

Les risques systémiques dans les infrastructures de post-marché

Colloque du Conseil Scientifique de l'Autorité des marchés financiers

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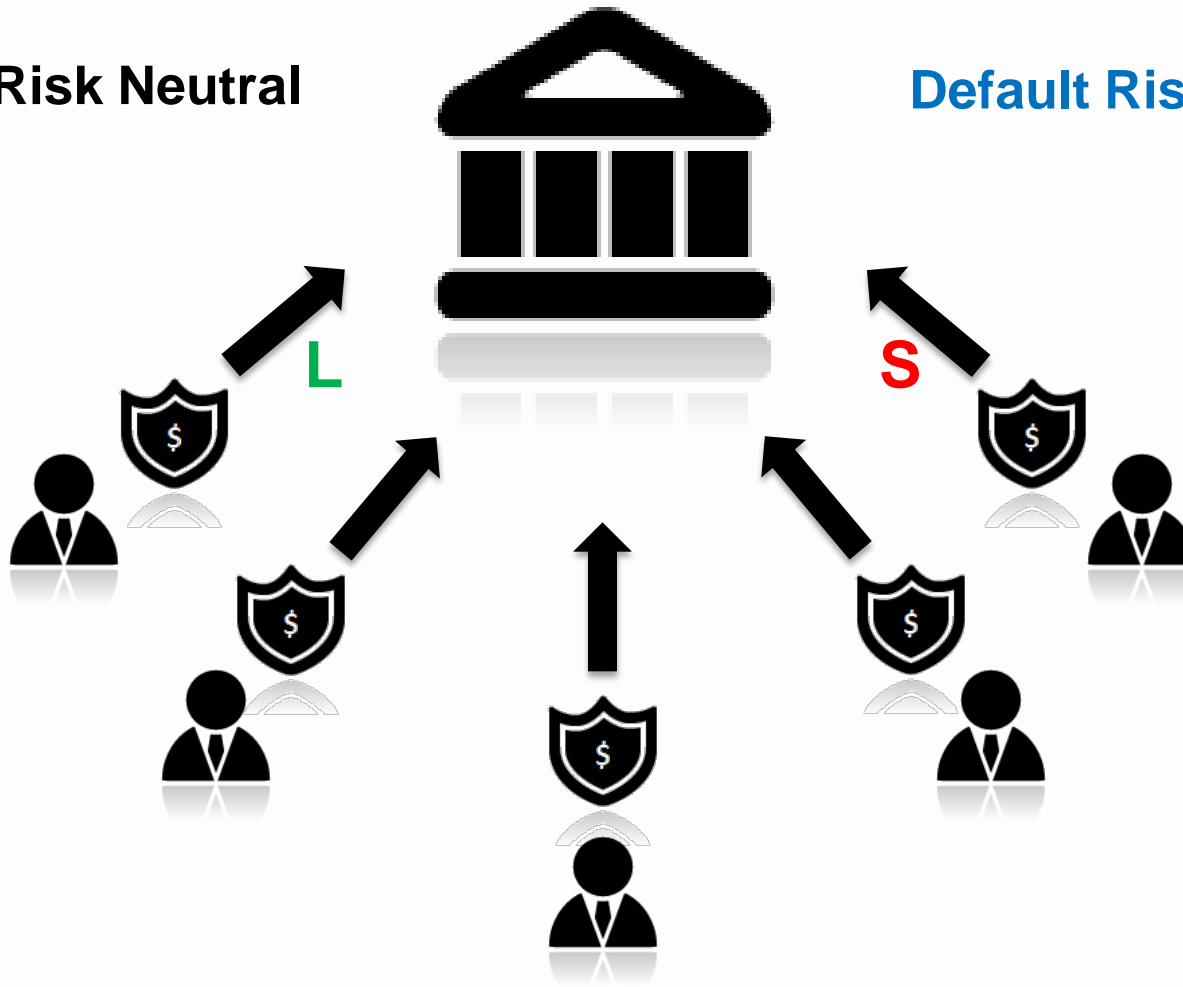
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- To propose a new methodology to estimate **collateral requirements in derivatives** central counterparties (CCPs): **CoMargin**
- Depends on both the **tail risk** of a given market participant and its **interdependence** with other participants (macroprudential approach).
- Controls the **probability** and minimizes the **shortfall** of simultaneous margin-exceeding losses.

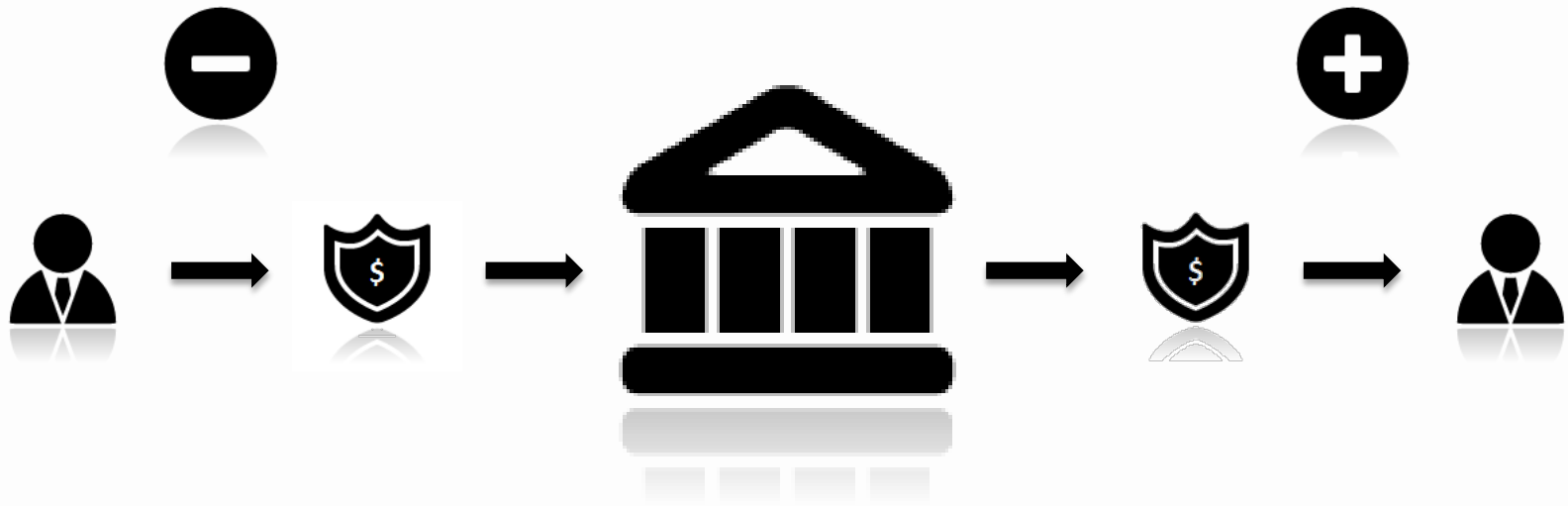
CCPs: Risk Management

Market Risk Neutral

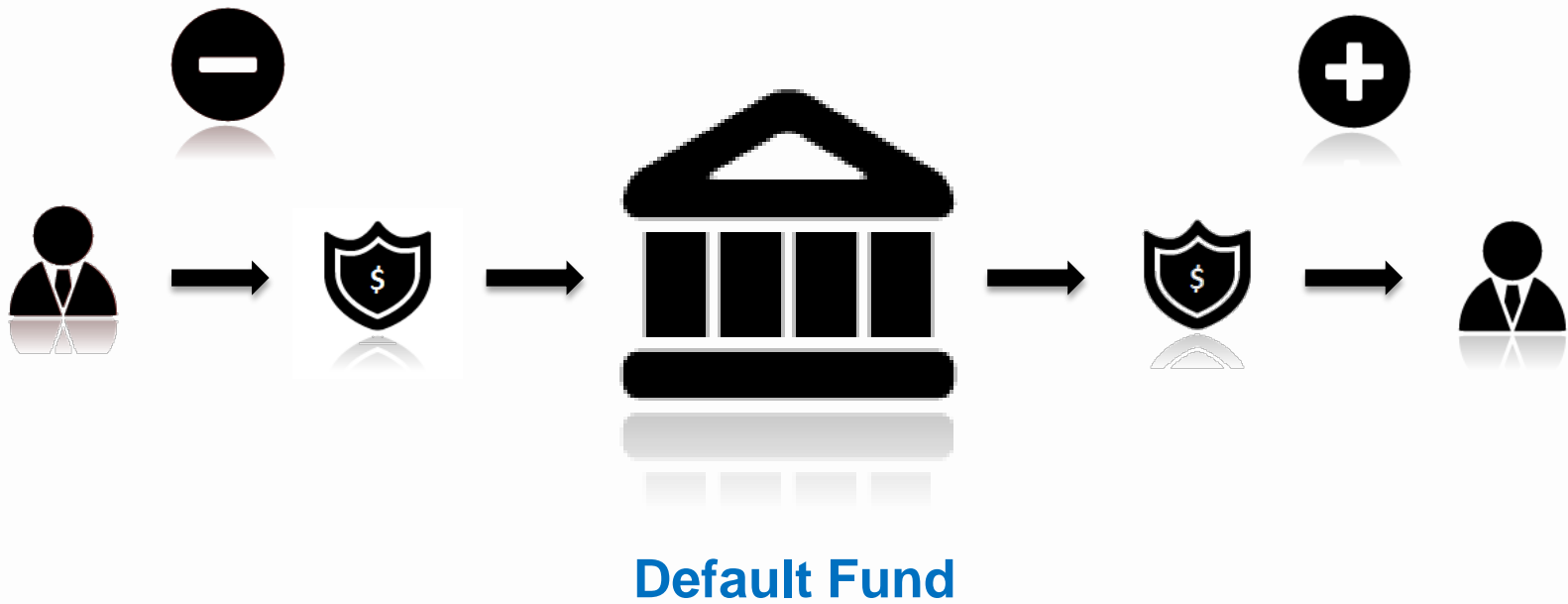
Default Risk Concentration



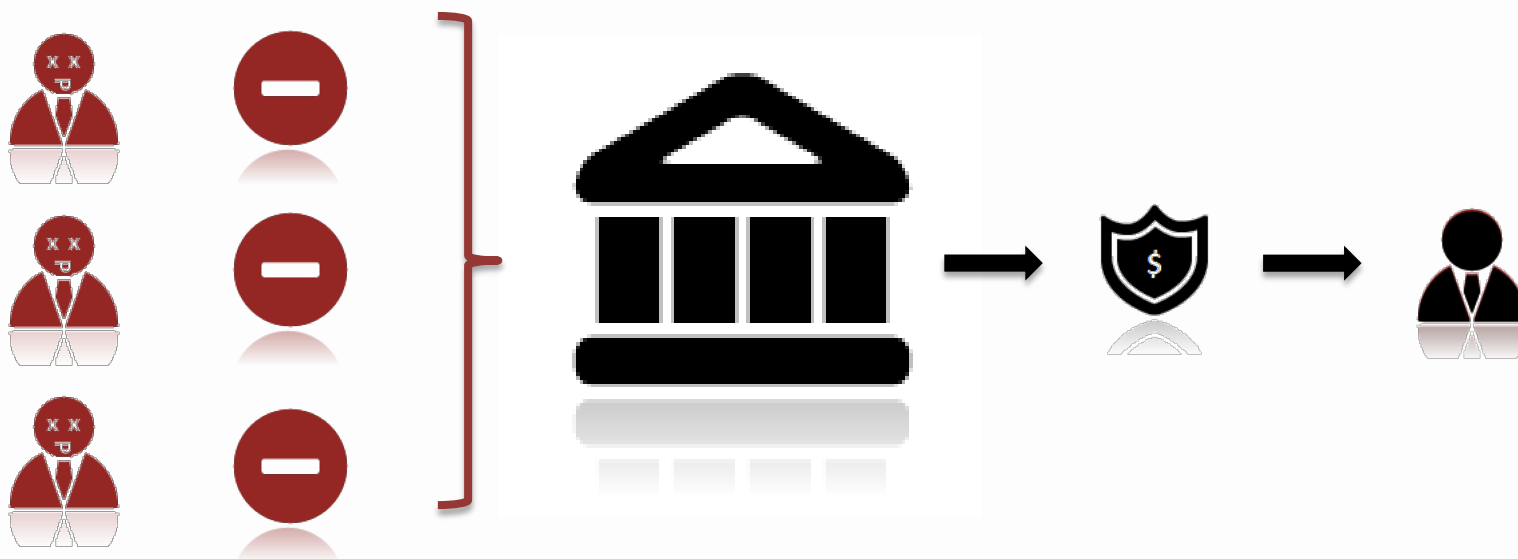
CCPs: Expected Mechanism



CCPs: Default Risk



CCPs: Systemic Risk



Why Is This Important?

- **OTC derivatives reforms**

- Current push to centrally clear OTC derivatives (US Department of Treasury, 2009; European Union, 2012)

- **Regulation of systemic risk**

- Optimal risk concentration for derivatives (Duffie and Zhu, 2011)
- The failure of a clearing house represents a major systemic shock
- Bank of England's Governor Carney: *"It is extremely important that CCPs organise themselves to make sure they can provide the necessary resilience plan [...] to the extent they can cover the failure of one or two major institutions"*

Basic Idea

Orthogonal Positions

CM1

CM2

Equity

L

S

Interest rate

S

L

CDS

L

S

Std margin



CoMargin



Correlated Positions

CM1

CM2

Equity

L

L

Interest rate

S

S

CDS

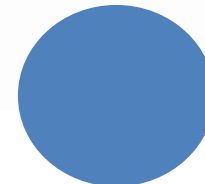
L

L

Std margin



CoMargin

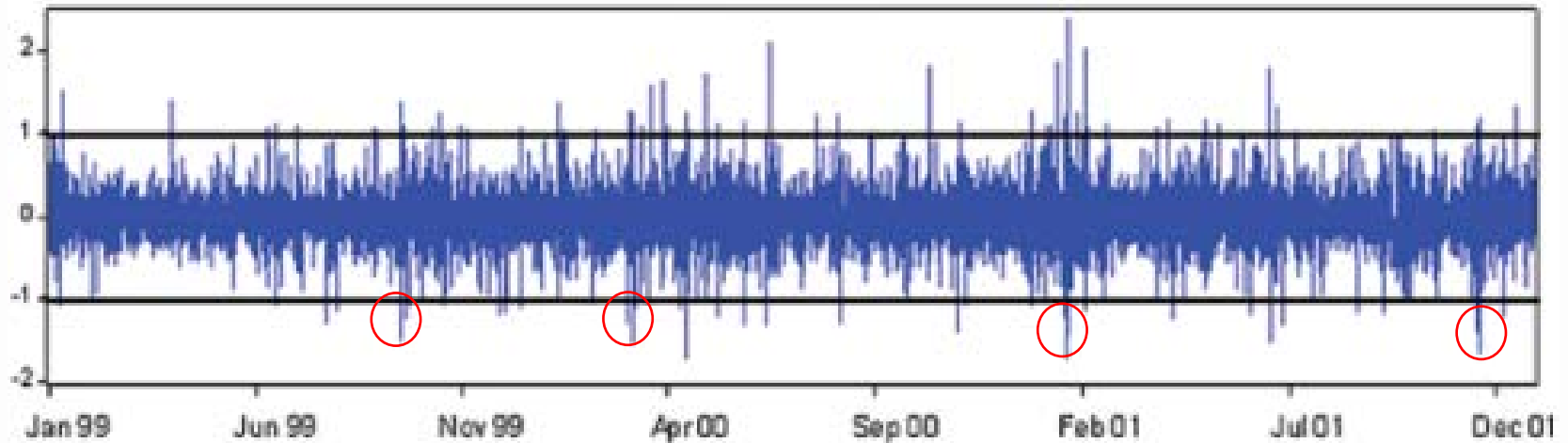


P&L Dependence: Theory

Level of P&L dependence across clearing members increases with:

- (1) Trade crowdedness (common information, same hedging needs)
- (2) Underlying asset comovement (increased during periods of high volatility)

P&L Dependence: Empirical Evidence



CME data, "Derivatives Clearing, Default Risk, and Insurance", Jones and Pérignon (2013)

Current System: SPAN

$$F = F(S, \sigma, T)$$

$$(\Delta S, \Delta \sigma, \Delta T) \Rightarrow \Delta F$$

- Sixteen risk scenarios applied **on a firm by firm basis**.
- Margin requirements for each contract family are set independently and differences in times to expiration are not taken into account at this point.

Current System: SPAN

<u>SCENARIO</u>	<u>PRICE OF UNDERLYING</u>	<u>VOLATILITY</u>	<u>TIME TO EXPIRATION</u>
One	Futures unchanged	Up	Reduced by 1 day
Two	Futures unchanged	Down	Reduced by 1 day
Three	Futures up 1/3 range	Up	Reduced by 1 day
Four	Futures up 1/3 range	Down	Reduced by 1 day
Five	Futures down 1/3 range	Up	Reduced by 1 day
Six	Futures down 1/3 range	Down	Reduced by 1 day
Seven	Futures up 2/3 range	Up	Reduced by 1 day
Eight	Futures up 2/3 range	Down	Reduced by 1 day
Nine	Futures down 2/3 range	Up	Reduced by 1 day
Ten	Futures down 2/3 range	Does	Reduced by 1 day
Eleven	Futures up 3/3 range	Up	Reduced by 1 day
Twelve	Futures up 3/3 range	Down	Reduced by 1 day
Thirteen	Futures down 3/3 range	Up	Reduced by 1 day
Fourteen	Futures down 3/3 range	Down	Reduced by 1 day
Fifteen	Futures up extreme move	Unchanged	Reduced by 1 day
Sixteen	Futures down extreme move	Unchanged	Reduced by 1 day

The VaR margin, B_i , corresponds to the $\alpha\%$ quantile of the P&L distribution:

$$\Pr(V_{i,t+1} \leq -B_{i,t}) = \alpha$$

- The probability of **joint financial distress** for firms i and j is given by:

$$\begin{aligned} & \Pr[(V_{i,t+1} \leq -B_{i,t}) \cap (V_{j,t+1} \leq -B_{j,t})] \\ = & \Pr(V_{i,t+1} \leq -B_{i,t} | V_{j,t+1} \leq -B_{j,t}) \times \Pr(V_{i,t+1} \leq -B_{i,t}) \end{aligned}$$

Fully Orthogonal Market

- We define a **fully orthogonal market** as a one that has firms with orthogonal trading positions and orthogonal underlying asset returns.
- In this case, firms have orthogonal risk exposures and their P&L are independent:

$$\Pr(V_{i,t+1} \leq -B_{i,t} | V_{j,t+1} \leq -B_{j,t}) = \alpha$$

$$\Pr[(V_{i,t+1} \leq -B_{i,t}) \cap (V_{j,t+1} \leq -B_{j,t})] = \alpha^2$$

Fully Orthogonal Market

- A fully orthogonal market minimizes the probability of joint financial distress across clearing members.
- Therefore, **given a common coverage probability**, a fully orthogonal market provides the **best possible level of market stability**.
- It can be used as a **common benchmark** for all margining systems.

The CoMargin, $B^{i|j}$, corresponds to the $\alpha\%$ conditional quantile of the joint P&L distribution:

$$Pr\left(V_{i,t+1} \leq -B_t^{i|j} \mid V_{j,t+1} \leq -B_{j,t}\right) = \alpha$$

- Bayes rule gives the following relation:

Probability of Joint Financial Distress

$$\Pr(V_{i,t+1} \leq -B_t^{i|j} | V_{j,t+1} \leq -B_{j,t}) = \frac{\Pr\left[\left(V_{i,t+1} \leq -B_t^{i|j}\right) \cap \left(V_{j,t+1} \leq -B_{j,t}\right)\right]}{\Pr(V_{j,t+1} \leq -B_{j,t})}$$

- From Definitions 1 and 2, we see that the CoMargin for firm i is defined as the margin level $B_t^{i|j}$ such that:

$$\Pr\left[\left(V_{i,t+1} \leq -B_t^{i|j}\right) \cap \left(V_{j,t+1} \leq -B_{j,t}\right)\right] = \alpha^2$$

- CoMargin is the margin level that ensures that **the probability of joint financial distress corresponds to that obtained in a *fully orthogonal market*.**

The Properties of CoMargin

(1) The CoMargin of a firm increases with the variability of its P&L.

$$\frac{\partial B^{i|j}}{\partial \sigma_i} > 0$$

(2) When there is no P&L dependence, CoMargin and VaR margin converge.

$$B^{i|j} = B_i \text{ when } \rho = 0$$

(3) The CoMargin of a firm increases with the dependence between its P&L and that of other firms.

$$\frac{\partial B^{i|j}}{\partial \rho} > 0$$

(4) When firms have perfect P&L dependence, their CoMargin converges to VaR margin (α^2).

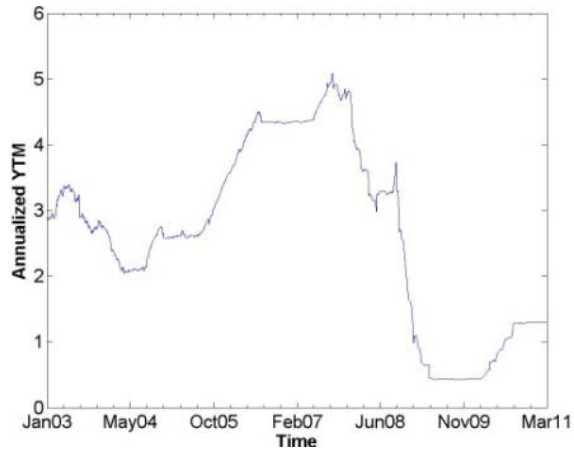
$$\lim_{\rho \rightarrow 1} B^{i|j} = B_i(\alpha^2)$$

(5) The CoMargin of a firm does not depend on the variability of the P&L of other firms.

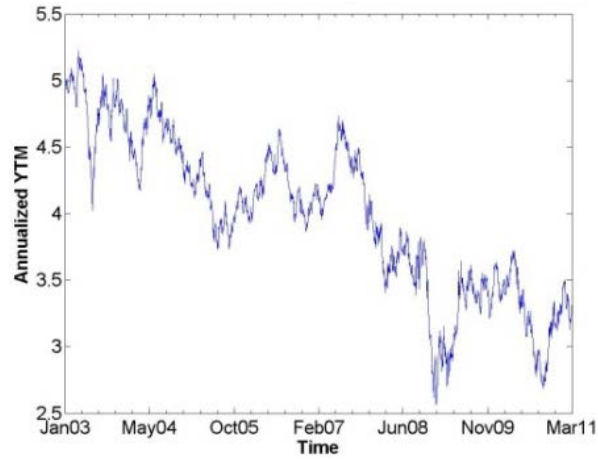
$$\frac{\partial B^{i|j}}{\partial \sigma_j} = 0$$

- **Proprietary data from the Canadian Derivatives Clearing Corporation (CDCC)**
 - Daily trading positions (customer and firm accounts)
 - 48 clearing members - January 2, 2003 and March 31, 2011
 - Three-month Canadian Bankers' Acceptance Futures (BAX)
 - Ten-year Government of Canada Bond Futures (CGB)
 - S&P/TSX 60 Index Standard Futures (SXF)

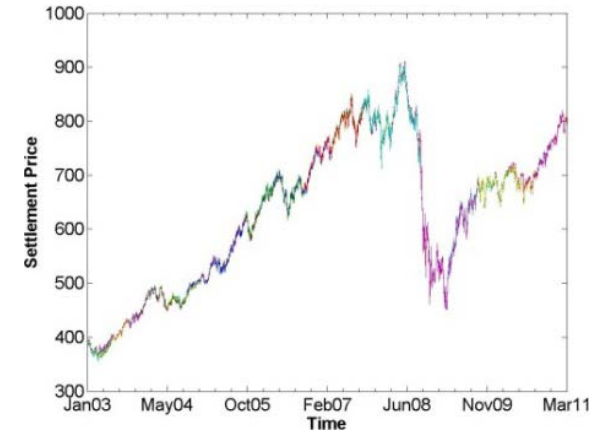
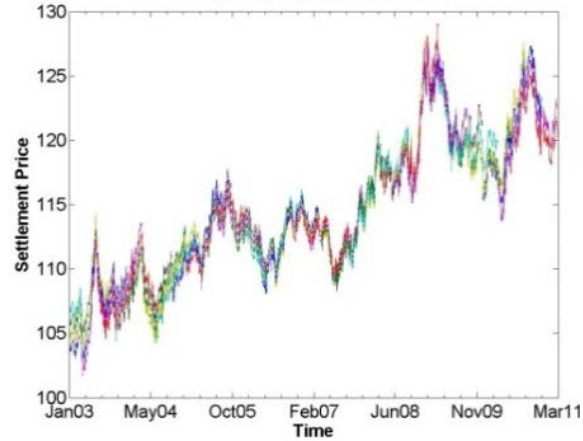
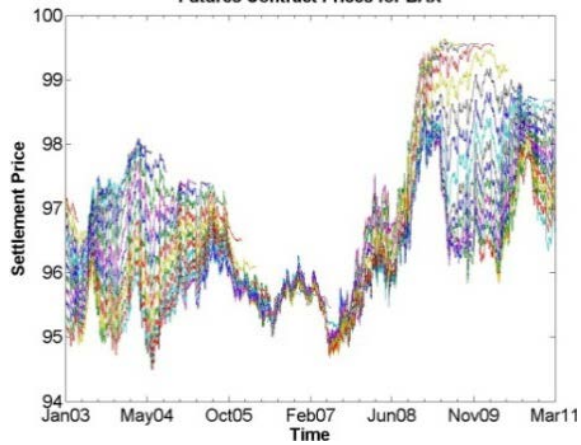
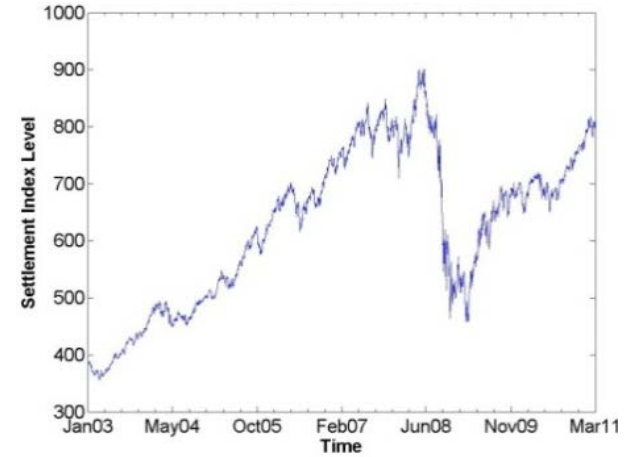
**Three-month Canadian Bankers' Acceptance
(BAX)**



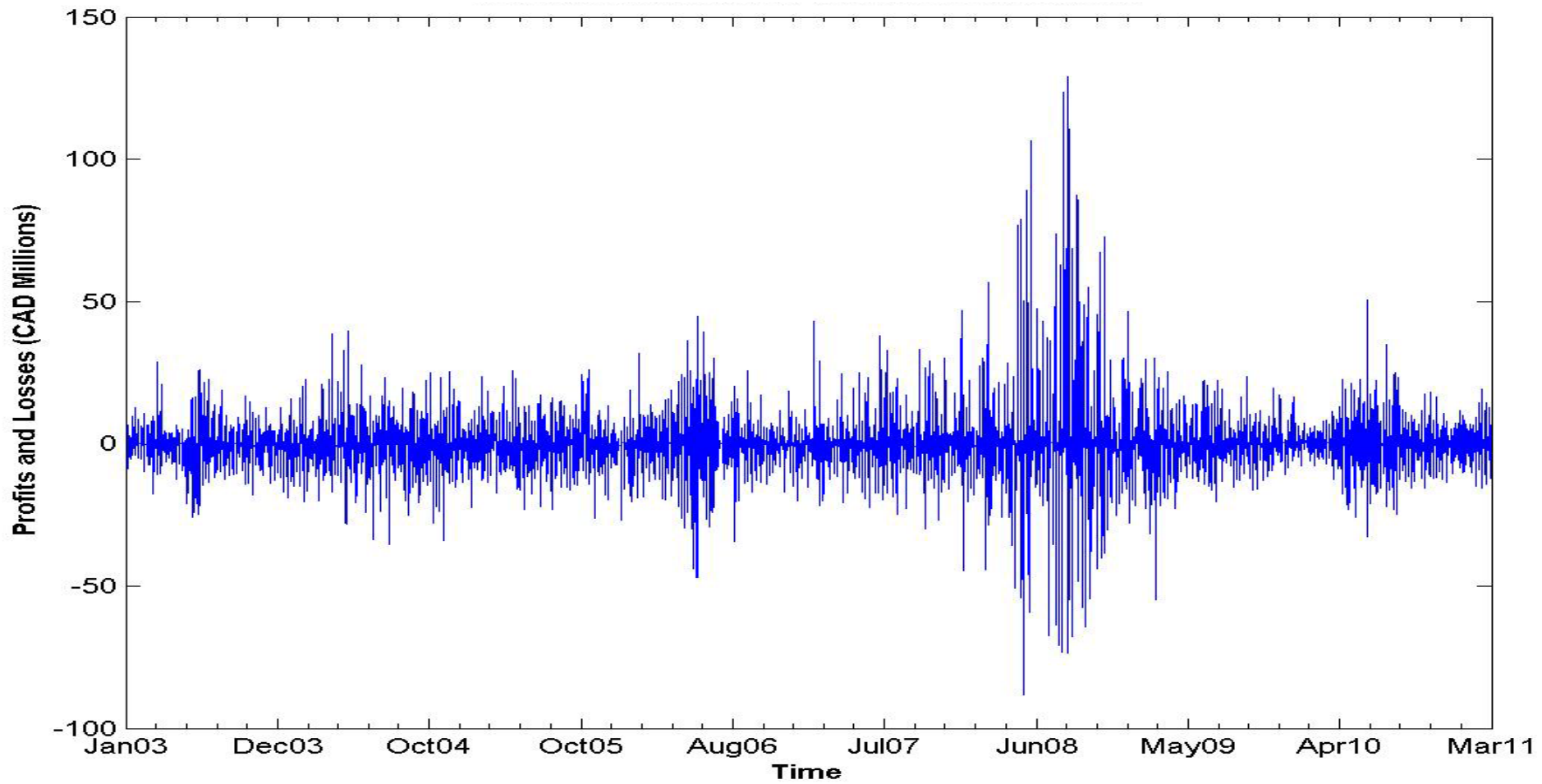
**Ten-year Government of Canada Bond
(CGB)**



**S&P/TSX 60 Index
(SXF)**



P&L for active firm accounts



Implementing CoMargin

- **Scenario generation**
 - each day: empirical marginals + t-copula
 - 100,000 simulations
- **Conditioning firms**
 - two firms with largest expected shortfall

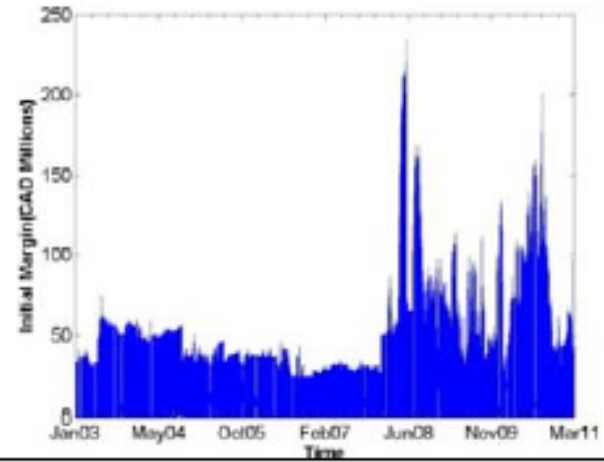
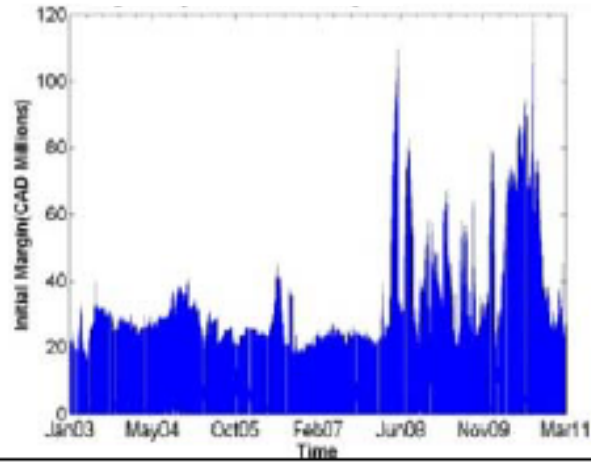
$$ES = E(V_{i,t+1} | V_{i,t+1} \leq -B_{i,t})$$

- **Coverage rate:** $\alpha = 2\%$

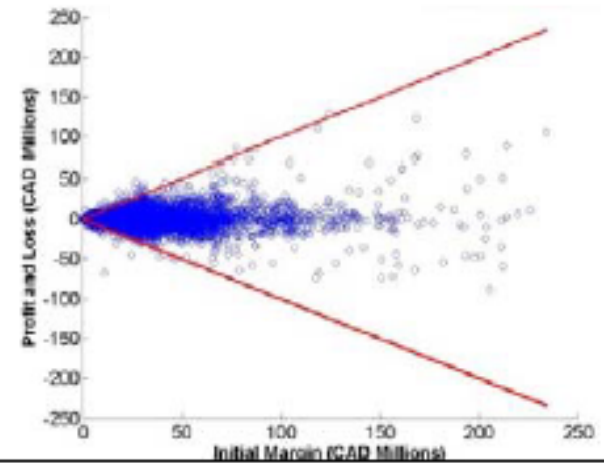
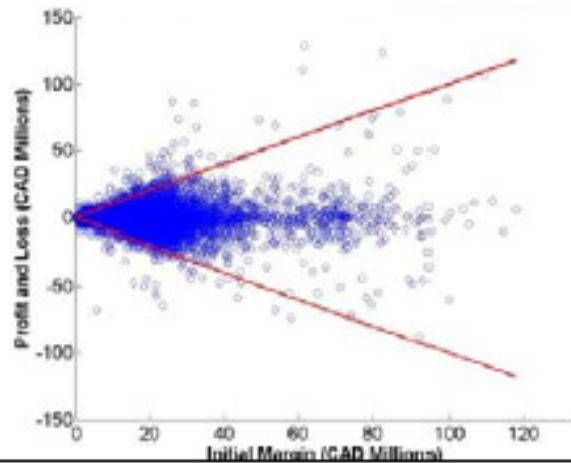
VaR

CoMargin

Panel A: Initial Margin



Panel B: Daily P&L and Initial Margins



Empirical Performance

	Unconditional			Conditional on at least one exceedance		
	Prob. of Exceedances	Avg. Exceedances	Avg. Shortfall (CAD Millions)	Prob. of Exceedances	Avg. Exceedances	Avg. Shortfall (CAD Millions)
	Aggregate Market (CCP level)					
SPAN	0.09	0.15	0.35	0.36	1.63	3.78
VaR	0.14	0.25	0.44	0.42	1.80	3.20
CoMargin	0.07	0.10	0.13	0.28	1.44	1.85
BNSPAN	0.02	0.02	0.16	0.38	1.47	10.15
BNVaR	0.02	0.03	0.16	0.36	1.47	9.45

- CoMargin is a **new and attractive method** to set margins.
- We show theoretically and empirically that CoMargin **outperforms** the widely popular SPAN and VaR margining approaches.
- Outperformance does not simply follow from these increased margins, but rather by **better allocating** margins across clearing members.
- Can be used as a margining system or simply to identify firms with high level of dependence.

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More information at:

<http://ssrn.com/abstract=1943562>