

Assessing the Safety of Central Counterparties

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- 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.

- 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

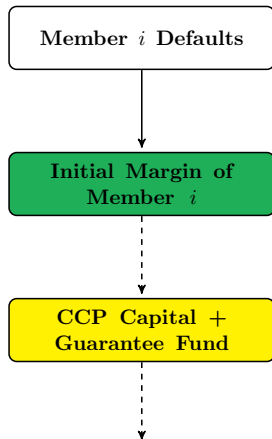
Data: CPSS-IOSCO Public Quarterly Disclosures:

- 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
<i>Funded Resources</i>				
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 of
Member i

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?



CCP Capital +
Guarantee Fund

Assessing GF Breach Likelihood

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

$$MC_{it} = VM_{it} + [IM_{it} - IM_{it-1}]. \quad (1)$$

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

$$\sum_i [MC_{it} - IM_{it-1}]^+ > GF_{t-1}. \quad (2)$$

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

$$\beta_t = P \left[\sum_i [MC_{it} - IM_{it-1}]^+ > GF_{t-1} \right]. \quad (3)$$

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:

$$VM_t = \sum_i [VM_{it}]^+ \rightarrow VM^{\max} = \max_t VM_t. \quad (4)$$

$$IMT_t = \sum_i [IM_{it} - IM_{it-1}]^+ \rightarrow IMT^{\max} = \max_t IMT_t. \quad (5)$$

- We transform these to margin call maximums:

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

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

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

- 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:

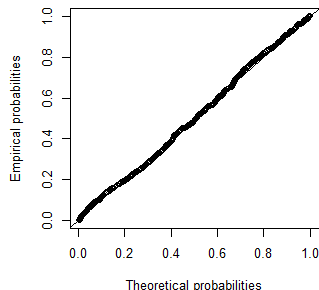
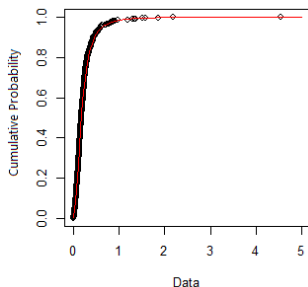
$$X = \frac{MC^{\max}}{IM^{\text{avg}}/2 + GF^{\text{avg}}}, \quad (7)$$

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

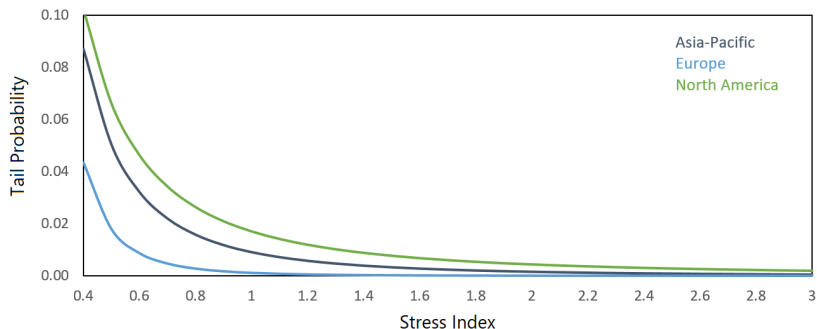
- Given there are at most 19 quarters of data per CCP, we pool the data and treat the realizations of $\mathbf{X}$ as if they came from a single CCP. The pooled sample fits a heavy-tailed Frechet distribution closely.



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

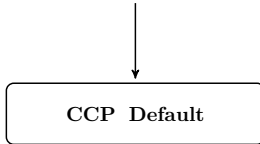
- Recall that a GF Breach occur when the stress index, $X > 1$.

GF Breach Likelihood of Largest 10 CCPs by Region				
	All	Asia-Pacific	Europe	North America
<i>Estimated Number of GF Breaches</i>				
2015 Q3 - 2019 Q4:	0	0	0	0
2020 Q1:	3	1	0	2
<i>Estimated Annual Frequency Per CCP (%)</i>				
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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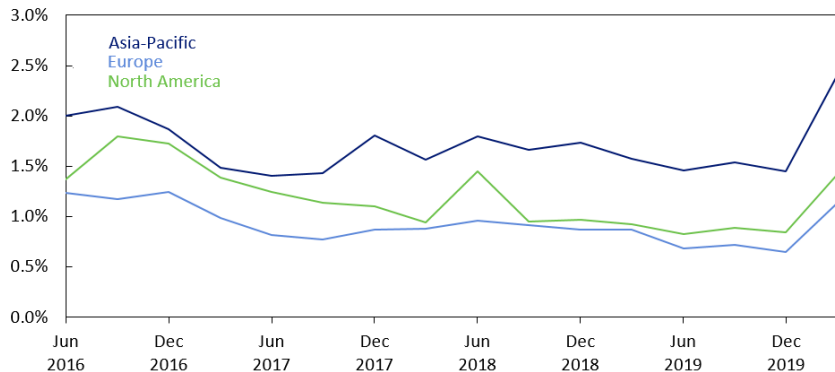
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Annual Default Probabilities Statistics				
Default Probability	All	Asia-Pacific	Europe	North America
All	2.47%	3.12%	2.53%	1.34%
Top 10	1.26%	1.70%	0.88%	1.19%
Top 5	1.25%	1.79%	0.79%	1.18%

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.