Assessing the Safety of Central Counterparties

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Motivation

- Following the crisis of 2008-09, regulatory reforms incentivized firms to clear through central counterparties (CCP).
  - CCPs provide greater transparency and ability to offset positions but also concentrate risk.

- Due to their sheer size and central position a CCP default would have major systemic consequences through:
  - losses of member firms
  - the freezing of asset markets
  - a general loss of market confidence

- Therefore it is crucial to estimate how prone CCPs are to default, and whether their risk management is capable of withstanding large member defaults.

Overview

- The analysis we present assesses the potential riskiness of CCPs through three metrics:
  - Initial Margin Breach Probabilities
  - Guarantee Fund Breach Probabilities
  - Default Probabilities (from any cause)

- The first two measures capture the likelihood of payment exceedances above the resources held, *not* the default probability.

- The third measures the likelihood that the CCP will not fulfill all of its payment obligations.

- Additionally, we introduce a new measure of risk called *Stress Index.*

- We conduct the analysis for over 100 CCPs located in three continents.

Layers of Protection: CCP Default Waterfall

Initial Margin of Member

- Initial margin (IM) covers potential shortfalls in VM and is held in segregated accounts, which is supposed to cover VM payments with high probability.

CCP Capital

- CCP Capital (CC) covers losses beyond the contributions of defaulting members.

Guarantee Fund

- Guarantee Fund (GF) is collected across members and is mutualized. It is supposed to cover the default of any two participants and their affiliates (CPMI-IOSCO Principle 4).

Assessments

- Assessments on members are made to cover losses beyond those of CC + GF. These are limited however, and may be difficult to raise on short notice.

Source: Authors' creation.

# Layers of Protection: CCP Default Waterfall

Data: CPSS-IOSCO Public Quarterly Disclosures:

- CPSS-IOSCO provides a framework for CCPs to provide relevant information to participants, authorities and public.
  - Quarterly filings 2015 Q3 - 2020 Q1.

Percent of Funded Resources By Region				
	All	Asia-Pacific	Europe	North America
Number of CCPs	59	27	20	12
Funded Resources				
Initial Margin	77.6	76.9	79.1	74.7
CCP Capital	2.8	6.0	1.3	0.7
Guarantee Fund	19.6	17.1	19.7	24.6

Sources: CCPView Clarus Financial Technology; authors' analysis.

Breaches in the CCP Default Waterfall
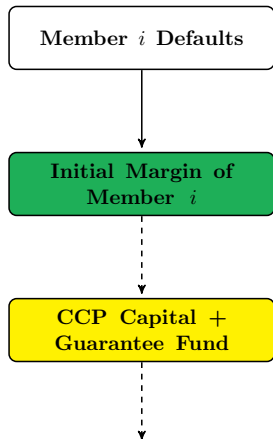
- Member i defaults on its VM payment

- An **Initial Margin Breach** occurs when the VM owed is larger than the IM held

- A **Guarantee Fund Breach** occurs when the aggregate IM breaches exceeds the CCP paid-in capital plus GF

How likely are Initial Margin Breaches?

Initial Margin Breaches are in line with CPMI-IOSCO

- Public Quarterly Disclosures provide the number of IM breach events at an individual account level per quarter.

	All	Asia-Pacific	Europe	North America
Daily VaR	99.79%	99.78%	99.78%	99.83%
Quarterly IM Breach Probability	12.46%	12.66%	12.89%	10.15%
CCP Sample	77	26	41	10

Source: CCPView Clarus Financial Technology; authors' analysis.

- Daily initial margin breach probabilities are in line with CPMI-IOSCO Principle minimum standards of 99%.
- Nevertheless **quarterly probabilities** are quite substantial.

Initial Margin Breaches Increased in mid-March

- There was a significant increase in the frequency of initial margin breaches for March 2020.

	All	Asia-Pacific	Europe	North America
Quarterly Account Probability:				
2015 Q3 - 2019 Q4	8.23%	12.22%	5.55%	8.88%
2020 Q1	20.25%	15.81%	21.79%	27.07%
CCP Sample	77	26	41	10

Source: CCPView Clarus Financial Technology; authors' analysis.

- In Europe and North America initial margin breach probabilities more than tripled in the first quarter of 2020.
  - Suggests there is strong positive correlation in stresses experienced by CCPs.

How likely are Guarantee Fund Breaches?

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CCP Capital +
Guarantee Fund
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Assessing GF Breach Likelihood

- Margin calls result from changes in market value and market risk:

$$\text{MC}_{it} = \text{VM}_{it} + [\text{IM}_{it} - \text{IM}_{it-1}]. \tag{1}$$

- The CCP incurs a *GF breach* on day t if the sum of the IM breaches exceeds the guarantee fund, that is,

$$\sum_i [\text{MC}_{it} - \text{IM}_{it-1}]^+ > \text{GF}_{t-1}. \tag{2}$$

- Our goal is to estimate the probability of this event:

$$\beta_t = \text{P}\left[\sum_i [\text{MC}_{it} - \text{IM}_{it-1}]^+ > \text{GF}_{t-1}\right]. \tag{3}$$

Assessing GF Breach using Public Quarterly Disclosures

- The data is limited due to its level of aggregation, however it lends itself to risk assessment. For VM & IM payments the data provides:

$$\text{VM}_t = \sum_i [\text{VM}_{it}]^+ \quad \rightarrow \quad \text{VM}^{\max} = \max_t \text{VM}_t. \qquad (4)$$

$$\text{IMT}_t = \sum_i [\text{IM}_{it} - \text{IM}_{it-1}]^+ \quad \rightarrow \quad \text{IMT}^{\max} = \max_t \text{IMT}_t. \qquad (5)$$

- We transform these to margin call maximums:

$$\text{MC}^{\max} = \text{VM}^{\max} + \text{IMT}^{\max}/2. \qquad (6)$$

- Also reported is the total amount of pre-funded resources posted on an average day during the quarter (63 days):

$$\text{IM}^{\text{avg}} = \frac{\sum_t \sum_i \text{IM}_{it}}{63}; \quad \text{GF}^{\text{avg}} = \frac{\sum_t \text{GF}_t}{63}.$$

CCP Stress Index

- Given the short period of data, tail events may not be realized. We estimate tail GF Breach probabilities by fitting a probability distribution to the public data.

- We fit the distribution to the quarterly realizations of the random variable:

$$X = \frac{MC^{max}}{IM^{avg}/2 + GF^{avg}}, \tag{7}$$

where IM^{avg} is the previous quarter's average posted initial margin and GF^{avg} is the previous quarter's guarantee fund.

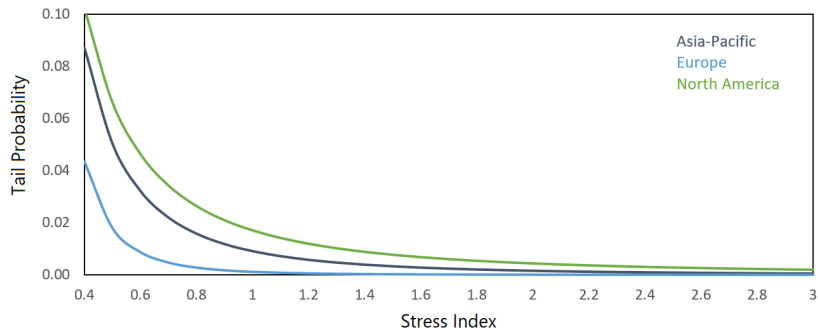- A GF Breach occurs when $X > 1$.

CCP Stress Index Estimation

- Given there are at most 19 quarters of data per CCP, we pool the data and treat the realizations of **X** as if they came from a single CCP. The pooled sample fits a heavy-tailed Frechet distribution closely.
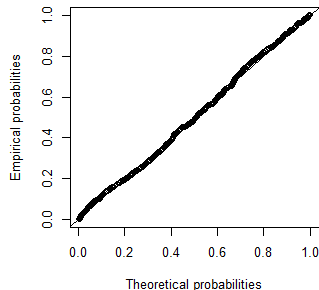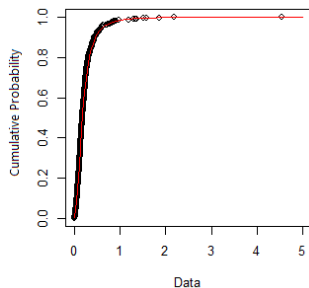
Source: CCPView Clarus Financial Technology; authors' analysis.

- A similar fit is obtained for subsets of CCPs such as the largest in each jurisdiction.

CCP Stress Index by Region

Source: CCPView Clarus Financial Technology; authors' analysis.

- Note that European CCP's as a group are more resilient by this measure.

GF Breach Probability Estimates

- Recall that a GF Breach occur when the stress index, $X > 1$.

GF Breach Likelihood of Largest 10 CCPs by Region				
	All	Asia-Pacific	Europe	North America
Estimated Number of GF Breaches				
2015 Q3 - 2019 Q4:	0	0	0	0
2020 Q1:	3	1	0	2
Estimated Annual Frequency Per CCP (%)				
Model w/o 2020 Q1:	0.96	1.43	0.32	1.55
Model w/ 2020 Q1:	3.20	3.63	0.48	6.67

Source: CCPView Clarus Financial Technology; authors' analysis.

- In 2020 Q1 probabilities increased markedly, suggesting there is strong positive correlation in stresses experienced by CCPs.
- Note that a GF Breach does not imply default, but it does signify severe stress relative to pre-funded resources.

Supervisory CCP Default Estimates

Supervisory Data: CCP Member Estimates

Data: CCAR Y-14Q Schedule L

- Quarterly US GSIB disclosures provide estimated 5-year CDS spreads for 106 CCPs as estimated by their member US GSIBs.
  - The CDS spread estimate allow us to infer default probabilities.

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- These numbers must be viewed with caution, as members' estimation methodologies are not specified.
  - However, the coefficient of variation in members' estimates is low, indicating that they are based on objective measures.

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Annual Default Probabilities Statistics

Default Probability	All	Asia-Pacific	Europe	North America
All	2.47%	3.12%	2.53%	1.34%
Top 10	1.26%	1.70%	0.88%	1.19%
Top 5	1.25%	1.79%	0.79%	1.18%

Source: Federal Reserve Y14 Q Schedule L; authors' analysis.

Risk Management Varies by Jurisdiction: Top 10
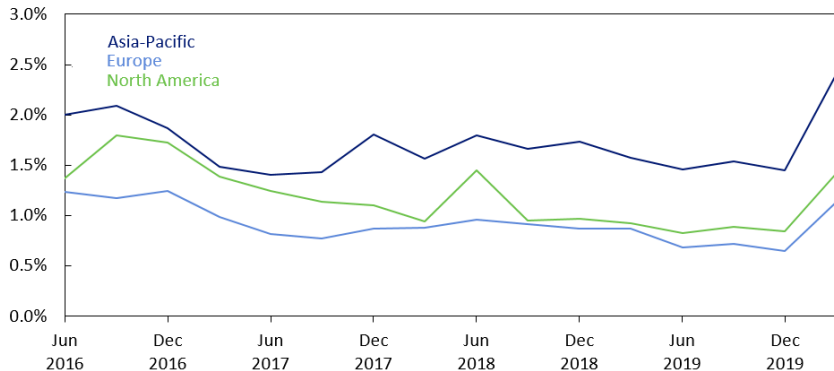
Source: Authors' calculations using FR Y-14 Q.

- Members' estimates for the three regions show a consistent pattern: Estimated risk is highest for CCPs in Asia-Pacific, lowest in Europe.

Conclusion

A CCP default would have systemic consequences, due to losses by member firms, clients, and spillover effects. Our analysis highlights:

1. large jurisdictional variation in CCP risk management from public data sources.

2. larger CCPs are relatively safer, as seen in both the GF Breach and default probabilities.

3. high correlation in CCP risk exposure, as measured by IM breaches, GF breaches, and default probabilities.

4. under extreme stress multiple CCPs could default due to network contagion and exposures to common shocks.