below the mean of the two-day returns of the portfolio over the past three years.

To aid comparison across the methodologies, the y-axis is an index with 100 as the margin requirement of the baseline methodology ("99.9% MAX NVAR") at the start of the sample on 2 January 2003. For instance, on 27 October 2008, the index for the margin

6 SXF: S&P/TSX 60 Index Futures; CGB: 10-Year Government of Canada Bond Futures; BAX: Three-Month Canadian Bankers' Acceptance Futures. These three contracts are traded on the Montreal Exchange and cleared at the CDCC and normally account for the bulk of CDCC's total margin requirements.

requirement prescribed by the baseline methodology reached 696, which is 6.96 times as large as the level prescribed on 2 January 2003 by this methodology.

Other research formally compares various approaches to addressing initial margin procyclicality (Murphy, Vasios and Vause 2016). While we do not undertake formal comparisons, Chart 1 is helpful in illustrating some of the key trade-offs faced in designing a margining regime to deal with procyclicality. We see the following patterns in Chart 1:

- The benchmark methodology (99.9% MAX NVAR) reacts very quickly to increasing price volatility and also tends to overshoot most of the largest losses observed in the sample period. The trade-off for this superior risk protection is a margining approach that imposes high collateral costs, and that may also have the potential for destabilizing procyclical effects during times of stress.
- The 3-year 99.9% NVAR methodology is very stable, even after large spikes in volatility, because these spikes tend to have limited impact when averaged across a three-year window. This approach is much less procyclical and has fewer collateral costs than the benchmark; however, it leads to two-day losses that frequently exceed the level of initial margin, and thus it does a poor job at mitigating risk.
- The 5-year HVAR methodology results in initial margin requirements that are more stable than the benchmark; however, there are periodic jumps in the required margin resulting from sudden changes to the worst two-day loss over the previous five years. This approach can be effective in mitigating risk but can also result in extended periods when collateral costs are high relative to the volatility of prices.

Adjusting the approach to margining is not the only way a CCP can address procyclicality. Another option may be for CCPs, in consultation with authorities, to expand the list of acceptable collateral in stressful times, albeit with conservative haircuts (Chande, Labelle and Tuer 2010). In crisis periods, clearing members may have plenty of lower-quality collateral to pledge with few or no alternative uses. Allowing members to pledge lower-quality collateral would be less disruptive than rapidly liquidating derivatives contracts or acquiring additional high-quality collateral on short notice amid stressed markets. However, this approach increases the liquidity risk of the CCP.

In summary, traditional through-the-cycle margining approaches may create more-stable margin requirements; however, to mitigate risks to an acceptable degree, these types of margining methodologies would have to impose high collateral costs, especially for more volatile products. In turn, these higher costs could potentially make CCPs economically non-viable and encourage bilateral trading.

We propose another approach that offers less-volatile margins in times of sudden market stress while providing adequate protection for the CCP, with affordable margin costs—the Countercyclical Margin (CCM) model, described in the next section.

3 Countercyclical Margin Model[7]

For CCPs using a standard risk-based approach to calculating initial margin requirements, margin calls have the potential to be so large and sudden that they can be destabilizing for the participants. Under the proposed CCM model, the CCP's standard initial margin methodology is employed but modified to provide members with the opportunity for temporary margin relief when they face a margin call so large and sudden that it could have the potential for procyclical effects. This temporary initial margin relief would be applied to only the portion of the large, sudden margin call that is deemed procyclical (i.e., not the entire margin call); the threshold beyond which temporary initial margin relief is available is a parameter that can be set in the model. Margin relief would not, however, be available for margin calls that result from increases in members' open positions.

Under a CCP's standard margining methodology, initial margin is required to cover potential future exposure with a high degree of confidence. However, if temporary margin relief is provided, the CCP would not be collateralizing potential future exposure to the same degree. The CCP would therefore shift slightly away from a defaulter-pay model and slightly towards a survivor-pay model.[8] In other words, if a default were to occur and the margin of the defaulter were insufficient because of the temporary relief provided under the proposed approach, then after all the defaulter's collateral was exhausted, survivors could face some residual loss mutualization.

Chart 2 shows the generic resource waterfall associated with the CCM model. This could be tailored to the specific needs of a CCP to include other resources available in case of a participant default, such as the CCP's own resources.

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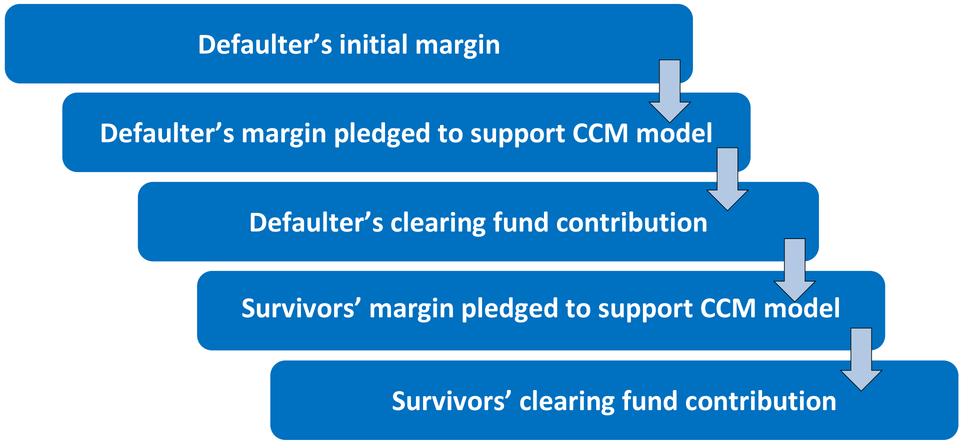
[7] Technical details behind the CCM model are described in a separate document with technical appendices, available upon request from the authors.

[8] Raykov (2014) examines the trade-off between margin and mutualized risk in the context of a CCP whose members face moral hazard.

Chart 2: Resource waterfall associated with the CCM model

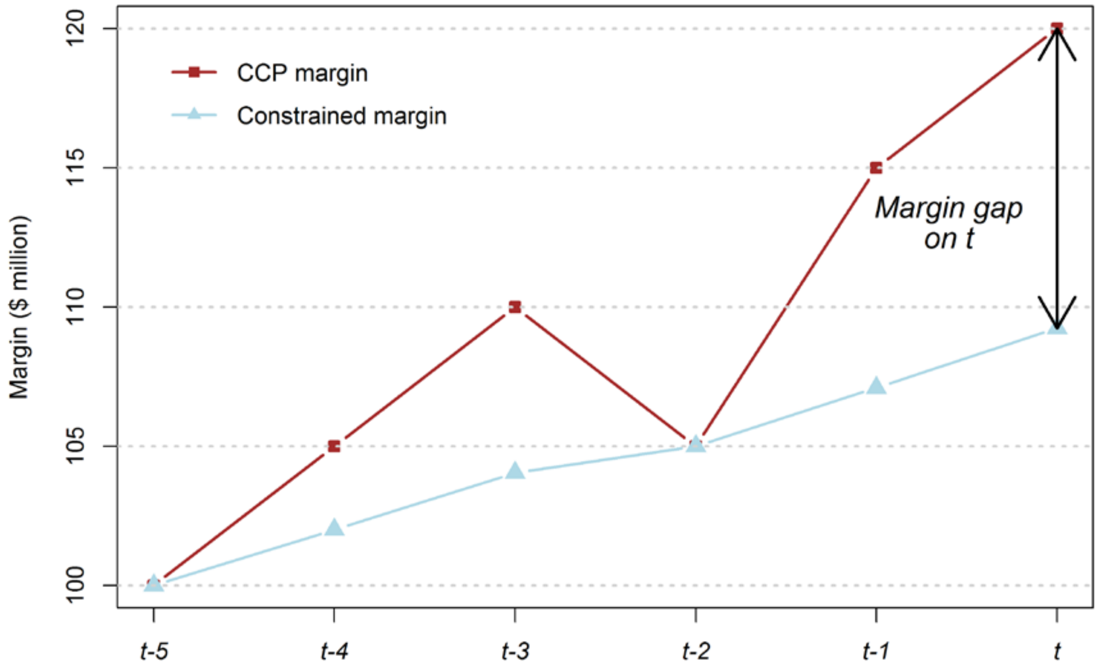


In essence, the CCM model offers a trade-off between decreased liquidity risk (in the form of the temporary margin relief) and increased credit risk (in the form of temporary increases in the potential for loss mutualization). The parameters of the model can be adjusted to find an appropriate trade-off between the margin relief that is afforded and the increased loss mutualization that can potentially occur.

Margin relief comes from restricting margin increases to a specific limit that constrains the transition from one level of margin to another by applying a maximum daily increase over a given time interval. This is sometimes referred to as a margin "speed limit."

To illustrate this concept, **Chart 3** shows a limit that constrains the increase of the initial margin on a given portfolio to 2 per cent per day, from time *t-5* to time *t*. It is important to note that, by construction, the constrained margin level can never exceed the CCP margin level. The gap between the constrained margin and CCP margin is always temporary; given sufficient time, the constrained margin will inevitably catch up with the margin prescribed by the standard CCP methodology. We call the difference between the CCP margin and the constrained margin the "margin gap."

Chart 3: Example of constrained margin applied at the portfolio level



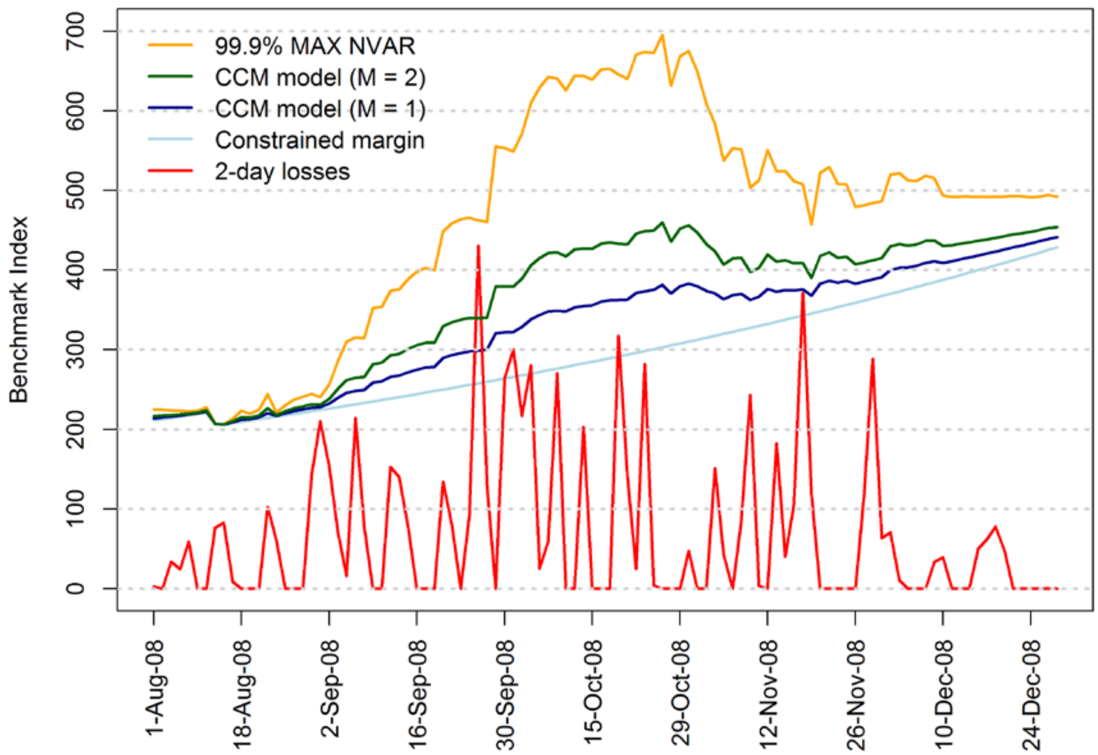
Once margin increases have been constrained by the CCP, the resulting margin gap has to be managed. The CCP could perform this task by increasing the reliance on loss-sharing arrangements, which is the first key characteristic of the CCM model.

3.1 Loss-sharing arrangements to support a speed limit

The CCM model generates temporary margin relief by not requiring full collateralization of all the margin gaps among clearing members. For example, the single largest margin gap could be collateralized, and this collateralization could take place through contributions to a collateral pool supporting the CCM model, available in the event of a default. More generally, the model can be calibrated to collateralize the *M* largest margin gaps, and contributions to the collateral pool to cover the *M* largest margin gaps are shared among clearing members pro rata. If a clearing member who had been provided initial margin relief were to default, and the total margin provided by the defaulter were insufficient, then survivors would have to cover the residual losses in proportion to the contributions they made to the pool.

To illustrate the concept, **Chart 4** compares the margin requirements for the selected portfolio of the benchmark methodology (i.e., 99.9% MAX NVAR) with those of the CCM model assuming that the single, or two, largest margin gaps are covered (i.e., assuming that $M = 1$ and $M = 2$).[9] The time period in Chart 4 is from 1 August 2008 through 31 December 2008. As in Chart 1, the y-axis is an index with 100 as the margin requirement of the baseline methodology ("99.9% MAX NVAR") at the start of the sample on 2 January 2003.

Chart 4: Margin requirements of the CCM model for the selected portfolio[a]



a. A daily limit of 0.77 per cent is used, which is equivalent to doubling the margin requirement over 90 trading days (i.e., $r = 2^{1/90}-1 \approx 0.77\%$).

The margin relief provided by the CCM model for the clearing member with the selected portfolio is evident in Chart 4. It is also clear that more margin relief is available when fewer of the largest margin gaps are covered. For example, the relief provided to the clearing member with the selected portfolio is greater with $M = 1$ than with $M = 2$. On the other hand, when fewer of the largest margin gaps are covered, there is a greater chance that survivors could incur some losses in the event of default. As long as the two-day losses remain below the required margin, there is always sufficient margin pledged by the defaulter(s) and thus the survivors will not incur losses on the contributions they make to the collateral pool. In the event that two-day losses do exceed the margin determined by the CCM model (as was the case on 25 September 2008 in this

[9] In this example, we simply assume that there are a total of five margin gaps of equal size.

illustration), then some loss mutualization among survivors would be required in the event of a default.

In addition to *M*—the number of largest margin gaps collateralized by the CCM model—another important parameter in the model is the margin speed limit, *r*, used to generate the margin gaps.[10] Both parameters impact the balance between the financial stability benefits that come from temporary margin relief and the potentially higher credit exposures that can be generated through the loss-sharing arrangements that ultimately provide the margin relief. The calibration of the CCM model to maximize the benefits it generates is outside the scope of this paper. Nonetheless, in the empirical exercise reported below, the CCM model provides significant margin relief while generating credit losses that clearing members can withstand.

3.2 Credit limits to control loss given default

In Section 3.1, we showed how a speed limit combined with loss-sharing arrangements can address the procyclicality of margins. At the same time, however, increased reliance on risk mutualization within a CCP can increase moral hazard (Raykov 2014). In addition, certain clearing members might not want to participate in new loss-sharing arrangements; or, on the other hand, they might prefer to participate only up to a certain limit or with a limited set of clearing members. Authorities may want to impose minimum and maximum credit exposures so that the CCM model can provide margin relief in times of stress without exceeding the capacity of clearing members to bear potential losses.

The CCM model can be supplemented with the use of bilateral credit limits (BCLs) as a way to control credit exposures generated through the loss-sharing arrangements that ultimately provide the margin relief. Canada's Large Value Transfer System (LVTS) provides a good example of how BCLs can be used within a financial market infrastructure to help participants manage the credit risk they face through their participation in the infrastructure.[11]

Much like the LVTS, the CCM model could include limits that apply bilaterally between pairs of clearing members as a tool to cap the exposures they could face through the CCM model. For instance, if two clearing members provided each other with a BCL of $1 million, and one of the members were then to default, the other would be exposed up to a maximum of $1 million through its participation in the CCM model. This cap would

[10] The look-back period *N* is a related parameter in the model. It determines how long the daily constraint can hold while generating margin relief.

[11] The LVTS has used BCLs since 1999. For more details, see Arjani and McVanel (2006).

not apply to exposures coming from outside the CCM model, such as exposures arising through other risk mutualizations performed by the CCP (e.g., the CCP's clearing fund). When the CCM model is providing margin relief to a clearing member, BCLs should not be allowed to be decreased during that time, or else margin relief will also decrease at a time when it is needed.

3.3 Advantages of the CCM model

While the CCM model generates uncollateralized residual credit exposures, the probability that these exposures will materialize into actual credit losses is very low. The strength of the CCM model is that it leverages this low credit risk along with the following benefits:

(i) Clearing members have lower and more-stable margin requirements in times of extreme volatility.

(ii) The CCM model reduces the likelihood, or the magnitude, of negative feedback effects resulting from liquidity spirals in times of crisis. Margins that are more stable in times of crisis will reduce the need to engage in asset fire sales, which constitute an important channel in the propagation of a financial crisis.

(iii) The CCM model can be combined with a wide range of margin methodologies and parameters.

(iv) The CCM model allows CCPs to clear derivative contracts with sudden and large increases in volatility, while providing more-stable margin requirements and redistributing credit risks in a tractable way.

(v) The CCM model can be supplemented with BCLs, which can be allocated in a tractable manner and controlled by the clearing members, the CCP and/or authorities.

(vi) If the CCM model is supplemented with BCLs, the entity in control (whether clearing members, authorities and/or the CCP) can choose the desired trade-off between credit risk and reduced margin requirements. By not extending BCLs, a clearing member could be excluded from the CCM model if this were preferable. Since the BCLs can cap potential losses incurred through loss-sharing arrangements, the implementation of the CCM model may be more acceptable.

(vii) Through the extensions of BCLs, the CCM model can accommodate different classes of clearing members that may not want to be exposed to other classes of clearing members (e.g., hedge funds versus insurance companies). Clearing members not receiving margin relief through the CCM model would still benefit from more-stable markets if they were to have to engage in market operations to meet sudden and large margin requirement increases.

In summary, by making use of a speed limit and increased risk mutualization, the CCM model enables temporary margin relief for large and sudden margin calls in times of stress that might be procyclical. The low probability that mutualized losses actually occur is traded off against more-stable margins and markets.

4 Empirical Exercise

The following empirical exercise demonstrates that the CCM model can provide significant margin relief without generating credit losses that clearing members cannot bear.

4.1 Data

The CDCC provided daily portfolio data from 2 January 2003 to 31 March 2011 for the three main futures contracts cleared by the CDCC: SXF, CGB and BAX.[12] The open positions were reported for each of the maturities available over this period, which includes 113 different futures contracts. Three net positions were reported for each contract and for each clearing member over the sample period: one for the client account(s), one for the firm account(s) and one for the market-maker account(s). For simplicity, the firm and market-maker accounts were netted into one firm account per clearing member. Thus, in this analysis, clearing members have one client and one firm account.

The futures prices used to calculate the profits and losses on the positions were taken from Bloomberg. The profits and losses were then used to compute the margin requirements at the account level and the clearing fund contributions at the clearing member level. Thus, the margin requirements and the clearing fund contributions are based on the authors' calculations and do not reflect actual conditions that were experienced at the CDCC.[13]

The CDCC also provided data on risk-adjusted capital (RAC) and net allowable assets (NAA) over the sample period. RAC and NAA are capital measures calculated for

[12] These three futures contracts accounted for over 70 per cent of the CDCC's total margin requirements during the sample period.

[13] The methodology used by the authors to calculate clearing fund contributions is described in a separate document with technical appendices, available upon request.

clearing members regulated by the Investment Industry Regulatory Organization of Canada (IIROC).[14] Adjusted Net Tier 1 capital, which is a measure of bank capital that was reported over the period, is used for one bank-clearing member in our sample.[15] These data on capital are used to evaluate the magnitude of the credit losses that clearing members could face as a result of the CCM model.

4.2 Strategy

The empirical strategy consists of comparing the baseline "99.9% MAX NVAR" methodology with the CCM model in terms of margin relief and losses, given simulated defaults. The "99.9% MAX NVAR" methodology sets the initial margin requirement for the morning on day t as the largest margin requirement over the past 20, 90 and 260 days, using a normal VaR model with a 99.9 per cent confidence interval and two-day liquidation period.

For the exercise, the parameter r (the daily speed limit, as described in Section 3) is equal to about 0.77 per cent and is applied from t-180 to t.[16] This is consistent with the margin requirement of a fixed portfolio not being allowed to more than quadruple over 180 trading days. If the constraint becomes binding, then the CCM model is activated and a margin gap is generated.

4.3 Results

4.3.1 Margin relief

Chart 5 shows total margin requirements across all clearing members from 3 January 2006 to 2 July 2009. The yellow line shows the level of total margin requirement prescribed by the 99.9% MAX NVAR benchmark methodology. The light blue line shows the constrained margin requirement, i.e., the level of margin that would be within a daily increase of approximately 0.77 per cent applied over 180 days. The dark blue line shows the total margin requirement of the CCM model when the single largest margin gap is covered (i.e., $M = 1$). As in Chart 1 and Chart 4, the time series are indexed to the level of margin prescribed by the 99.9% MAX NVAR methodology as of 2 January 2003. For instance, the total margin requirement of the benchmark methodology reached a peak of 589 on 30 October 2008, which is 5.89 times as large as the level on 2 January 2003.

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[14] For more detail, see Statement B of the Dealer Member Rules at http://www.iiroc.ca/Rulebook/MemberRules/Form1_en.pdf.

[15] For bank data, see http://www.osfi-bsif.gc.ca/Eng/wt-ow/Pages/FINDAT.aspx.

[16] The speed limit r and the associated look-back period N are arbitrary and chosen to illustrate the model. The optimal choices of parameters in the model, including M (the number of largest margin gaps covered), would need to be further investigated.

Chart 5: Total margin requirements across all clearing members

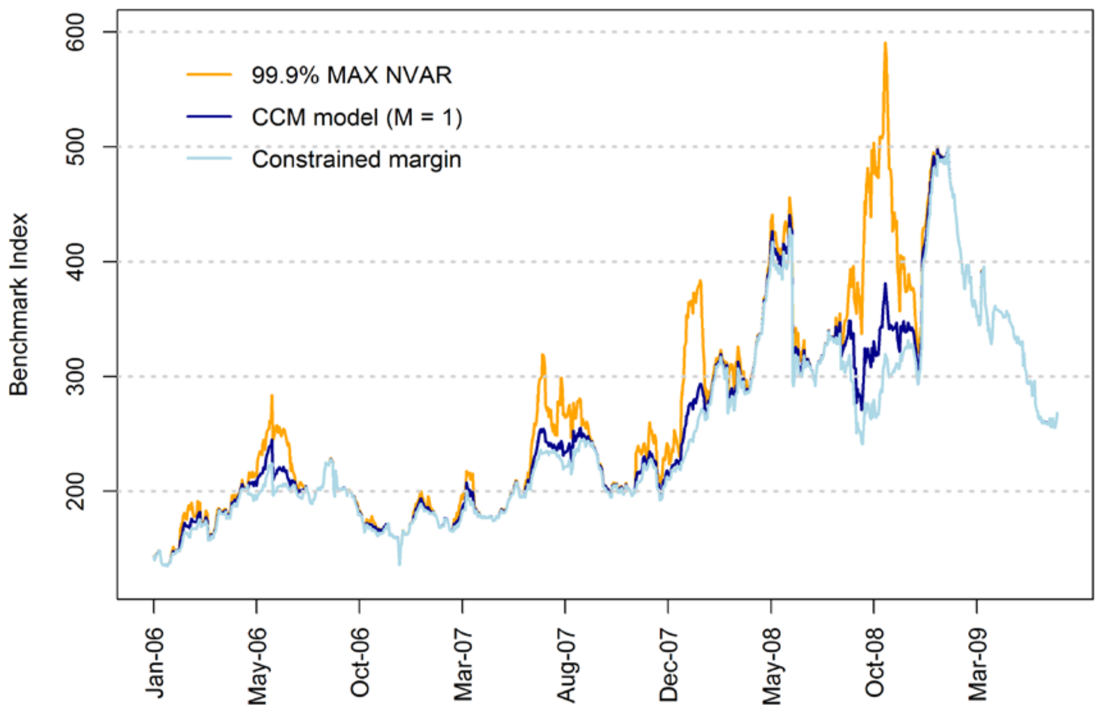
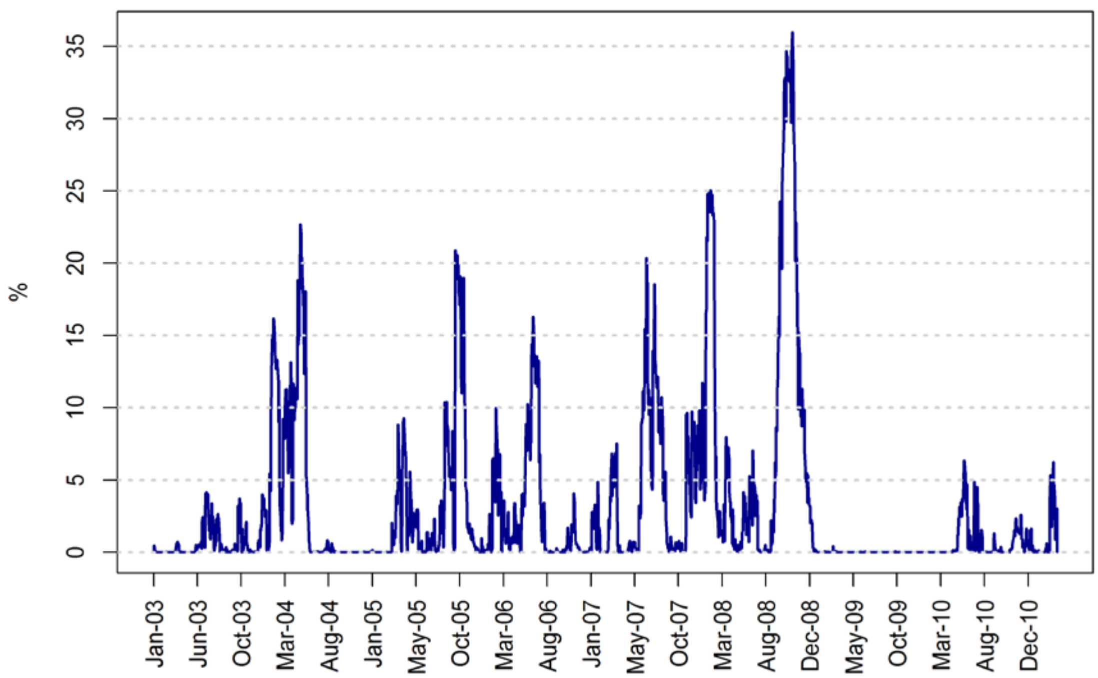


Chart 6 shows the margin relief provided by the CCM model in percentage terms across all clearing members from 2 January 2003 to 31 March 2011. Total margin relief reached a peak of 36.0 per cent on 31 October 2008.

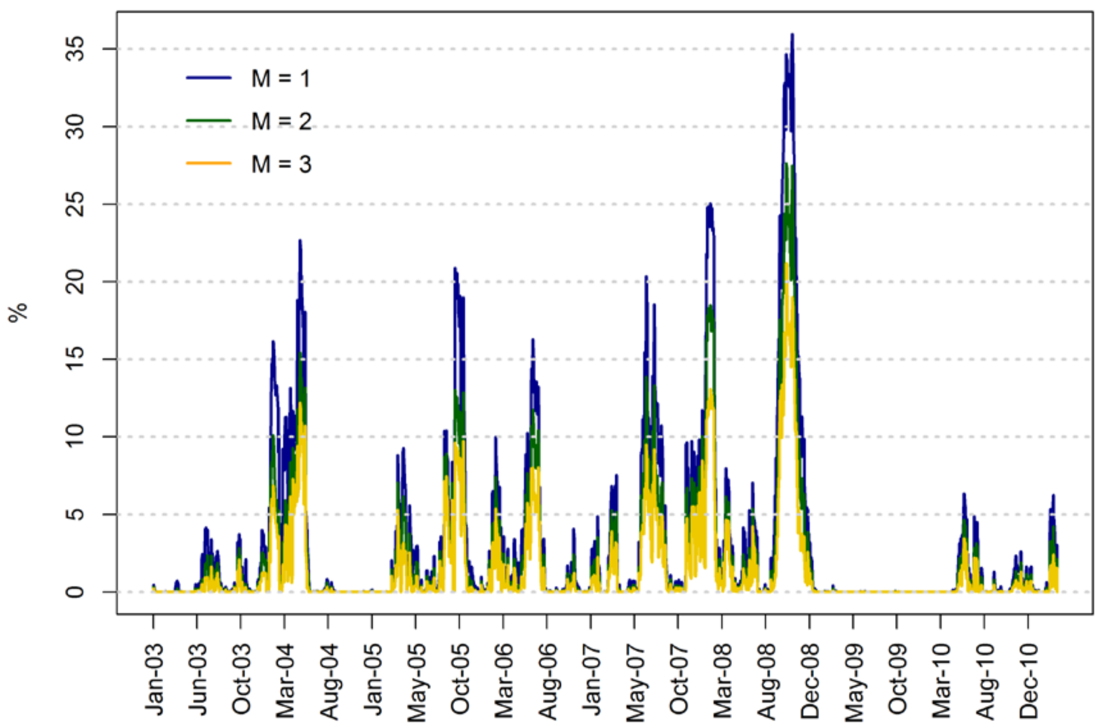
Chart 6: Total margin relief provided by the CCM model (*M* = 1)



4.3.2 Impact of increasing the number of largest margin gaps covered

The CCM model generates margin relief by not requiring full collateralization of all the margin gaps among clearing members. If all margin gaps were collateralized through contributions to the survivor-pay collateral pool, then the CCM model would not provide any margin relief. As the number of margin gaps that are covered increases, the amount of possible margin relief decreases. **Chart 7** shows the total margin relief provided if the single largest, two largest and three largest margin gaps are covered. Increasing the number of largest margin gaps covered still allows the CCM model to generate significant margin relief.

Chart 7: Margin relief provided by the CCM model for multiple margin gaps

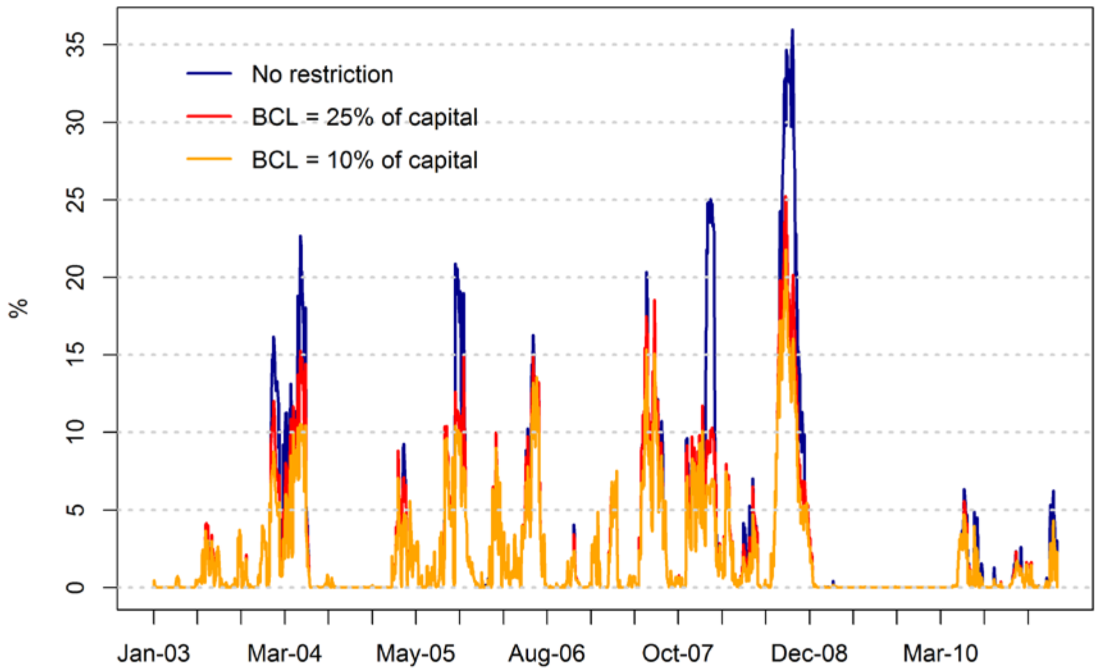


4.3.3 Impact of decreasing the BCLs

BCLs can be imposed on the loss-sharing arrangements associated with the CCM model. In this exercise, reciprocal BCLs were generated among pairs of clearing members, for each day over the sample, equal to a given percentage of the lower of the two levels of capital. For example, with reciprocal BCLs set at 10 per cent, if one clearing member has capital of $10 million and the other has capital of $20 million, the reciprocal BCL between them would be $1 million (i.e., 10 per cent of $10 million, the lower of the two capital levels). It is also important to note that, if a clearing member is experiencing margin relief via the CCM model, then during that time any BCLs granted to that clearing member cannot be decreased.

Chart 8 illustrates the impact on margin relief from various reciprocal BCLs. Despite conservative limits imposed on the potential losses, the CCM model still generates significant margin relief.

Chart 8: Margin relief provided by the CCM model under binding BCLs (*M* = 1)



4.3.4 Default simulations

The CCM model provides margin relief by collateralizing a number, *M*, of the largest margin gaps through loss-sharing arrangements. Through default simulations, we measure the amount of additional losses incurred by each of the survivors resulting from the CCM model and then examine how manageable those losses would be.

The order in which members' margin resources are accessed follows the default waterfall for the CCM model, described in Chart 2.

The default simulations are conservative in two respects. First, the waterfalls take into account the segregation of client and firm assets; the CCP can never use client assets to cover firm losses. Second, the CCP will always reimburse variation margin payments to clients even if the clearing member does not have sufficient initial margin to cover losses in the firm account. In other words, the CCP fulfills its obligation with the clients even though the firm is generating losses for the CCP. Typically, CCPs have obligations only at the clearing member level, i.e., the variation margin payments are netted across client and firm accounts. If the clearing member owes variation margin payments to its clients, the clients normally have to settle this issue outside the rules of the CCP, potentially in bankruptcy court.

Exercise 1: Simulated defaults with model calibrated to M = 1 and no BCLs in place

A total of 24,247 single-member defaults were simulated with the CCM model calibrated to cover the single largest margin gap. A default was simulated for a given clearing member on the day t if the client *or* the firm account would have incurred cumulative losses over the next two days (on t+1 and t+2). In other words, a default was simulated for a clearing member each time the sum of the next two days' worth of losses was negative for either the client or firm portfolio.

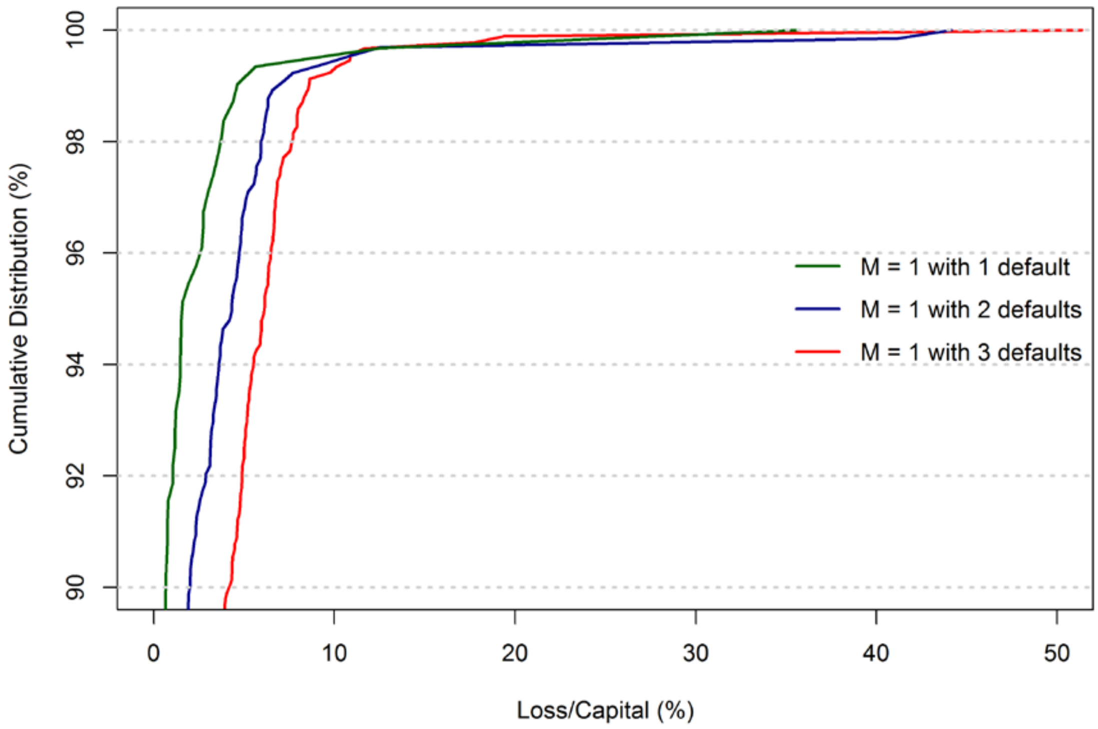
From the sample of over 24,000 simulated single-member defaults, only 23 led to losses to survivors in the CCM model. Across these 23 default simulations, there were 308 instances of individual survivors incurring losses. Only 2 such losses exceeded 10 per cent of the survivor's capital, with the highest ratio reaching 35.7 per cent of capital.

When two defaults on the same day were simulated, and with the CCM model still calibrated to cover the single largest margin gap (M = 1), 47 such simulations led to losses for survivors in the CCM model. In these 47 default simulations, there were 653 instances of individual survivors incurring losses. Only 4 of these instances exceeded 10 per cent of the survivor's capital, with the highest ratio reaching 44.2 per cent of capital.

When all possible combinations of three defaults on the same day were simulated, 71 such simulations led to losses for survivors in the CCM model. In these 71 default simulations, there were 922 instances of individual survivors incurring losses. Only 7 of these instances exceeded 10 per cent of the survivor's capital, with the highest ratio reaching 51.4 per cent of capital.

For the rare case when one, two or three simultaneous defaults led to survivor losses, **Chart 9** provides additional detail on how those losses are distributed. In particular, Chart 9 shows the empirical cumulative distributions of the survivors' losses relative to their capital, when the CCM model is calibrated to $M = 1$. For example, the green line shows that, in the extremely rare event when a single-member default leads to any survivor losses, 99 per cent of these losses make up less than 5 per cent of the survivors' capital.

Chart 9: Empirical cumulative distribution of survivors' losses to capital (*M* = 1)

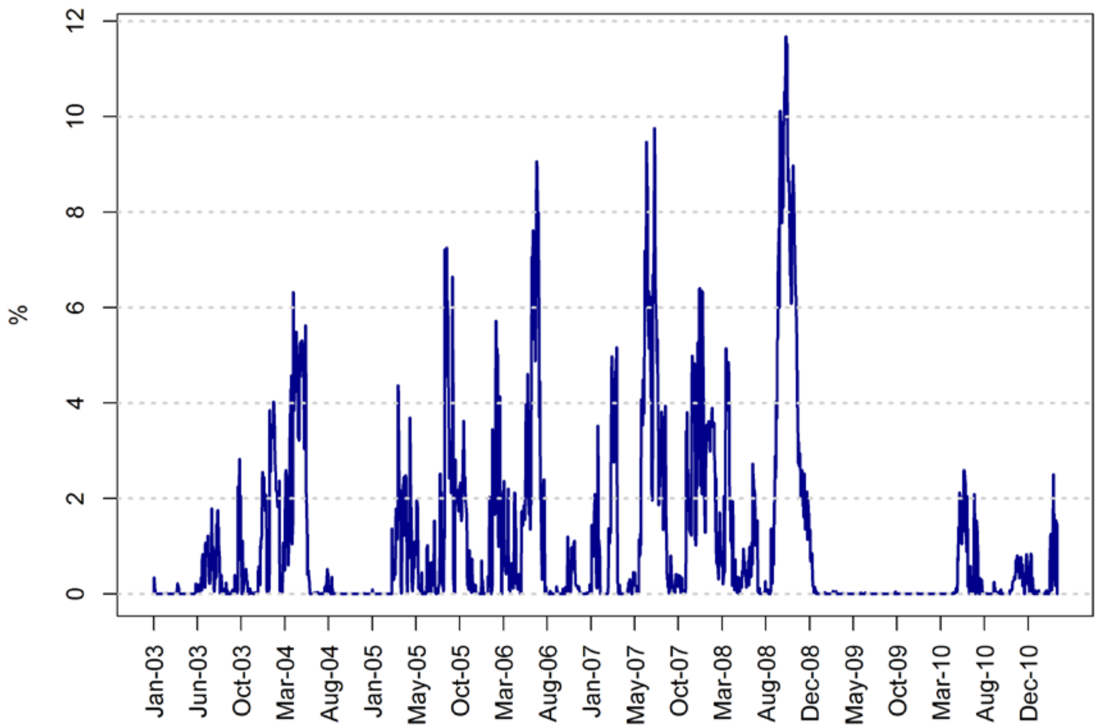


Exercise 2: Simulated defaults with model calibrated to M = 2 and 5 per cent reciprocal BCLs in place

To demonstrate the practical applicability of the CCM model, we conduct the same analysis as above, except with more conservative settings. In this exercise, the CCM model is calibrated to cover the two largest margin gaps (*M* = 2) and also reciprocal BCLs are set to not exceed 5 per cent of capital.

As **Chart 10** shows, the model still generates significant margin relief for clearing members, even under these conservative assumptions. Total margin relief provided under these settings reached a peak of 11.5 per cent on 14 October 2008.

Chart 10: Margin relief provided by a conservative CCM model
(*M* = 2; reciprocal BCLs = 5% of capital)



Of the 24,247 single-member defaults simulated under these conservative conditions, only 11 led to additional losses for survivors in the CCM model. Of these 11 simulated defaults, there were 159 instances of a survivor incurring losses. The largest loss relative to capital was 1.4 per cent.[17]

Two defaults on the same day were also simulated under these conditions. There were 22 default simulations that led to additional losses for survivors in the CCM model. The largest loss incurred by a survivor was 2.7 per cent of its capital.

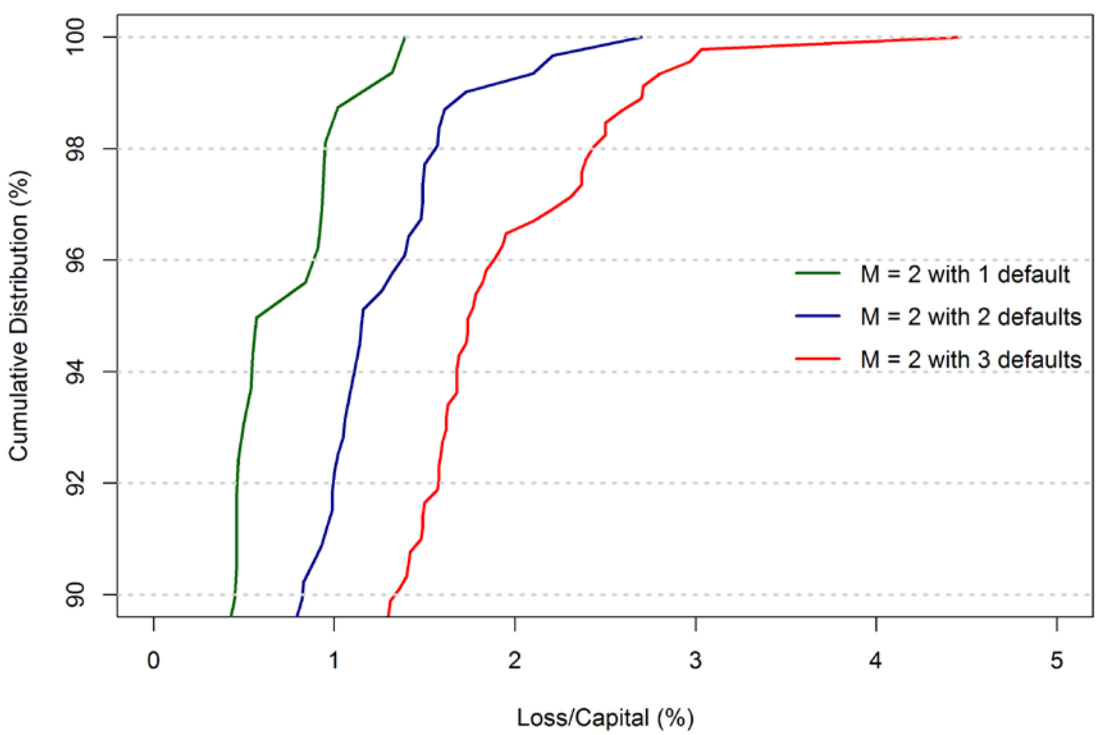
When all possible combinations of three defaults on any same day were simulated under these conditions, 35 simulations led to additional losses for survivors in the CCM model. The largest loss incurred by a survivor was 4.5 per cent of its capital.

Chart 11 shows the empirical cumulative distributions of survivors' losses relative to capital, where one, two or three simultaneous defaults led to survivor losses. For example, the green line shows that, in the extremely rare event when a single-member

[17] This is significantly below the 5 per cent BCL, since all the defaulter's collateral, including contributions to the clearing fund, are exhausted prior to survivors incurring losses through the CCM model.

default leads to any survivor losses, 99 per cent of these losses make up less than 1.2 per cent of the survivors' capital.

Chart 11: Empirical cumulative distribution of survivors' losses to capital
(M = 2, BCLs = 5% of capital)



Overall, these results demonstrate that the CCM model is capable of generating margin relief while keeping potential losses within the capacity of clearing members to incur them.

4.4 Discussion

To deal with the potentially procyclical nature of a CCP's margining practices, we propose a model that trades off a small increase in risk mutualization in return for more-stable margins during times of stress. Credit exposures arising from the CCM model can be controlled through the allocation of BCLs, which can be set by clearing members, authorities and/or the CCP.

Although this paper empirically explores the potential implications of the CCM model, much is left for future work. The fundamental assumption of the CCM model is that, if the parameters are properly adjusted, the benefits of margin relief would more than offset the increased credit exposures. Verifying this assumption and properly calibrating the model for the optimal speed limit are left for future work.

Future work will also have to investigate the issue of which entity should control the allocations of BCLs when the CCM model is supplemented by this feature. Clearing members might be interested in controlling their own BCLs, but leaving the allocation of BCLs to clearing members could potentially lead to less margin relief in times of stress, since clearing members might decrease the BCLs they provide, fearing credit losses. This would have the effect of reducing the potential margin relief that the CCM model is designed to provide when conditions become more volatile. This is why the CCP or the authorities might have to set minimum and maximum BCL allocations, as a percentage of capital measures, to provide minimum margin relief while not exceeding the capacity of clearing members to bear credit losses.

Another issue that needs further investigation is how the CCM model can be integrated between clearing members and clients. If clearing members reap all the benefits of the CCM model in terms of margin relief but do not pass on any margin relief to their clients, the financial stability benefits could be limited to clearing members. One could envision a model where clients accept some credit risk and participate in the CCM model, although this would need to be supported by proper systems and rules.

5 Conclusions

CCPs continue to play an increasingly prominent role in the financial system, helping to support financial markets and reinforce financial stability. CCPs rely heavily on the collection of margin collateral to manage the risks brought by their members. As the role of CCPs in the financial system continues to grow, their margining practices have greater potential for procyclical effects during times of stress. Recognizing that this is a potential concern is an important first step, but the more difficult question is how to address the issue.

One often-suggested solution to address the procyclical nature of initial margin requirements is to use through-the-cycle margining methodologies. Traditional through-the-cycle margining approaches may create more-stable margin requirements but, to properly mitigate risks, it seems that they impose excessive collateral costs, especially for volatile products. In turn, these higher costs could potentially make CCPs economically non-viable and encourage bilateral trading.

This paper suggests an innovative solution, the CCM model, which imposes a limit on the speed of initial margin increases that result from spikes in market volatility. This can temporarily smooth out the margin demands that can suddenly arise when a CCP's standard margin model reacts quickly to enhanced market stress. To continue protecting the CCP with a high degree of confidence, any temporary margin relief that is provided under the CCM model is supported by greater reliance on loss mutualization. The increased credit exposures arising from this loss mutualization can be carefully controlled through the allocation of BCLs.

The paper shows, empirically, that the CCM model can generate significant initial margin relief for clearing members. The model also imposes some additional credit risk on members, but the probability that this risk will materialize into actual credit losses is very low. In the rare event where surviving clearing members do face losses as a result of the CCM model, the empirical exercise shows that these would be manageable. The paper also demonstrates that, even with BCLs in place to contain the size of credit losses that can result from the CCM model, the approach can still generate meaningful margin relief in times of stress.

An important caveat is that the results are based on a set of specific portfolios held by clearing members from January 2003 through March 2011. Clearing members may have behaved differently had the CCM model been in place during that time. Moreover, it is unknown whether the CCM model would deliver similar results for other CCPs with different clearing member portfolios, or for other financial crises.

While more work is needed to calibrate and evaluate the benefits of the CCM model, it could be a safe and efficient tool for CCPs to address the procyclical nature of initial margin requirements during times of stress.

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