Central Clearing and the Sizing of Default Funds

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Central Counterparty Clearinghouse (CCP)

- **CCPs:** G20 mandatory clearing of standardized derivatives
  - Dodd-Frank, European Market Infrastructure Regulation (EMIR), Australian Securities and Investments Commission
  - CCPs act as the buyer to every seller and the seller to every buyer
  - CCPs guarantee terms of trades, pool the counterparty risks
  - IRS: 87% for US, 62% for EU (FSB, 2017)
  - CDS: 55% global clearing rate (BIS, 2017)

- **Design of CCPs:** still large debate
  - “it is an understatement that it would be a disaster if a clearing house failed”, Paul Tucker
● We focus on the design of default funds collection.
  - Members contribute to a loss mutualization default fund.
  - Cover II Rule: total funds sufficient to cover failure of two largest members

● Is the Cover II rule effective?

● How to choose the optimal default fund level?
This Paper: the sizing of default funds

- A model of central clearing to analyze risk-taking in a CCP network
- Main results
  1. Default fund loss mutualization is intrinsically vulnerable.
  2. Network externality pushes members to become riskier ex-ante.
  3. The default fund is a tool to regulate member’s risk-taking incentives.
  4. Optimal default fund trades off risk-taking with funding cost.
  5. Propose a Cover X rule: cover a fraction of clearing members.
Literature

- Central clearing and counterparty risk
  - Duffie, Zhu 2011; Antinolfi, Carapella, Carli 2016; Koeppel, Monnet 2010; Stephens, Thompson 2014

- Stress testing CCPs and default funds
  - Paddrik, Young 2017; Menkveld 2017; Ghamami, Glasserman 2017

- This paper
  - first on the role of risk-taking incentives under default fund arrangement
  - proposes a new Cover X rule
Institutional Details on CCP
CCP: novation

Bilateral clearing

- End-user
- Small financial institution
- Large financial institution
Central clearing

CCP: novation
CCP: default waterfall

1. Defaulter’s prefunded resource (margins and default fund)
2. CCP own resources
3. Surviving members’ default fund contributions
CCP: default waterfall

Defaulter’s prefunded default fund

Surviving members’ default fund contributions
CCP: Cover II rule

- “Exposures to the two largest clearing members to be covered by clearing capital and default fund.” —EMIR

- “A globally systemically important CCP must have the resources necessary to cover the failures of its two largest clearing members.” —CPSS-IOSCO

- Cover II rule is adopted by major CCPs: ICE Clear Credit, CME Clearing US, ICE Clear, and LCH
Stylized Model
Environment

- $N$ risk-neutral CDS sellers, a continuum of risk-averse CDS buyers
  
  $$U(X) = \mathbb{E}[X] - \gamma \text{Var}(X)$$

- $t = 0$: buyers and sellers trade CDS; buyers pay a unit price 1
  
  - sellers choose $a = \{\text{risky (r)}, \text{safe (s)}\}$, unobservable

  $R_a = 0$

  $q_a$

  $r$

  $s$

  $\mu = (1 - q)R$ is expected return

  - $R_r > R_s$ but $q_r > q_s$

  - $\mu_s > \mu_r$: safe project is socially optimal

- $t = 1$: i.i.d. payoffs are realized, insurance payments $\delta$ are made
CCPs Create Value from Risk-sharing

- CCP guarantees insurance payment $\delta$ to buyers with certainty.

- We assume that buyers are sufficiently risk-averse:

  $$\gamma > \frac{\beta + q_r}{\mu r q_r (1 - q_r) \delta} - \frac{1}{(1 - q_r) \delta},$$

where $\beta$ is the opportunity cost of collateral: buyers value risk-sharing and pay a premium $f > 0$ to a default-free seller.

- Sellers scale up investment by $f$ and are better off joining the CCP.

- Participation in central clearing is an equilibrium outcome.
Default Fund and Cover II

- $t = 0$: CCP collects a default fund $F \in (0, \delta]$ from each member.
- The fund is segregated, so members incur a funding cost $\beta \times F$.
- **Cover II rule**: default fund pool covers at least two members’ default shortfalls:
  \[ NF \geq 2\delta. \]
- The rest of the shortfall is covered by CCP’s equity capital.
Loss Mutualization Mechanism

- Member $i$ defaults, with probability $q_{a_i}$
  - $i$’s default fund is used to cover his liability $\delta$

- Member $i$ survives, with probability $1 - q_{a_i}$
  - receives $(1 + f)R_{a_i}$, pays $\delta$ to the insurance buyer
  - $i$’s default fund is used to absorb shortfall of defaulting members $N_d$

- Member $i$ chooses $a \in \{r, s\}$ to maximize expected payoff

$$\max_a \mathbb{E} \left[ 1_{i \text{ survives}} \left( (1 + f)R_{a_i} - \delta + \left( F - \frac{N_d(\delta - F)}{N - N_d} \right)^+ \right) \right] - (1 + \beta)F$$
Proposition: For a given default fund $F$, equilibrium risk profiles are

$$a^e(F) = \begin{cases} r, \forall i & F < \hat{F} \\ r, \forall i, \text{ or } s, \forall i & \hat{F} \leq F \leq \overline{F} \\ s, \forall i & \overline{F} < F \end{cases}$$

- If $F > \hat{F}$, where $\hat{F}$ satisfies $\frac{\mu_s - \mu_r}{q_r - q_s} = \frac{\delta - \psi(N - 1; \hat{F})}{1 + f}$, all choosing safe is an equilibrium and is socially optimal.
- High $F$ discourages risk taking.
Default Fund as a Tool to Mitigate Risk-taking

- Given strategy $\alpha^e(F)$, the optimal $F^e$ maximizes aggregate value

$$F^e = \arg \max_F \left( (1 + f) \sum \mu_{a_i} - \delta N - N\beta F \right)$$

- As members switch from risky to safe at $\hat{F}$, total value increases by

$$\Delta = (1 + f)(\mu_s - \mu_r) > 0$$

- but funding cost increases by $\beta \left( \hat{F} - \frac{2}{N}\delta \right)$. 

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- **Proposition:** Under mild conditions, the default fund that maximizes aggregate value is

$$F^e = \begin{cases} 
\hat{F}, & \text{if } \Delta > \beta \left( \hat{F} - \frac{2}{N}\delta \right), \\
\frac{2}{N}\delta, & \text{else}.
\end{cases}$$

- The funding cost impacts the socially optimal default fund level.
- Cover X＞II if funding cost is low (low interest rate environment).
Cover X Rule

- **Cover X Rule** for a given number of participating members $N$ is

$$X(N) = \frac{N F^e(N)}{\delta}.$$ 

- Cover X rule increases with $N$.
- Cover ratio $X(N)/N$ has little variation with $N$. 

Limiting Result in a Large CCP Network

• Limiting result: In a large CCP network,

\[
\frac{X(N)}{N} \rightarrow 1 - \frac{(1 + f)(\mu_s - \mu_r)(1 - q_s)}{(q_r - q_s)\delta},
\]

if funding costs are not too high; otherwise \( \frac{X(N)}{N} \rightarrow 0 \).

• Implications: cover a fixed fraction rather than a fixed number.
  - The rule should account for the number of clearing members.
  - ICE and LCH have more than 20 members, with entries and exits.
Extensions
Extension 1: continuous choice of risk

- We allow members to choose over a continuum of risk levels.
  - Members’ risk-taking decreases with $F$.
  - Optimal $F$ trades off risk-taking sensitivity with funding cost.
Extension 2: size heterogeneity

- CCPs’ exposures tend to concentrate in one or a few large clearing members.
  - We extend the base model to account for size heterogeneity.
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Case 1: a size-K member makes a protection payment $K\delta$, has investment payoff $K(1 + f)R$, default fund $KF$; $K > 1$, $K/N \to 0$.
  - the large member has zero mass;
  - all results in the base model hold, including $F^e$;
  - the big member does not affect the pooled outcome.
Extension 2: size heterogeneity

- **Case 2:** a size-$K$ member makes a protection payment $K(N - 1)\delta$, has investment payoff $K(N - 1)(1 + f)R$, default fund $K(N - 1)F$; $K > 0$.

  - It is $K$ times the total mass of others, $(\frac{K}{1+K} \times 100)\%$ of total mass.
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  - The required default fund to induce safe investment is

    lower for big member, \( \hat{F}^B < \hat{F} \)

    larger for small member, \( \hat{F}^S > \hat{F} \)
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  - The size-K member has default fund proportional to size, which makes it easier to internalize externalities.

  - A small member has zero mass and free rides to take risks.
Conclusions

• This paper studies the optimal level of clearinghouse default fund.

• Default fund loss mutualization is intrinsically vulnerable.

• An inherent externality pushes members to become riskier ex-ante.

• Cover II is suboptimal, especially in low funding cost environment

• We propose a Cover X rule that covers a fraction of clearing members.