Contagion in the CDS Market
by
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Discussion

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Summary

- Use DTCC data on CDS exposures of members of the largest CDS clearing house (ICE) as well as their clients
- Compute network of variation margin payments that would be owed after FED's Comprehensive Capital Analysis and Review (CCAR) shock scenario.
- Adapt Eisenberg and Noe's model of systemic risk in financial systems to resolve 'cyclical interdependence' within the payment network and determine the firms that most contribute to systemic risk within the network.
- Main finding:

  Even though CCP appears most central, based on network centrality measures, it contributes less to contagion than other counterparties who are large net sellers of CDS protection.

The CCAR shock

- Use DTCC to obtain information on all positions (on index and single-name CDS) cleared through ICE and traded bilaterally by ICE's clearing members.
- Mark to market all the single-name and index CDS positions following shock assumed under FED's CCAR:

Table 1: The Impact of 2015 CCAR Severely Adverse Market Shocks on Credit Default Swaps

Corporate Credit							
Advanced Economies							
	AAA	AA	A	BBB	BB	B	<B or Not Rated
Spread Widening (%)	130.0	133.0	110.2	201.7	269.0	265.1	265.1
Emerging Markets							
	AAA	AA	A	BBB	BB	B	<B or Not Rated
Spread Widening (%)	191.6	217.2	242.8	277.5	401.9	436.4	465.8

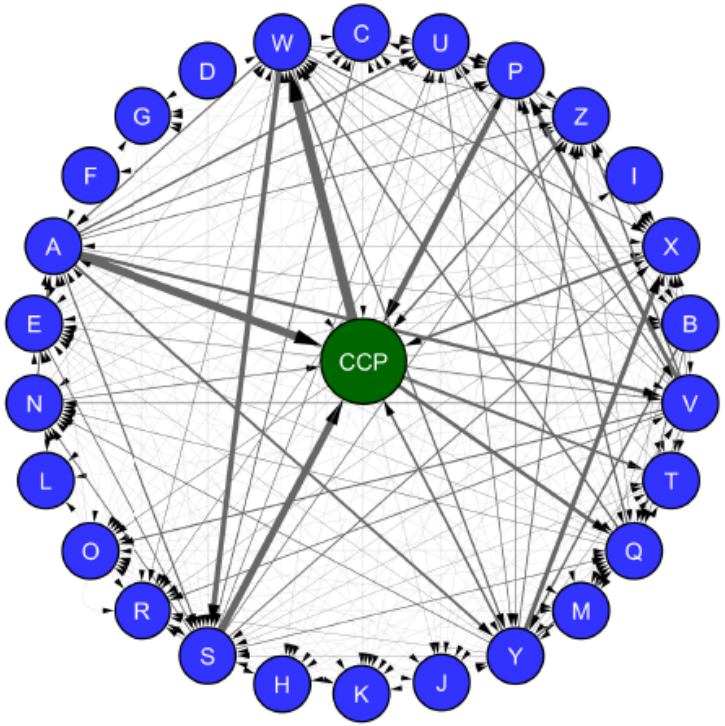
State & Municipal Credit							
	AAA	AA	A	BBB	BB	B	<B or Not Rated
Spread Widening (bps)	12	17	37	158	236	315	393

Sovereign & Supra Credit
See FRB worksheet: CCAR-2015-Severely-Adverse-Market-Shocks-data.xlsx

Source: Federal Reserve Board (FRB (2016))

The VM payment network among clearing members

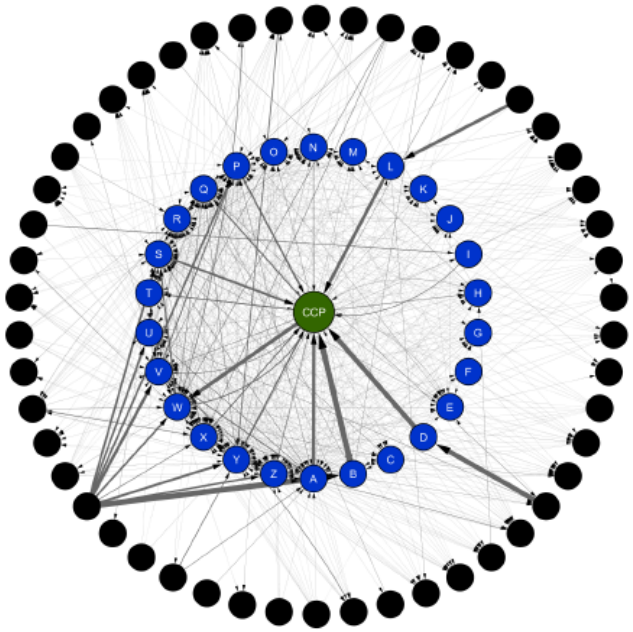
Figure 1: Variation Margin Payment Network after 2015 CCAR Shock



- CCP clearly central (most on-the-run index trades must be centrally cleared).
- Not cleared via CCP: mostly single-name CDS and off-the-run index trades?

The VM payment network with members and their clients

Figure 2: Variation Margin Payment Network after 2015 CCAR Shock for CCP Members and a Subsample of Nonmember firms



- Most clients have exposure to one member.
- Clients may have large net directional exposure, while CCP has zero net exposure.
- Characteristics of the clients with the largest VM exposures?

Q? If one node defaults on its VM payments, which other nodes may be affected and, in turn, default?

The Eisenberg-Noe (2001) model of systemic risk

- Consider network of payments $\overline{p}_{ij} \geq 0$ owed by i to j. So i owes total $\overline{p}_i = \sum_{j \neq i} \overline{p}_{ij}$
- In addition:
  - i owes b_i to outside the network
  - i receives c_i from outside the network.
- Define p_i to be the actual total payment i can make while respecting limited liability of equity and strict priority rules :

  $\rightarrow$ node i pays each creditor a fraction a_{ij} of p_i in proportion to her claim: $a_{ij} = \frac{\overline{p}_{ij}}{b_i + \overline{p}_i}$
- There exists a unique payment clearing vector $p = [p_1 \ldots p_N]^\top$ which satisfies:

$$p_i = \overline{p}_i \wedge (c_i + \sum_{j \neq i} a_{ji} p_j) \quad \forall i = 1, \ldots, N$$

- It is a fixed point of the operator $\Phi(p) = \overline{p} \wedge (c + a^\top p)$ obtained recursively:

$$p^{n+1} = \Phi(p^n) \text{ starting from } p^0 = \overline{p}.$$

- Note the corresponding sequence of default sets $D^n = \{i \ s.t. \ p_i^n < b_i + \overline{p}_i\}$ which pick up recursive layers of contagion through the network.

Adapting Eisenberg-Noe (2001) to CDS contagion

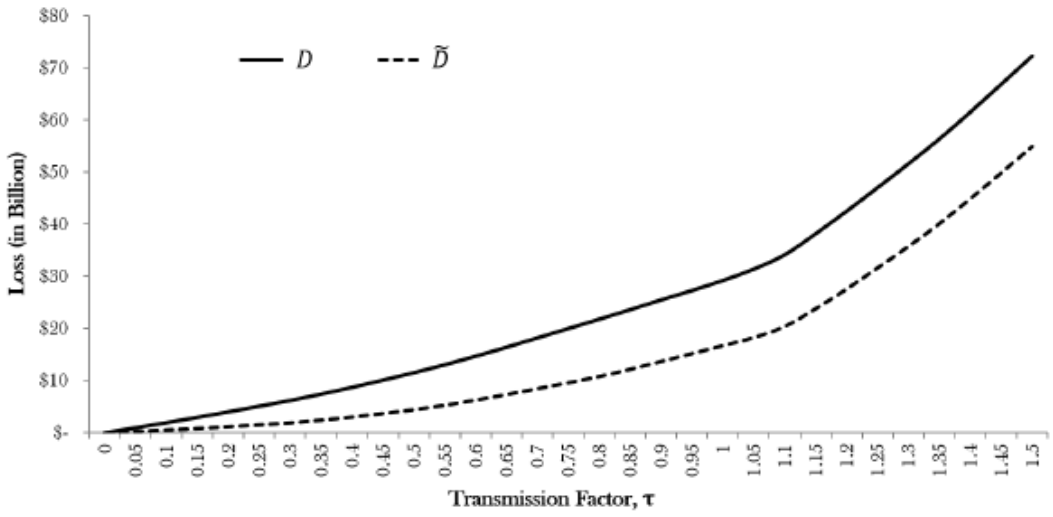
- $\overline{p}_{ij}$ are the VM payments owed by i to j after the CCAR shock (i owes $\overline{p}_i = \sum_{j \neq i} \overline{p}_{ij}$)
- Initial Margin c_{ki} paid by k to i (can only be used to cover k^{th} VM).
- CCP also collects guarantee fund γ_0 from all members.
- Define stress
  - at node i as $s_i = \overline{p}_i - \sum_{j \neq i}(p_{ji} + c_{ji}) \wedge \overline{p}_{ji}$ (could be negative?)
  - at CCP $s_0 = \left[\overline{p}_0 - \sum_{j \neq 0}(p_{j0} + c_{j0}) \wedge \overline{p}_{j0} - \gamma_0\right]^+$
- assume payment deficiency from i to j:

$$\overline{p}_{ij} - p_{ij} = (\underbrace{\tau_i}_{\text{transmission}} \frac{\overline{p}_{ij}}{\overline{p}_i} s_i) \wedge \overline{p}_i$$

- Solve for p_{ij} fixed point.(Existence, Uniqueness, Conditions on $\overline{p}_{ij}$?)
- Compute total deficiency $\sum_{j \neq i}(\overline{p}_{ij} - p_{ij})$ and IM-adjusted $\sum_{j \neq i}[\overline{p}_{ij} - p_{ij} - c_{ij}]^+$.
- Comparing to $\tau_i = 0$ isolates systemic contribution of node i to deficiency.

Total and IM-adjusted Deficiency

Figure 3: Contagion Model Results for CCAR 2015 Shock



- interpretation of $\tau_i > 1$?
- Model allows to study the impact of various margin rules and guarantee fund sizes on systemic risk
- Centrally clearing all trades always reduces deficiency (for any γ_0)?

Equilibrium stress

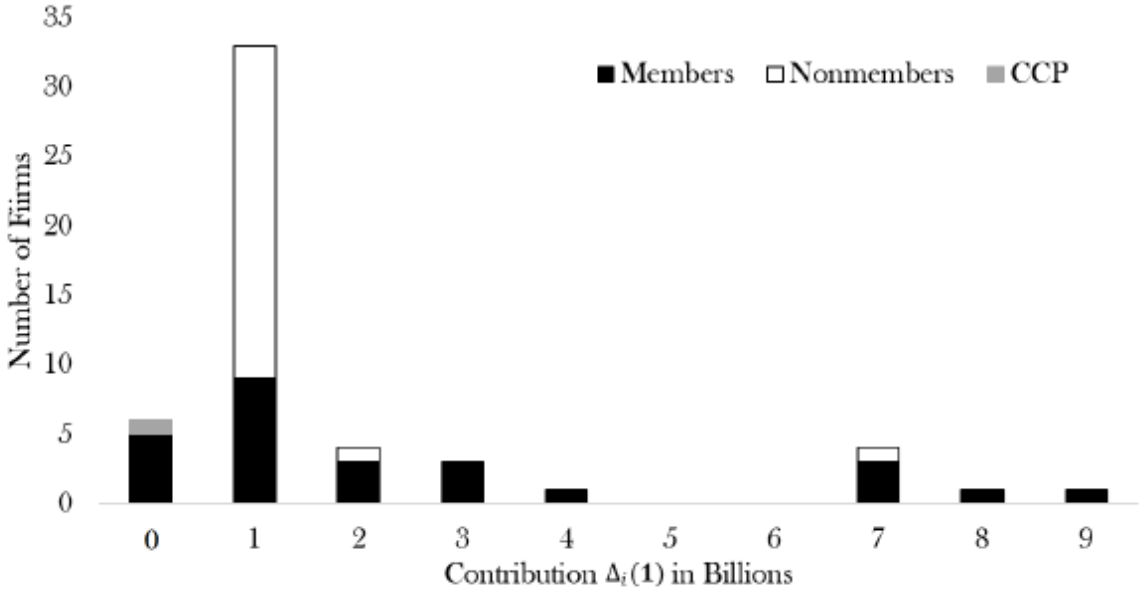
Table 5: Stress Equilibrium when all $\tau_i = 1$

	Initial Stress	Equilibrium Stress
CCP	-	-
Members		
A-E	1,554	3,626
F-J	7	22
K-O	23	1,622
P-T	1,118	4,621
U-Z	563	6,468
Nonmembers		
I-V	9,466	10,006
VI-X	936	1,324
XI-XV	380	414
XVI-XX	287	1,052
XXI-XXVI	303	345

- Big difference between initial stress (e.g., assuming $p_{ij} = \overline{p}_{ij}$) and equilibrium stress.
- Non-members have higher level of stress than members and CCP
- CCP has no stress (sensitivity to γ_0)?

Systemic contribution to VM risk

Figure 4: Distribution of Firms' Marginal Contributions to Contagion



- Members have far larger systemic contribution than CCP even though not as 'central' to the network.
- What matters is asymmetry in their exposure.

The definition of 'stress'

- Not clear whether the assumed relation between "stress" and payment deficiency captures economic reality
  ($\neq$ Eisenberg-Noe model where default at a given node follows from limited liability and priority rules).

- May want to consider different model than linear with constant transmission factor τ_i:
  - transmission may depend on node characteristics (bank, hedge-fund, size of outside assets).
  - if VM shortfall triggers bankruptcy then perhaps more appropriate to assume $p_{ij} = 0$ (that is, in the short-term the network would only collect IM and actual payments would be delayed to bankruptcy close-out).

  $\Rightarrow$ Binary threshold model where if $p_{ij} = \overline{p}_{ij}\mathbf{1}_{\{s_i < K\}} + c_{ij}\mathbf{1}_{\{s_i > K\}}$ with K function of node characteristics (such as asset size, type...).

  - Linear model perhaps better for cash-management due to (short-term) delayed payments within the network.

Is DTCC information sufficient?

- Positions outside the network would seem relevant to determine 'stress.' Compare:
  - Outright trade.
  - Bond basis trade.
  - Tranche delta hedge trade

$\Rightarrow$ Is systemic risk only driven by VM cash shortfalls within the network?

- Would be nice to know more about characteristics of the more systemic members and non-members (bank, hedge-fund, asset manager, insurance company, . . .)

- Are positions held by JPM prime brokerage treated identically (in the framework) to those held by 'London whale'?

Conclusion

- Impressive data work and interesting results
- Motivate better the definition of stress and the economic mechanism that will trigger a payment shortfall at a given node.
- Differentiate between short-term cash-deficiency or actual default of the node.

→ perhaps a threshold model is more realistic to capture default events (such as CCAR)?

- Would be nice to report more on characteristics of the systemic members, clients.
- Variation Margin payments are only one source of contagion in the CDS market. How to extend the framework to account for impact of (i) positions outside the network, (ii) fire-sales, (iii) information contagion?