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

Cover II Rule

- 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.

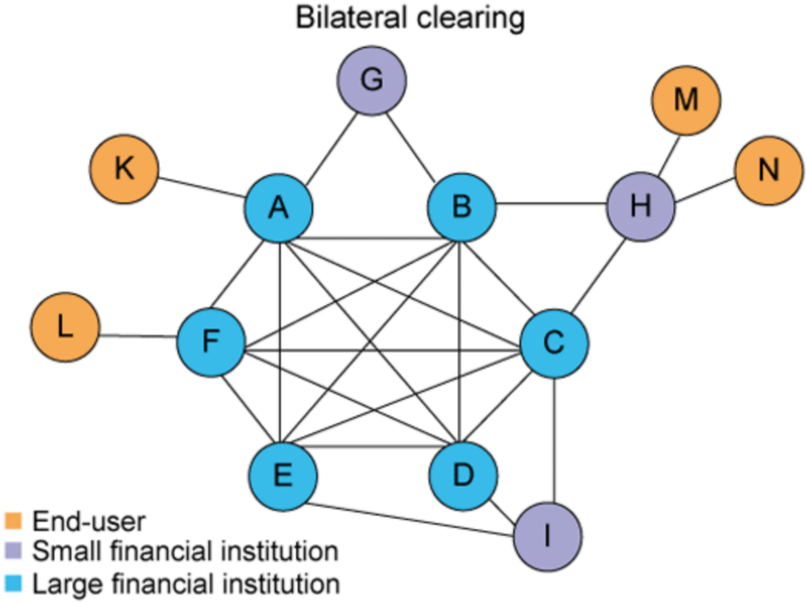
Literature

- Central clearing and counterparty risk
  - Acharya, Bisin 2014; Zawadowski 2013; Biais, Heider, Hoerova 2012, 2016
  - Duffie, Zhu 2011; Antinolfi, Carapella, Carli 2016; Koeppl, 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



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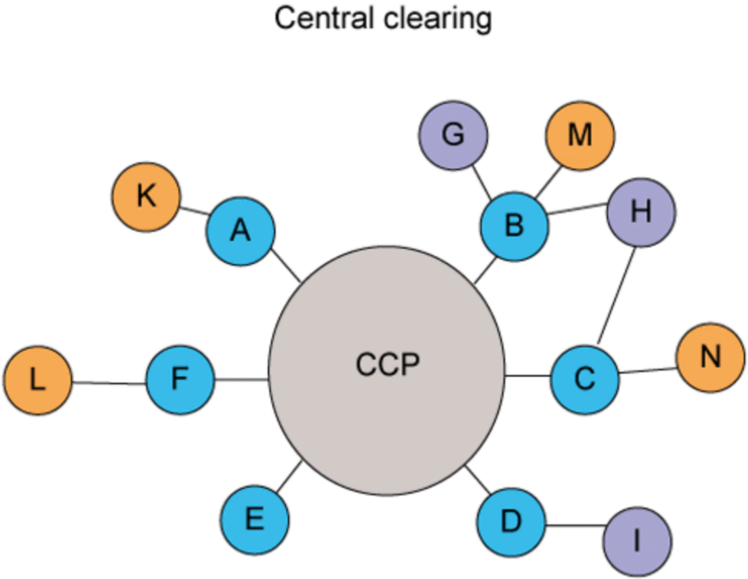
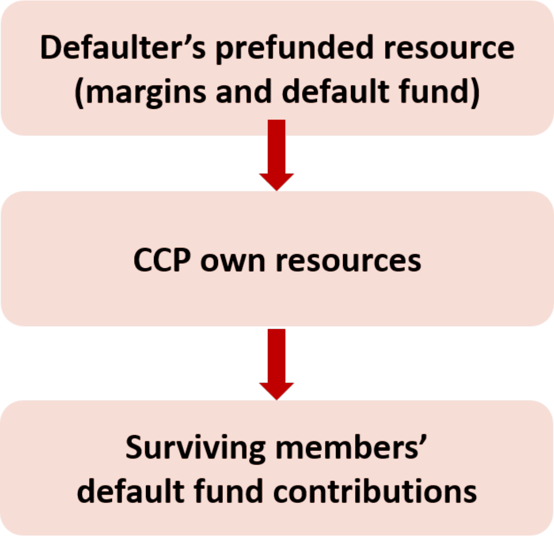


CCP: default waterfall



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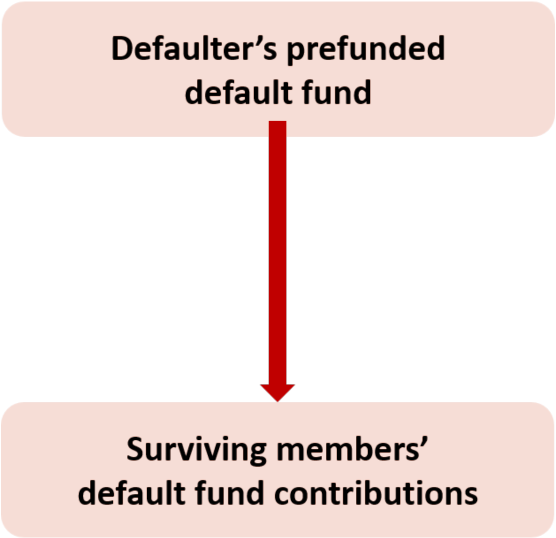


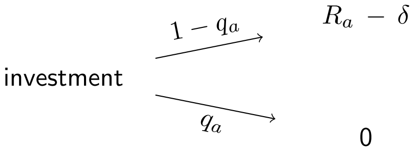
CCP: Cover II rule

- "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
  - $U(X) = \mathbb{E}[X] - \gamma Var(X)$
- $t = 0$: buyers and sellers trade CDS; buyers pay a unit price 1
  - sellers choose $a = \{$risky (r), safe (s)$\}$, unobservable



  - $R_r > R_s$ but $q_r > q_s$; $\mu = (1 - q)R$ is expected return
  - $\mu_s > \mu_r$: safe project is socially optimal
- $t = 1$: i.i.d. payoffs are realized, insurance payments δ are made

CCPs Create Value from Risk-sharing

- CCP guarantees insurance payment δ 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 β 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

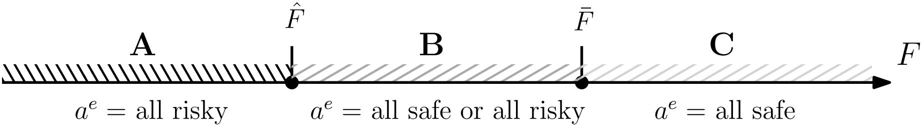
- Member i defaults, with probability q_{a_i}
  - i's default fund is used to cover his liability δ
- Member i survives, with probability $1 - q_{a_i}$
  - receives $(1+f)R_{a_i}$, pays δ to the insurance buyer
  - i's default fund is used to absorb shortfall of defaulting members $\mathcal{N}_d$
- Member i chooses $a \in \{r, s\}$ to maximize expected payoff

$$\max_a \mathbb{E}\left[\mathbf{1}_{i \text{ survives}}\left((1+f)R_{a_i} - \delta + \left(F - \frac{\mathcal{N}_d(\delta - F)}{N - \mathcal{N}_d}\right)^+\right)\right] - (1+\beta)F$$

Members' Investment Choice

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 $a^e(F)$, 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

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

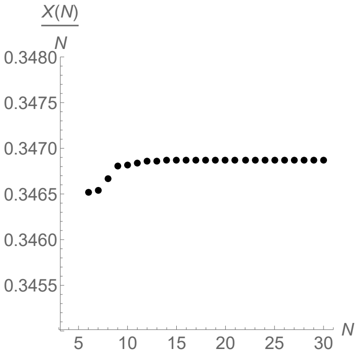
  - The funding cost impacts the socially optimal default fund level.
  - Cover X>II if funding cost is low (low interest rate environment).

Cover X Rule

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

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

  - 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,

$$\frac{X(N)}{N} \to 1 - \frac{(1+f)(\mu_s - \mu_r)(1-q_s)}{(q_r - q_s)\delta},$$

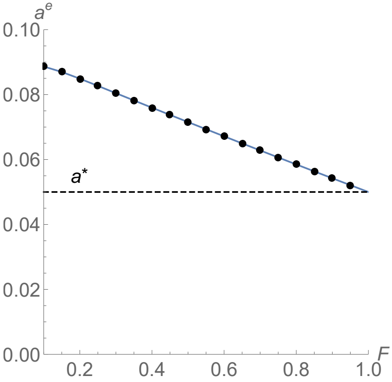
  if funding costs are not too high; otherwise $\frac{X(N)}{N} \to 0$.

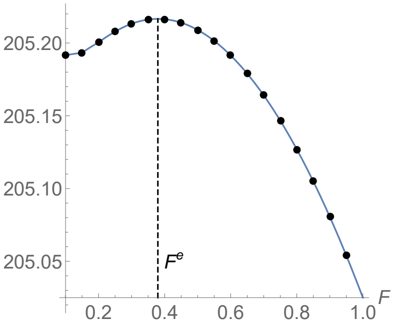
- Implications: cover a fixed fraction rather than a fixed number.
  - The rule should account for the number of clearing members.
  - ICE and LCH have more than 20 members, with entries and exits.

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.
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  - We extend the base model to account for size heterogeneity.
- 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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    lower for big member, $\hat{F}^B < \hat{F}$

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    larger for small member, $\hat{F}^S > \hat{F}$
  - 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.