The Market for OTC Derivatives

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over-the-counter (OTC) credit derivatives

- Large volume of bilateral trades between lots of banks

  creating an intricate liabilities linking all banks

- Gross notionals are highly concentrated in large banks

  worldwide, about 80% of gross notional held by 14 large banks

- Concentration arises from specific patterns of entry and participation

  large banks participate a lot, intermediating lots of trades

  middle-sized banks participate less, mostly as customer

  small-sized banks do not participate

▸ call report pictures

what we do

A parsimonious equilibrium model of entry and trade in an OTC market

- Positive question: friction(s) $\Rightarrow$ observed market structure?

  bilateral trade patterns: linkages btw institutions and prices

  entry patterns:

    why do large banks become intermediaries?

    why do middle-sized banks become customers?

- Normative question: can planner or policy maker do better?

  inefficiencies arise at the entry stage

  the market is too concentrated in large banks

some related literature

- Search-and-matching models of OTC markets

  Duffie Gârleanu Pedersen (05), Afonso Lagos (12)

- Formation and stability of financial networks

  Rochet Tirole (96), Allen and Gale (00), Babus (09)

- CDS markets

  Bolton and Oehmke (12,13), Biais, Heider, and Hoerova (12)

the economic environment

preference and endowment

- Unit continuum of identical CARA agents called "traders"
- Traders are organized in large coalitions called "banks"
- Banks differ in **size**

  size: measure of traders in the coalition

  the distribution of bank sizes: $S \sim f(S)$, $\int_0^\infty Sf(S)\,dS = 1$

- Banks differ in **endowment of non-tradeable risky tree**

  $\omega \in [0,1]$ trees per trader, $\omega \times S$ for the bank

  $\omega \sim \mathcal{U}_{[0,1]}$ in banks' cross-section, independent from S

  each share of the *tree* has random payoff $1 - D$

  D is the same same for all banks = aggregate default risk

timing

- **Entry**

  each bank receives its endowment $\omega \in [0, 1]$ per trader

  chooses whether to pay a fixed cost to enter the OTC market

- **OTC market trading**

  traders from all participating banks are matched

  sign derivative contracts (CDS) subject to trade size limit

- **Consolidation and payoff**

  each bank consolidates the contracts signed by all its traders

  loan portfolios and contracts payoff

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trade size limits in practice

"Traders are specifically hired to take financial risk for the firms gain. Assigning risk limits for each trader is the key control that, when aggregated with all trader limits, ensures that the firms overall market risk remains tolerable. When traders exceed their limits, they are going rogue and exposing the firm to higher market risks than management intended."

09/18/13, WSJ, Stephen R. Etherington

OTC market trading, after entry

period one: OTC market opens

- Each trader matches with a trader from some other bank
- When a bank-ω trader matches with a bank-$\tilde{\omega}$ trader, they bargain
- Trader ω sells $\gamma(\omega, \tilde{\omega})$ CDS contracts to trader $\tilde{\omega}$

  each CDS contract promises the state-contingent payment D

  in exchange for fixed payment $R(\omega, \tilde{\omega})$ = the price

- Trade size limit: $\gamma(\omega, \tilde{\omega}) \in [-k, k]$

  common risk management practices

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  this is the main trading friction ($\neq$ search) of the model

period two: consolidation and payoff

- All traders from bank ω consolidate their CDS positions

- After consolidation, the "post-trade exposure" to default risk, D:

$$g(\omega) = \omega + \int_0^1 \gamma(\omega, \tilde{\omega}) n(\tilde{\omega}) \, d\tilde{\omega} \quad \text{per capita}$$

- CARA certainty equivalent cost of bearing $g(\omega)$ units of D,

$\Gamma[g(\omega)]$: increasing and convex

Nash Bargaining

- A ω-trader is small relative her bank

sell γ CDS $\Longrightarrow$ cost of risk bearing increases by $\gamma \times \Gamma' [g(\omega)]$

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$\Rightarrow$ Low post-trade exposure sells CDS to high post-trade exposure

$$\gamma(\omega, \tilde{\omega}) = \begin{cases} k & \text{if } g(\omega) < g(\tilde{\omega}) \\ [-k, k] & \text{if } g(\omega) = g(\tilde{\omega}) \\ -k & \text{if } g(\omega) > g(\tilde{\omega}) \end{cases}$$

$\Rightarrow$ CDS prices split the gains from trade in half

$$R(\omega, \tilde{\omega}) = \frac{1}{2}\left(\Gamma' [g(\omega)] + \Gamma' [g(\tilde{\omega})]\right)$$

the equilibrium fixed point problem

- Contracts $\gamma(\omega, \tilde{\omega})$ are optimal given post-trade exposures

$$\gamma(\omega, \tilde{\omega}) = \begin{cases} k & \text{if } g(\tilde{\omega}) > g(\omega) \\ [-k, k] & \text{if } g(\tilde{\omega}) = g(\omega) \\ -k & \text{if } g(\tilde{\omega}) < g(\omega) \end{cases}$$

- Post-trade exposures are consistent with the signed contracts

$$g(\omega) = \omega + \int_0^1 \gamma(\omega, \tilde{\omega}) n(\tilde{\omega}) \, d\tilde{\omega}$$

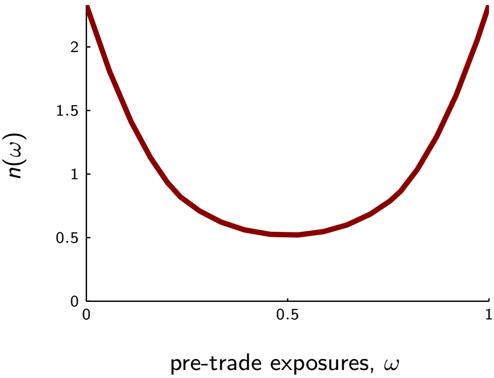
basic properties

- Unique $g(\omega)$ and $R(\omega, \tilde{\omega})$
- Post-trade exposures, $g(\omega)$, are non-decreasing
- Post-trade exposures are closer together than pre-trade exposures

  $$|g(\tilde{\omega}) - g(\omega)| \leq |\tilde{\omega} - \omega|$$

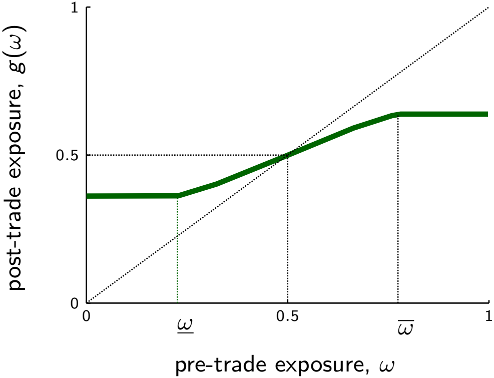
  a manifestation of risk sharing!

a special case of interest



result of entry decisions to be determined later in equilibrium

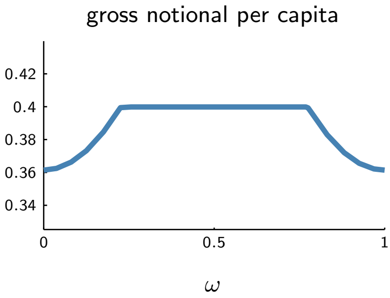
post-trade exposure, $g(\omega)$



- $g(\omega)$ is flat in regions where the density of traders, $n(\omega)$, is large

b/c in these region traders find each other easily to pool their risks

contracts signed per capita



- Middle-ω banks trade more than extreme-ω banks

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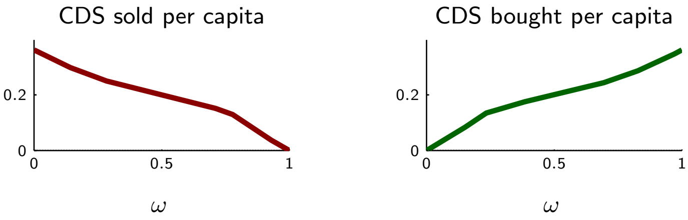
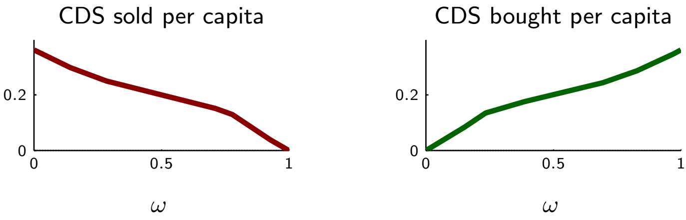


- Middle-ω banks trade more than extreme-ω banks
- Low-ω banks sell much more than they buy
- High-ω banks buy much more than they sell

contracts signed per capita



- Middle-ω banks trade more than extreme-ω banks
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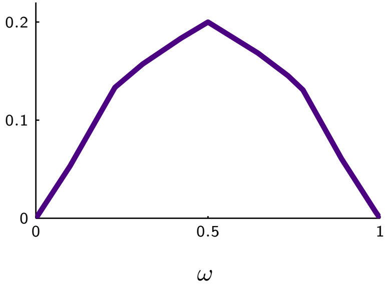
- All banks provide some intermediation: they *buy and sell* CDS

intermediation per capita



- Volume of fully offsetting CDS contracts

  $$\text{min}\{\text{CDS sold}, \text{CDS purchased}\}$$

- Middle-ω banks are the biggest intermediaries

  net exposures $\simeq 0$

  use all their trading capacity

entry in the OTC market

the entry decision

- Utility of entering per capita, before cost:

$$\Delta(\omega) = \Gamma[\omega] - \Gamma[g(\omega)] + \int_0^1 \gamma(\omega, \tilde{\omega}) R(\omega, \tilde{\omega}) n(\tilde{\omega}) \, d\tilde{\omega}$$

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- Enter if and only if:

$$\Delta(\omega) \geq \frac{c}{S} \quad \Longleftrightarrow \quad S > \Sigma(\omega) \equiv \frac{c}{\Delta(\omega)}$$

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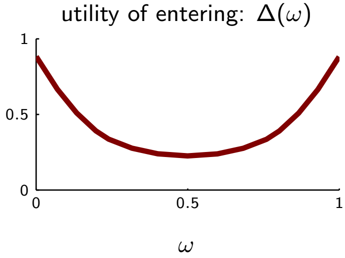
- Implies a fixed point equation for $n(\omega)$

$$n(\omega) = \frac{\Phi[\Sigma(\omega)]}{\int_0^1 \Phi[\Sigma(\tilde{\omega})] \, d\tilde{\omega}}, \text{ where } \Phi(S) \equiv \text{ \# traders in banks } \geq S$$

Schauder $\Rightarrow$ an equilibrium with positive entry exists

equilibrium entry incentives

- Per capita, assuming quadratic cost of risk bearing



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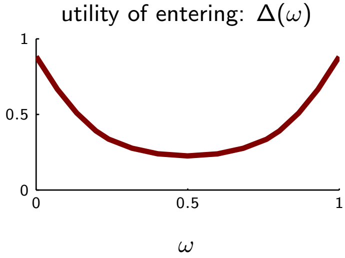
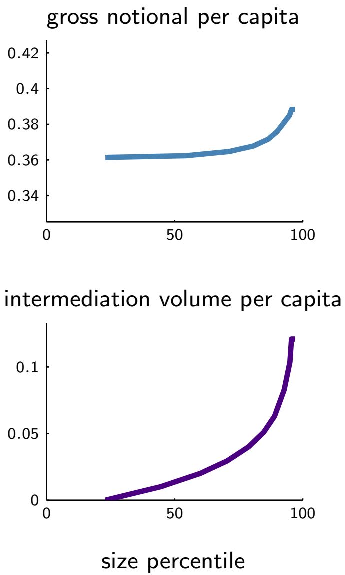


Now recall that banks have to pay a fixed cost to enter. Therefore:

- small-sized banks do not enter
- middle-sized banks only enter at the extremes, as customers
- large-sized banks enter in the middle, as intermediaries

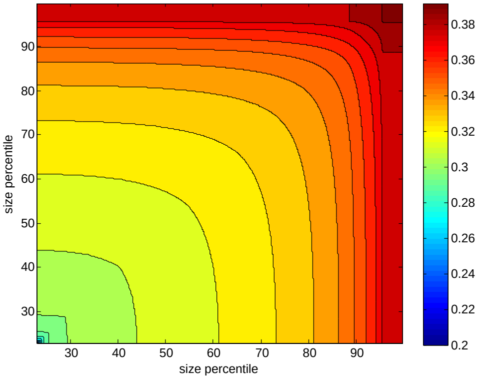
positive results

positive results



linkages

per capita



welfare

is equilibrium entry socially optimal?

- Perturb the equilibrium

  at each ω, add a small measure $\delta(\omega)$ of ω-traders

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- Result 2: however, composition, $n(\omega)$, is not socially optimal.

  extreme-ω banks should enter

  small banks at the margin

  middle-ω banks should exit

  large banks at the margin

conclusion

- A new framework for OTC credit derivatives
- Networks of cross-exposures arises endogenously

    incentives to hedge and intermediate

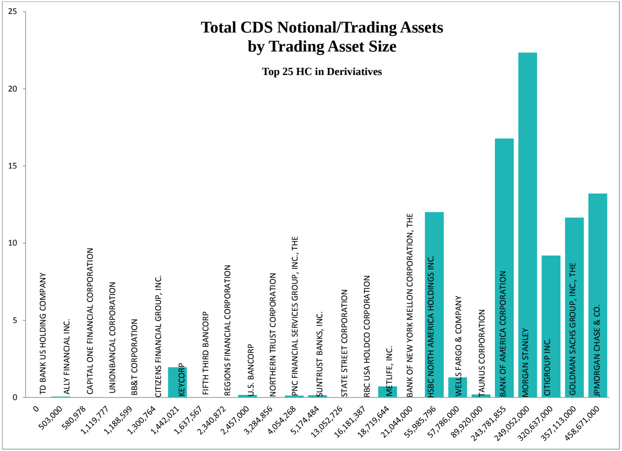
    economies of scale when entering in OTC markets

- Rationalizes observed patterns of participation
- Identifies an inefficiency

    large banks enter too much

    middle sized banks enter too little

large banks trade disproportionately more



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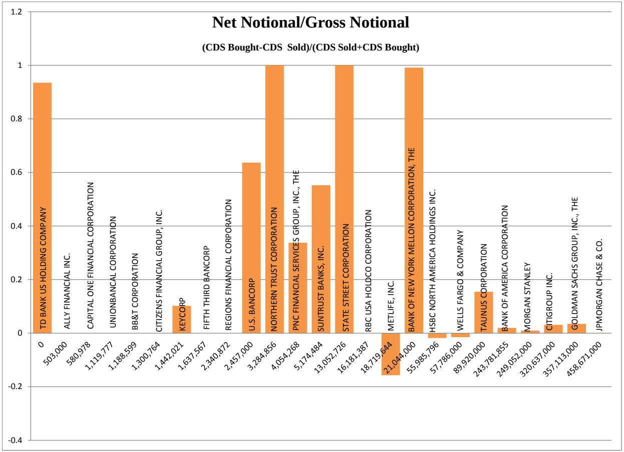
large banks intermediate

for large banks, net positions are much smaller than gross positions



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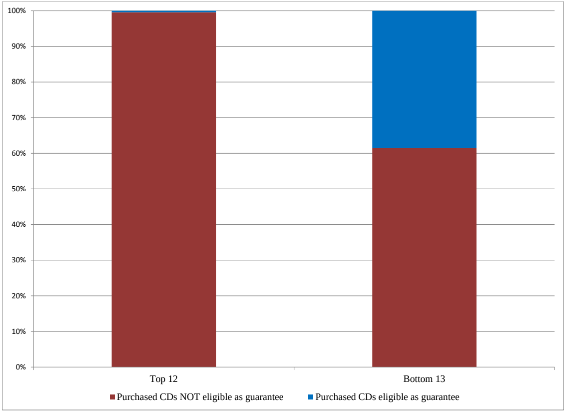
middle-sized banks hedge

Q2 2009 to Q4 2011, % notional that count as hedge (“guarantee”)

i.e., that the bank can use to reduce regulatory capital requirement



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