Endogenous Risks in Central Clearing

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The analysis and opinions set forth are solely those of the author and do not indicate concurrence by other members of the research staff or the Board of Governors.
Endogenous risk

...the risk from shocks that are generated and amplified within the system. Danielsson and Shin, “Endogenous Risk” 2003

...additional risk and volatility that the financial system adds on top of the equilibrium risk and volatility as commonly understood. Danielsson et al., “Endogenous and Systemic Risk” 2012

For CCPs, loosely endogenous risk relates to challenges with managing risk due to

• Structural characteristics
• Participant behavior
More central clearing was a major policy response to the financial crisis

- Counterparty risk was a key driver of the financial crisis; firms stopped trading because of fears about counterparties
- Central counterparties performed fairly well. Globally, CCPs did not experience any credit losses but did face some liquidity pressures
- G-20 agreed at the Pittsburgh meeting in 2009 to mandate central clearing of standardized over-the-counter derivatives
- Dec. 2013 failure of HanMag securities firm led to mutualized losses among the non-defaulting clearing members of the Korea Exchange
CCPs transform counterparty credit exposure

1 Bilateral exposures to other market participants exchanged for exposure to specialized entity that does not engage in trading activity on its own
2 Risk management is core function: centralized and standardized
3 Risk is concentrated
4 Heightened regulatory oversight as more central clearing is mandated
CCPs transform counterparty credit exposure

1. Bilateral exposures to other market participants exchanged for exposure to specialized entity that does not engage in trading activity on its own
2. Risk management is core function: centralized and standardized
3. Risk is concentrated
4. Heightened regulatory oversight as more central clearing is mandated

- Little research on CCPs and particularly their risk management
CCPs’ Coverage of Tail Risk

- **Participant 1**
  - EP1 = LGD under extreme market conditions
  - GF1
  - M1

- **Participant 2**
  - EP2
  - GF2
  - M2

- **Participant 3**
  - GF3
  - M3

- **CCP**
  - GF = GF1 + GF2 + GF3
  - 99th percentile
  - Available Margin
Quick Notation: Loss Distributions

Portfolio Value  At time $t$, a portfolio $X$ has value $V(X, t)$. For risky portfolios, the value is an unobservable random variable for all $s > t$

Loss Distribution  The loss distribution is equal to the distribution of $L_t^A = V(X, t + \Delta) - V(X, t)$: $Pr(L_t^A \leq l)$ for some value $l$

Default indicator  $d_t^i$ equal to 1 if the $i$-th firm has defaulted at $s \leq t$ and 0 otherwise

Default-conditioned Loss Distribution  Conditional distribution of loss given a default: $Pr(L_t^A \leq l \mid d_t^i = 1)$
What are the relevant individual loss distributions for a CCP?
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1. CCP loss distribution must be conditional!
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1. CCP loss distribution must be conditional!
   - CCP has no portfolio and no market exposure except conditional on the default of one of its clearing members
   - This structure is key to CCP’s mitigation of risk
   - For clearing members with a low probability of default, the 99-th percentile of the CCP’s unconditional exposure would be zero
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1. CCP loss distribution must be conditional!

2. The conditional distribution is not observed!
   - Distribution of markets moves under default may be completely different than usual distribution (e.g. Lehman)
   - Defaults are rare. Generally can estimate loss distribution of the portfolio only
   - Let $L_{i,t}^\Delta$ be the loss distribution for the $i$-th clearing member’s portfolio, then portfolio risk is generally not equal to conditional risk

$$\Pr(L_{i,t}^\Delta \leq l) \neq \Pr(L_{i,t}^\Delta \leq l \mid d_t^i = 1)$$
CCP exposure is not just the portfolio exposure

- Margin is calculated assuming default but without accounting for the impact of default on markets.
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• Aligns with the CCP’s conditional risk only if market risk is independent of default, so that

\[
Pr \left( L_{i,t}^A \leq l \mid d_t^i = 1 \right) = Pr \left( L_{i,t}^A \leq l \right) \cdot Pr \left( d_t^i = 1 \right)
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Endogenous Risk 1 The default of a clearing member will affect the value of its portfolio
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**Endogenous Risk 1** The default of a clearing member will affect the value of its portfolio

- Similar to wrong way risk issues with CVA. Current counterparty risk models struggle to capture wrong-way risk (Ghamami & Goldberg, 2014)
Margin model must be applicable to any possible portfolio the CCP could clear

- CCPs do not create portfolios
- Even unconditional risk measurement requires a model, and there is resulting model risk.
- Although new trades may be subject to some sort of risk filter, generally a CCP accepts trades and must be able to calculate margin for whatever portfolio is presented.
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**ER 2** CCP margin models need to cover any cleared contract; as a result the scale of margin models can introduce distortions in addition to more common model risks
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The scale of margin models can create noise by itself along the effects observed in Random Matrix Theory.
CCP Default Management

Positives
• Centralized and standardized liquidation and hedging
• Quick liquidation horizon
• Pre-funded resources to cover losses
• Pre-arranged auction process

Potential Issues
• Liquidation of portfolio is public knowledge
• Portfolio specifics known to other CMs
• CMs already hold mutualized tail risk
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**ER 6** Market structure can impact ability to liquidate and costs
CCP risk depends on joint default dependence

**Toy default model**

For every \( i \)

\[
\Pr (d_t^i = 1) = f (\alpha^i M_t + \beta^i Z_t^i)
\]

where \( M_t \) is a common market factor, \( \forall i \), \( Z_t^i \) is an independent idiosyncratic factor, and \( \alpha^i \) and \( \beta^i \) are parameters. The function \( f \) is a monotonic map to \([0, 1]\).
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- For CCPs, membership criteria and credit monitoring designed to ensure that unconditional likelihood of default is low for CMs
- In toy model, low default probability implies low idiosyncratic risk.
Conditional default dependence may be much higher

- Default of one member can be driven by increase in market factor, which implies increase in the probability of default for every member
- Market perceptions may increase expectation of probability of default for non-defaulters, because of perceived increase in market risk
  - Default expectations can be self-fulfilling
- Prior to crisis, credit default spreads generally low for large financial institutions, but jumped substantially for all of them following large defaults
- Such systemic risk can be hard to measure
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ER 7 CCPs loss distribution depends on difficult to determine joint default probabilities, or systemic risk
CMs play multiple roles in multiple systems

- Large clearing members participate in numerous CCPs
- Clearing member may provide other services, e.g.
  - Clearing bank
  - Repo counterparty
  - Liquidity provider
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**ER 8** A default of a large clearing member is likely to occur in multiple CCPs simultaneously and may affect additional services upon which a CCP relies

**ER 9** Multiple CCPs may be executing default management simultaneously which could generate unforeseen cross-dependencies
Conclusion

- CCPs can provide crucial risk mitigation
  - Key aspect of CCP risk mitigation is CCP exposure is conditional on default
  - Successful risk mitigation depends on CCP risk management
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**Fundamental Endogenous Risk**
CCPs ability to mitigate systemic risk depends on CCPs performance when there are one or more (possibly major) defaults. But CCP exposure and performance when there are multiple defaults is exactly the most difficult situation to ascertain ahead of time.

Given the increasing importance of CCPs’ role in financial markets, research into how to address CCPs’ endogenous risks could significantly enhance financial stability.