Design of CCP Default Management Auctions

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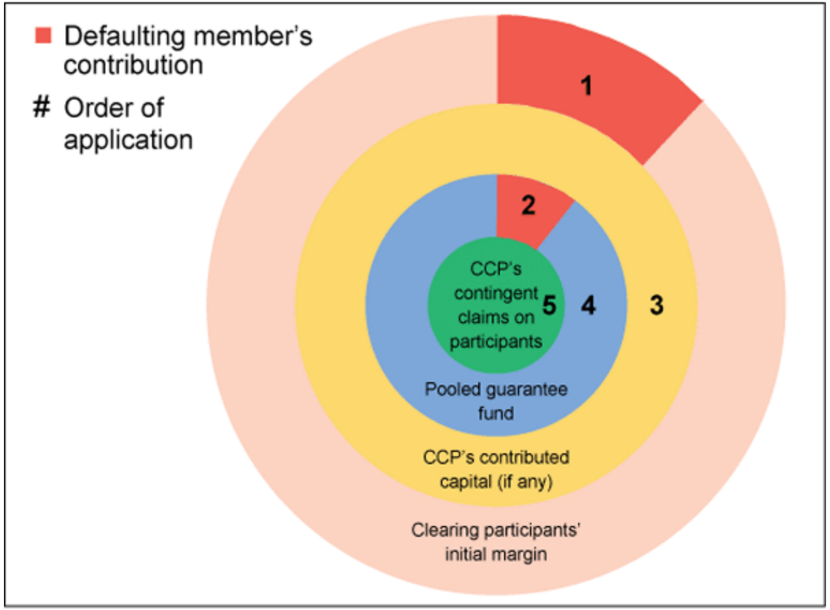
CCP recovery and resolution: Resources

1. Defaulter's initial margin
2. Defaulter's guarantee fund (g-fund)
3. CCP's capital
4. Survivors' g-fund
5. Survivors' assessment

1—3 vs 4—5: Incentives are different! CCP can be quite creative in 4—5.

CCP's Financial Resource Depletion in Response to a Clearing Member Default



Source: Adapted from Duffie, Li and Lubke (2010)

Source: Reserve Bank of Australia

CCP recovery and resolution: Procedure

- ISDA (2017): “Most importantly, successful CCP recovery or resolution must both: (1) allocate losses; and (2) rebalance the CCP’s book.”
- Step 1: Hedging the positions to slow down/stop further losses—similar to an auction, but facing the entire market and sometimes anonymous.
- Step 2: Auction off the defaulter’s position (including the hedges).
  - Case 1: The defaulter’s resource and CCP’s skin-in-the-game are sufficient.
  - Case 2: Use survivors’ g-fund (including assessment)—my focus today.
  - Case 3: G-fund is exhausted. Resort to more extreme method such as partial tear-ups or variation margin gain haircut.

Outline

- ➢ **<u>The use of guarantee fund – The effect of juniorization</u>**

- **Dynamic considerations – Before and after the auction**

A model of CCP default management auctions (1)

- The fundamental value of the auctioned portfolio is v per unit.
- The auctioned portfolio has size $Q > 0$.
- Auction is uniform price and fully divisible.
- Resources from the defaulter and the CCP sum up to $M > 0$.
- There are n strategic bidders (clearing members and customers)
- Bidder i already has inventory z_i of this portfolio. Denote $Z = z_1 + z_2 + \cdots + z_n$.
- Bidder i has $g_i \geq 0$ guarantee fund (g-fund) at the CCP. Denote $G = g_1 + g_2 + \cdots + g_n$.
- Denote the auction price by p. Convention: p is how much the bidders pay the CCP, so $p < 0$ (CCP pays bidders) is the more interesting case.

A model of CCP default management auctions (2)

- Denote by x_i the amount purchased by bidder i in the auction. By definition, $x_1 + x_2 + \cdots + x_n = Q$. Bidder i maximizes

$$\pi_i = \underbrace{(v-p)x_i}_{\text{Profit}} - \underbrace{0.5\lambda(z_i + x_i)^2}_{\text{Inventory cost}} - \underbrace{T_i}_{\text{Use of bidder } i\text{'s g-fund}}$$

- Three cases:
  - $pQ + M \geq 0$: Zero use of (survivors') g-fund.
  - $pQ + M < 0$ but $pQ + M + G \geq 0$: G-fund is used but is not exhausted.
  - $pQ + M + G < 0$: G-fund is exhausted.
- Each bidder wishes to buy the portfolio cheap, but he also wants to minimizes the use of his g-fund.
- CCP's design of $\{T_i\}$ will affect bidders' strategies.

Juniorization

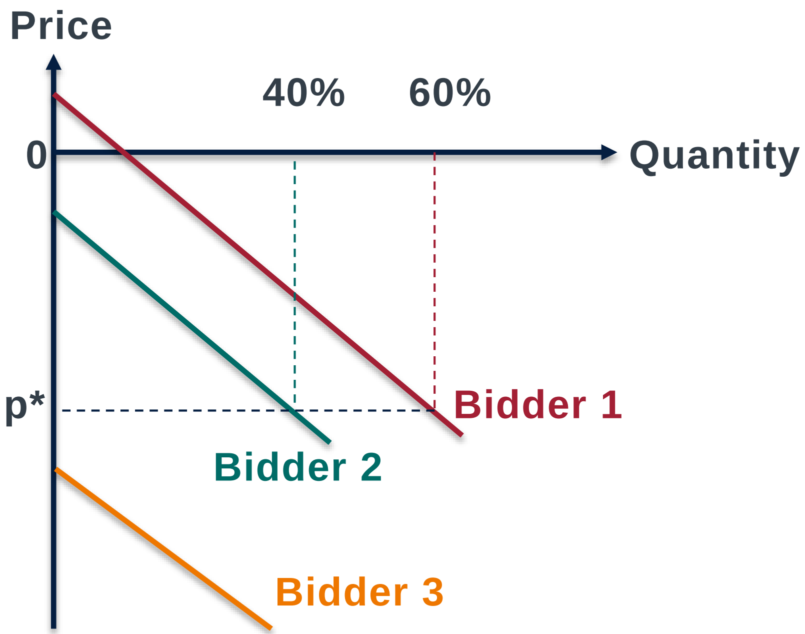
- We focus on the case where g-fund is used but not exhausted, $-G < pQ + M < 0$.
- A bidder can easy avoid the penalty for not bidding enough by submitting bad bids.
- If a bidder puts in bad prices relative to peers by some metric, his guarantee fund is juniorized.
- To model juniorization, I assume CCP uses the rule:

$$T_i = \underbrace{-\frac{p^* Q + M}{G}}_{\text{Shortfall}} \times \underbrace{(A g_i - C x_i(p^*))}_{\text{Juniorization}}$$

p^* is final auction price, and $A > 1$ and $C > 0$ are constants to be calibrated.

- Pro-rata means $A = 1$ and $C = 0$. $T_i = -(p^* Q + M) \times g_i / G$.
- But $T_1 + T_2 + \cdots + T_n + (pQ + M) = 0$ and $x_1 + x_2 + \cdots + x_n = Q$, so $A = 1 + \frac{CQ}{G}$.

Juniorization: Example



- Suppose there are three bidders, with equal g-fund contribution.
- Suppose at the final price p^*, they win 60%, 40% and 0% of the auction portfolio.
- Normalize $Q = 1$. Suppose the shortfall $-(pQ + M)$ is 100 million.
- Bidder 1's g-fund use: $\frac{100}{G} \times (A\frac{G}{3} - 0.6C)$
- Bidder 2's g-fund use: $\frac{100}{G} \times \ (A\frac{G}{3} - 0.4C)$
- Bidder 3's g-fund use: $\frac{100}{G} \times A\frac{G}{3}$
- Similar to ranking by prices
- In my view, ranking by quantity at the equilibrium price is slightly better than ranking by non-equilibrium prices.

Juniorization: Bidding strategy

- Each bidder's optimal demand curve (implemented by limit orders) is

$$x_i(p) = \frac{n-2}{\lambda(n-1)}\left(v - p - \lambda z_i + \left(-\frac{pQ+M}{G}\right)C\right) + \frac{Q}{n-1}\frac{g_i}{G}.$$

  where C is the juniorization sensitivity, to be determined.
- Low inventory or high g-fund encourages bidding (also true for pro-rata).
- Assuming all bidders purchase positive amounts, the final auction price p^* is

$$p^* = \underbrace{v - \lambda\frac{Z+Q}{n}}_{p^c\text{,competitive price}} + \underbrace{\left(-\frac{p^*Q+M}{G}\right)C}_{\text{juniorization}}$$

- Conditional on a positive shortfall, juniorization increases bids and the price.

Juniorization: Incentives

- $T_i = \underbrace{-\frac{p^*Q+M}{G}}_{\text{Shortfall}} \times \underbrace{\left(Ag_i - Cx_i(p^*)\right)}_{\text{Juniorization}}$. We need $0 \le T_i \le g_i$ for all $x_i(p^*) \in [0, Q]$.
- $T_i \ge 0$ part: $Ag_i - CQ = \left(1 + \frac{CQ}{G}\right) g_i - CQ > 0$, so C needs to be small enough:

$$C \le \min_i \left\{ \frac{g_i}{Q\left(1 - \frac{g_i}{G}\right)} \right\} \Rightarrow \text{maximum is } \frac{G}{(n-1)Q}$$

- $T_i \le g_i$ part: We want $-\frac{pQ+M}{G} Ag_i \le g_i$.

$$A = \left(1 + \frac{CQ}{G}\right) \le \frac{G}{-(p^*Q+M)},\ C \le \frac{G}{Q} \times \frac{p^*Q+M+G}{-(p^*Q+M)}$$

- If the total g-fund G is sufficient, the condition on g_i is more likely binding.

Juniorization: Bidders' profits

- Somewhat surprisingly, juniorization (in this model) does not affect the equilibrium allocations or the profits of bidders.

$$x_i(p^*) = \frac{n-2}{n-1}\left(\frac{Z}{n} - z_i\right) + \frac{Q}{n-1}\left(\frac{n-2}{n} + \frac{g_i}{Q}\right).$$

$$\pi_i = \frac{\lambda(Z+Q)}{n} x_i(p^*) - 0.5\lambda\big(z_i + x_i(p^*)\big)^2 + \frac{p^c Q + M}{G}.$$

- Intuition: Since everyone bids more by the same amount, there is no change in allocation. And the cost of paying a higher price is exactly offset by a lower use of g-fund.
- Bidder i buying a positive amount means $z_i < \frac{Z+Q}{n} + \frac{g_i}{G}\frac{Q}{n-2}$.

Juniorization: Summary

- If the price is low enough that g-fund is used (but not exhausted), juniorization can increase the auction price, implying less use of g-fund.
- But the net effects on allocations and bidder profits could be neutral.
- The incentive and higher price brought by juniorization are limited by the lowest g-fund among all bidders.

Juniorization: Questions & discussion

- Since bidding incentives depend on g-funds at stake, should customers be charged g-fund to participate in bidding?
- Do clearing members have incentives to let in their customers?
- If customers do not wish to put in g-fund, does an aggressive enough juniorization schedule effectively limit participation to clearing members?
- If juniorization is so effective that only a tiny amount of g-fund ends up being used, does the CCP want to fill in a bit more capital to avoid using g-fund altogether?

Juniorization vs competitive equilibrium

- Juniorization of g-fund does not deliver efficient allocations.
- In principle, one can achieve the competitive equilibrium and efficient allocations using the “mechanism design” approach.
- The use of g-fund is $T_i^c = -x_i(p^*)p^* + \frac{n-1}{\lambda}[(p^*)^2 - (p^c)^2] - \frac{M}{n}$.
- But T_i^c requires “too much” knowledge by the CCP before the auction, in particular λ and p^c. And the conditions for $x_i(p^*) > 0$ and $T_i \in [0, g_i]$ are more stringent than those for juniorization. See accompanying notes for full comparison.
- Bottom line: Juniorization seems a good mechanism (albeit imperfect).

Outline

- The use of guarantee fund – The effect of juniorization

➢ **Dynamic considerations – Before and after the auction**

Pre-auction hedging

- CCPs hedge the most important risks of the auctioned portfolio before the auction.
- Pre-auction hedging vs auction:

Pre-auction hedging	Auction
Use defaulter's and CCP's resources	Could dip into g-fund
Anonymous or not	Not anonymous
Facing the entire market	Facing mostly clearing members (customers need approval)
Potentially hedge multiple risks	Sell vertical slice of the same portfolio

Do hedging and auction conflict?

- The hedging CCP is competing against its future self, the auctioning CCP.

Hedging (price p^h)
Bidder i starts with w_i
Acquires y_i

Auction (price p^*)
Bidder i starts with $z_i = w_i + y_i$
Acquires x_i

- Recall π_i is bidder i's profits in the auction stage, taking z_i as given.
- Bidder i's total profit in the two stages is $\Pi_i = (v - p^h)y_i + \pi_i$. Fixing G and Z:

$$\frac{d\Pi_i}{dy_i} = v - p^h + \frac{d\pi_i}{dz_i}, \qquad \frac{d^2\Pi_i}{dy_i dg_i} = \frac{d^2\pi_i}{dz_i dg_i} = -\frac{\lambda}{n}\frac{Q}{G} < 0.$$

- Every additional unit of g-fund decreases a bidder's willingness to pay during the hedging stage by $\lambda Q/(nG)$, assuming that g-fund is used but not exhausted.

Liquidity during hedging vs auction

- If clearing members correctly anticipate the auction and juniorization, they may not be willing to provide sufficient liquidity during the hedging stage.
- Worse, they may even sell to get to an advantageous position for the auction.
- CCPs should recognize clearing members' purchase in the hedge stage in the juniorization schedule (CCPs know the identities)—to encourage early "bids."
- Who are in the best position to provide liquidity during the hedging stage? Those with low g_i, i.e., small clearing members or customers, and those with negative z_i, i.e., those with positive mark-to-market value on the auctioned portfolio. They need to be involved and encouraged to participate.
- In terms of incentives, it seems clearing members and CCP would be more willing to involve customers in the hedging stage than the auction stage.

Post-auction liquidation

- Unless bidders would like to buy anyway, they are likely to liquidate some of their purchases after the auction.
- This creates a “crowded trade” scenario—multiple auction winners could be liquidating the same portfolio! This is particularly risky if bidders are “forced” to purchase the portfolio due to juniorization.
- Because crowded trades are riskier if they are more crowded, there is an argument for size priority at the same price.
  - Example: The auction price is $-\$100{,}000$ per 1%. At this price, prioritize bids with larger quantities. (Bids with strictly better prices are filled fully.)

Final thoughts

- My talk today focuses on the middle ground case in which the g-fund is used but not exhausted.
- What if g-fund is not used at all? In this case, wider participation is usually better for efficiency and is in the CCP’s interest.
- What if g-fund is exhausted? More extreme methods like partial tear-ups actually encourage participation in the auction, especially from the in-the-money side. One can also model this formally.
    - Settle-to-market (STM) vs collateral-to-market (CTM): STM slightly weakens the “threat” of tear-ups because the lost variation margin is only for one day.

Summary

- Incentives are critical in CCP auction design.
- During the hedging stage, the CCP should:
  - Count clearing members' liquidity provision during the hedging stage toward the juniorization schedule in the auction stage.
  - Invite broad participation (including customers).
- During the auction stage:
  - Allow bids to be submitted conditional on the use of g-fund. Because incentives depend on g-fund use, this reduces guesswork and makes bidding easier.
  - The juniorization schedule increases the auction price, but it also requires careful calibration to keep incentives aligned. The lowest g-fund could be the binding factor.
  - What are the incentives to involve customers in the auction?