The Cost of Clearing Fragmentation[1]

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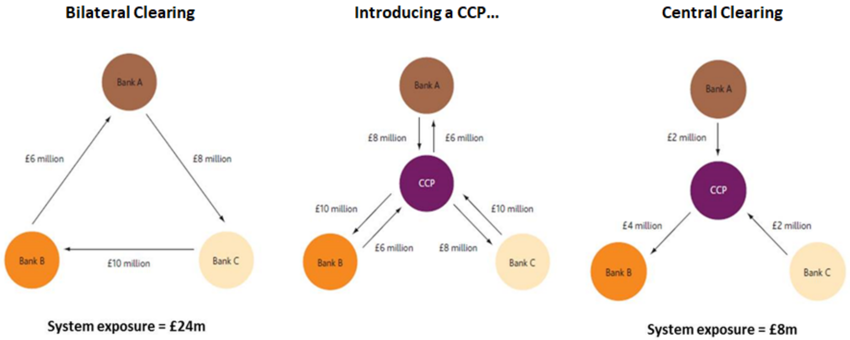
[1]The views expressed in this paper are those of the authors and not necessarily those of the Bank of England or the Bank for International Settlements or the European Securities and Markets Authority.

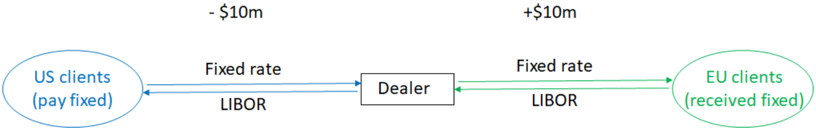
Central Clearing & Multilateral Netting

- Central Clearing reduces exposures and associated collateral costs via *multilateral netting*



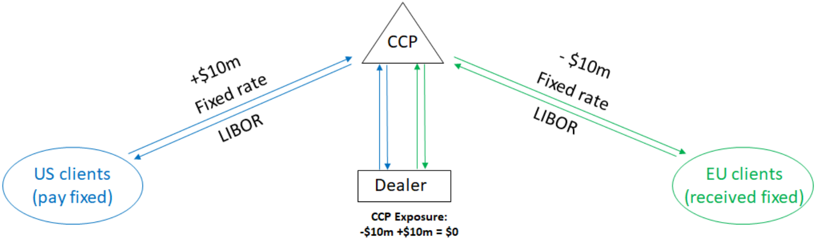
OTC Swap Trading

- Dealers provide liquidity globally



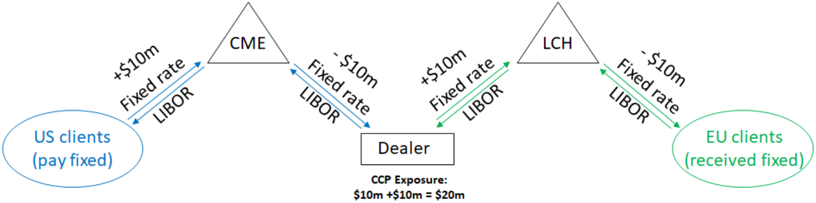
One CCP (No fragmentation)

- Multilateral netting: Dealers have no exposures and no collateral obligations to the CCP



Two CCPs (Clearing fragmentation)

- No multilateral netting: Dealers have exposures and collateral obligations to *each* CCP



What we do & find

1. We characterize the economics of a fragmented clearing landscape
2. We show that when clearing fragments, the associated increase in collateral costs leads to economically significant price distortions.
3. These price distortions take form of a price differential (basis) when the same products are cleared in two different CCPs
4. We validate our model's predictions using proprietary data from LCH.

Motivation

- Key role of central clearing in the post-crisis derivatives reform agenda

  $\rightarrow$ G-20 commitment to centrally clear most OTC-traded derivatives

- What shape and form should clearing arrangements have?

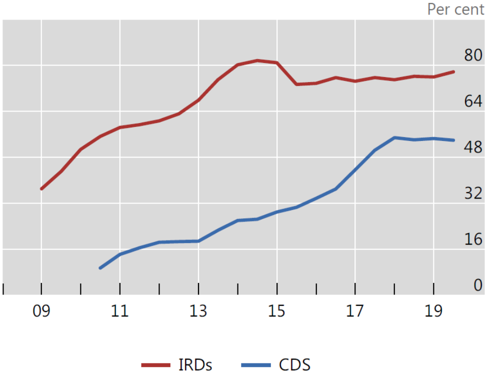
  $\rightarrow$ One, few, or many CCPs?
  $\rightarrow$ What are the netting benefits in each case?
  $\rightarrow$ What is the impact on collateral demand?

- In practice, multiple CCPs clearing the same or similar products (e.g. LCH-CME, LCH-Eurex, LCH-JSX)

  $\rightarrow$ Is this optimal? Is it costly? Should regulators encourage or avoid it?

Motivation

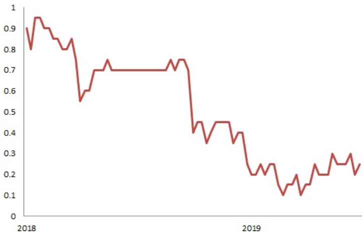
Clearing rates in IRD, CDS



Amounts Outstanding, H2 2019: $449 trn (IRD), $8.12 trn (CDS)
Source: BIS, 2019

Motivation

(a) CME-LCH basis (bps), 5Y USD IRS



(b) LCH-Eurex basis (bps), 10Y EUR IRS

Source: Bloomberg

- CCP bases are observed for products cleared in multiple CCPs
- Economically significant
- Why do these bases arise?

Motivation

Central Clearing and Brexit:

- The European Markets Infrastructure Regulation (EMIR) prohibits clearing members domiciled in the EU from accessing the services of third-country CCPs deemed by regulators to be **systemically important**.
- The rules only allow clearing members to access these services if the third-country CCP in question *relocates* these services to an EU jurisdiction.
- This rule is likely to apply to LCH following the departure of the United Kingdom from the EU, although UK CCPs have been granted temporary equivalence. Requiring LCH to migrate activity in the EU would **fragment clearing**.

Motivation

Recent developments:

- FT, September 15, 2020, "EU set to extend access to London clearing houses to mid-2022": "...Brussels wants EU financial institutions to use the extra time as a breathing space to steadily "reduce their exposure to United Kingdom market infrastructures""
- FT, September 28, 2020, "EU regulators to vet LCH on future European market access": "The move could open the institutions up to demands from Brussels to relocate activities into the EU to keep serving European customers."

The intuition

- In trading across jurisdictions with clients who clear their trades locally, dealers cannot fully net offsetting positions.
  - $\rightarrow$ E.g. an IRS sell trade with a US client, cleared in CME, cannot be netted against an equally sized buy trade with an EU client, cleared in LCH.
- This increases dealers' collateral requirements and associated costs.
  - $\rightarrow$ In the above case, the dealer would have to pledge collateral with both CME and LCH.
- To recoup these costs, dealers set a higher price where clients are mostly buyers and a lower one where clients are mostly sellers.
- This gives rise to the observed CCP bases.

Literature

- **Netting and collateral in clearing**
  - → **Theory**: Duffie and Zhu 2011, Garratt and Zimmerman 2018
  - → **Evidence**: Sidanius and Zikes 2012, Duffie at al 2015
- **Price effects of regulation via dealer balance sheets**
  - → **Theory**: Garleanu and Pedersen 2011
  - → **Evidence**: Andersen et al 2019 (Funding value adjustments), Du at al. 2018 (CIP deviations), Boyarchenko et al 2018 & Klinger and Sundaresan 2019 (Negative swap spreads), Cenedese et al. 2018 (OTC premia)
- **Inventory management**
  - → **Theory**: Stoll 1978, Ho and Stoll 1981, Foucault et al 2013, etc.
  - → **Evidence**: Lyons 1995, Reis and Werner 1998, Hendershott and Menkveld 2014, etc.

Questions?

A model of fragmented clearing

Based on *Foucault et al 2013*

- **Asset**:
  - A contract of infinitely long maturity
  - Fundamental value: $\mu_t = \mu_{t-1} + \epsilon_t \quad \epsilon_t \sim (0, \sigma^2)$
  - Cleared in two CCPs (A and B)
  - Quoted and traded at price p_t^i in CCP i with $p_t^{i,\text{bid}} \neq p_t^{i,\text{ask}}$
  - $m_t^i \equiv (p_t^{i,\text{bid}} + p_t^{i,\text{ask}})/2$

- **Liquidity traders**:
  - Unit mass
  - $\delta < 1$ are price sensitive: buy (sell) if $m_t^i < \mu_t$ ($m_t^i > \mu_t$), otherwise abstain; *can* choose where to clear
  - $1 - \delta$ are price insensitive (i.e. always trade) and equally split between CCP A and B; *cannot* choose where to clear
  - Fraction π $(1 - \pi)$ of price insensitive buy in CCP A (B)
  - Price-insensitive net flow in CCP A: $\frac{1}{2}(1 - \delta)(2\pi - 1)$
  - Price-insensitive net flow in CCP B: $\frac{1}{2}(1 - \delta)(1 - 2\pi)$

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A model of fragmented clearing

Total (price-sensitive plus price-insensitive) client net flow:
$\Delta \equiv \frac{1}{2}(1-\delta)(2\pi - 1)$

		CCP A $E_t[d_t^A]$	**CCP B** $E_t[d_t^B]$
1.	$\mu_t \le m_t^A < m_t^B$	Δ	$-\Delta - \delta$
2.	$m_t^A < \mu_t < m_t^B$	$\Delta + \frac{1}{2}\delta$	$-\Delta - \frac{1}{2}\delta$
3.	$m_t^A < m_t^B \le \mu_t$	$\Delta + \delta$	$-\Delta$
4.	$\mu_t < m_t^A = m_t^B$	$\Delta - \frac{1}{2}\delta$	$-\Delta - \frac{1}{2}\delta$
5.	$m_t^A = m_t^B = \mu_t$	Δ	$-\Delta$
6.	$m_t^A = m_t^B < \mu_t$	$\Delta + \frac{1}{2}\delta$	$-\Delta + \frac{1}{2}\delta$
7.	$\mu_t \le m_t^B < m_t^A$	$\Delta - \delta$	$-\Delta$
8.	$m_t^B < \mu_t < m_t^A$	$\Delta - \frac{1}{2}\delta$	$-\Delta + \frac{1}{2}\delta$
9.	$m_t^B < m_t^A \le \mu_t$	Δ	$-\Delta + \delta$

A model of fragmented clearing

- **Dealer**:
  - Competitive and risk neutral
  - Chooses number of contracts q_t^i, where $q_t^i \in \{-1, 0, +1\}$
  - CCP i inventory: $z_{t+1}^i = z_t^i - q_t^i$
  - Bears unit collateral cost ϕ
  - No netting across CCPs $\rightarrow$ Total collateral cost: $\phi\sigma|z_{t+1}^A| + \phi\sigma|z_{t+1}^B|$

- **Dealer's problem**:

$$\max_{q_t^A, q_t^B} E[\omega_{t+1}]$$

where:

$$\omega_{t+1} = \underbrace{(p_{t+1}^A - p_t^A)z_{t+1}^A}_{\text{Mark-to-market value of } z_{t+1}^A} + \underbrace{(p_{t+1}^B - p_t^B)z_{t+1}^B}_{\text{Mark-to-market value of } z_{t+1}^B} \underbrace{- \phi\sigma|z_{t+1}^A| - \phi\sigma|z_{t+1}^B|}_{\text{Total collateral cost}}$$

- **Market Clearing condition**:
  - $q_t^i = d_t^i$, $i \in \{A, B\}$

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A model of fragmented clearing

- **Equilibrium**: *Conjecture* a linear relationship between quoted prices and dealer inventories so that prices may reflect collateral costs:

$$p_t = \mu_t - \beta z_{t+1} = \mu_t - \beta(z_t - q_t)$$

where

$$m_t = \mu_t - \beta z_t, \quad p_t^{\text{Ask}} = m_t + \beta, \quad p_t^{\text{Bid}} = m_t - \beta$$

- **Dealer's FOC + Conjecture → Equilibrium Quoted prices**:

$$\begin{bmatrix} p_t^A \\ p_t^B \end{bmatrix} = \begin{bmatrix} \mu_t \\ \mu_t \end{bmatrix} - \frac{\phi\sigma}{\delta - |(1-\delta)(2\pi - 1)|} \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix} \begin{bmatrix} z_{t+1}^A \\ z_{t+1}^B \end{bmatrix}, \text{if } z_{t+1}^A z_{t+1}^B < 0$$

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A model of fragmented clearing

When $z^A_{t+1} z^B_{t+1} < 0$:

- **Equilibrium mid-quotes**:

$$\begin{bmatrix} m_t^A \\ m_t^B \end{bmatrix} = \begin{bmatrix} \mu_t \\ \mu_t \end{bmatrix} - \frac{\phi\sigma}{\delta - |(1-\delta)(2\pi - 1)|} \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix} \begin{bmatrix} z_t^A \\ z_t^B \end{bmatrix}.$$

- **CCP Basis**:

$$\textbf{Basis}_t \equiv m_t^B - m_t^A = \frac{2\phi\sigma}{\delta - |(1-\delta)(2\pi - 1)|} (z_t^A - z_t^B).$$

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$$\textbf{Basis}_t \equiv m_t^B - m_t^A = \frac{\overbrace{2\phi}^{H3}}{\underbrace{\delta - |(1-\delta)(2\pi - 1)|}_{H2}} \underbrace{\sigma(z_t^A - z_t^B)}_{H1, H4, H5},$$

Hypotheses:

H1: *The CME-LCH basis is increasing in dealers' posted collateral with LCH.*

H2: *The CME-LCH basis is decreasing in the LCH volume share of price-sensitive participants who can clear flexibly in multiple CCPs.*

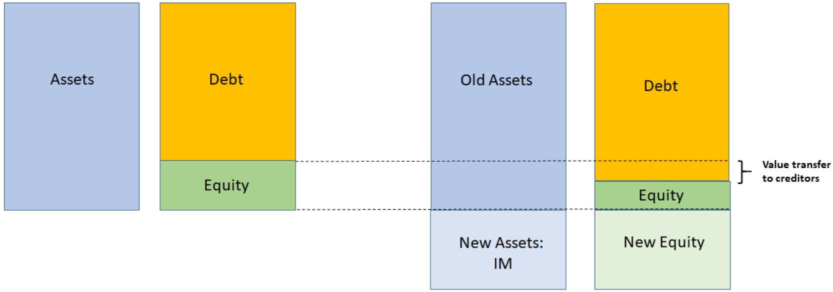
H3: *The CME-LCH basis is increasing in the amount of* **debt overhang** *faced by dealers' shareholders and as such is increasing with dealers' credit risk.*

H4: *The above effects are more pronounced for longer-maturity contracts than shorter-maturity ones.*

H5: *The CME-LCH basis is decreasing in client net buy volume in USD swap contracts cleared in LCH.*

Debt Overhang

- If margin is funded via equity or junior debt, senior debt becomes safer and thus more valuable at the expense of the firm's equity.



Questions?

Data

- Initial margin posted by the major dealers with LCH
- Transaction reports on LCH SwapClear products between Jan 2014 and June 2016 in all major currencies
  - $\rightarrow$ This includes IRS, FRA and OIS contracts
  - $\rightarrow$ All contracts belong to the same netting set
  - $\rightarrow$ LCH data include information on contract characteristics and counterparty IDs
  - $\rightarrow$ We can identify D2C, D2D, bank vs. non-bank volumes, etc.
- Daily USD yield curves used by LCH and CME to price IRS contracts
- Libor, Fed Fund rates collected from Bloomberg

Constructing the CME-LCH Basis

- Dealers submit eod quotes to CCPs
- CCPs use submitted quotes to back out a (zero-coupon) yield curve
- We use CCPs' yield curves to price CME and LCH-cleared contracts:

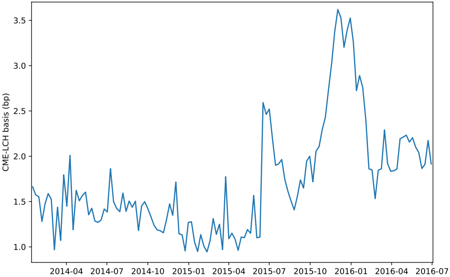
$$\sum_{i=1}^{2T} \frac{R_{k,t}^{fixed,6M}/2}{(1+\frac{R_{k,t,i}}{2})^i} = \sum_{j=1}^{4T} \frac{R_{k,t,j}^{floating,3M}/4}{(1+\frac{R_{k,t,j}}{4})^j}$$

- The CME-LCH basis for a given contract maturity is:

$$\textbf{CME} - \textbf{LCH} \ \ \textbf{Basis}_t \equiv R_{CME,t}^{fixed,6M} - R_{LCH,t}^{fixed,6M},$$

Constructing the CME-LCH Basis

- Cross-maturity average CME-LCH basis (in bps) of fixed-to-floating USD plain vanilla IRS contracts; Jan '14–Jun '16



→ Economically significant:

$$\underbrace{2bps}_{\text{Avg basis}} \times \underbrace{9.7y}_{\text{Avg IRS maturity}} \times \underbrace{\$48bn}_{\text{Avg daily client sell vlm on LCH}} \approx \$80mn$$

→ We use the cross-maturity average basis as a dependent variable

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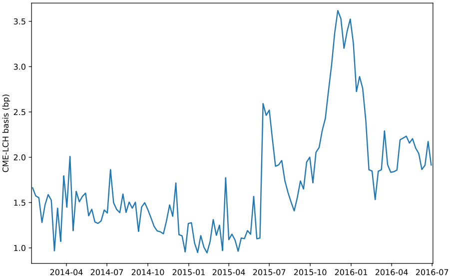

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Independent Variables

Parameters	Variable	Description	Exp. Sign
$\sigma(z_t^A - z_t^B)$	*IM*	Dealers' initial margin posted with LCH	$+$
$z_t^A - z_t^B$	*AbsCumNetVlm*	Dealers' absolute cumulative net volume across all LCH products	$+$
	Δ*Exp_Fed_Funds*	Expected Fed Funds rate: Proxy for order flow imbalance at CME	$+$
δ	*Flex_Ratio*	Fraction of volume traded by non-dealer banks	$-$
ϕ	*Libor_Spread*	1-month USD Libor minus 1-month T-Bill rate	$+$
	CDS	Dealer CDS spread	$+$
	Equity	Dealer MV Equity over Assets	$-$

Evidence from LCH - Time series

$$Basis_t = a + b \cdot Collateral_t + c \cdot Flex\_Ratio_t + d \cdot Libor\_Spread_t + u_t$$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Basis	Basis	Basis	Basis	Basis	Basis	Basis	Basis	Basis	Basis
IM	0.1412***					0.1319***			0.1772***	0.0468
	(5.44)					(6.11)			(3.87)	(1.42)
AbsCumNetVlm		0.0002***					0.0002***		-0.0001	
		(4.82)					(5.45)		(-1.25)	
Δ*Exp_Fed_Funds*			3.4803***					2.7899***		2.1877***
			(7.71)					(6.78)		(3.32)
Flex_Ratio				-1.9920***		-1.4049***	-1.3934***	-0.6717*	-1.4764***	-0.7893**
				(-3.97)		(-3.36)	(-3.27)	(-1.90)	(-3.38)	(-2.08)
Libor_Spread					17.1348***	16.7882***	18.7980***	12.6261***	15.7025***	13.4342***
					(6.20)	(7.47)	(7.38)	(5.72)	(6.86)	(5.76)
cons	0.1545	1.3975***	1.1017***	2.3926***	0.5752***	-0.3837	0.5273**	0.6119***	-0.5775	0.1844
	(0.59)	(19.77)	(16.40)	(12.29)	(3.22)	(-1.21)	(2.04)	(3.29)	(-1.65)	(0.53)
R^2	0.170	0.056	0.385	0.094	0.236	0.456	0.398	0.513	0.462	0.521
N	130	130	128	130	130	130	130	130	128	128

- $\rightarrow$ More collateral (*IM*, *AbsCumNetVlm*, *Exp_Fed_Funds*) associated with a higher basis (H1)
- $\rightarrow$ A higher activity ratio by non-dealer banks (*Flex_Ratio*) associated with a lower basis (H2)
- $\rightarrow$ Higher credit risk (*Libor_Spread*) associated with a higher basis (H3)

Evidence from LCH - Time series

$$BasisDiff_t \equiv (Basis\_7Y_t + Basis\_10Y_t + Basis\_30Y_t) - (Basis\_2Y_t + Basis\_3Y_t + Basis\_5Y_t)$$

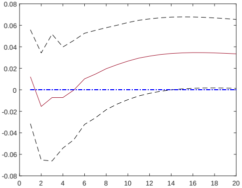
$$BasisDiff_t = a + b \cdot Collateral_t + c \cdot Flex\_Ratio_t + d \cdot Libor\_Spread_t + u_t$$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	BasisDiff	BasisDiff	BasisDiff	BasisDiff	BasisDiff	BasisDiff	BasisDiff	BasisDiff	BasisDiff
IM	0.6413***					0.4243***			0.4174**
	(6.75)					(2.64)			(2.47)
AbsCumNetVlm		0.0012***					0.0005		
		(7.81)					(1.37)		
Δ*Exp_Fed_Funds*			15.1860					19.1656	12.0076
			(0.87)					(1.35)	(1.10)
Flex_Ratio				-9.0724***		-7.0382***	-7.1637***	-7.2248***	-7.1179***
				(-5.72)		(-4.67)	(-4.76)	(-5.02)	(-4.71)
Libor_Spread					23.8095***	10.7865	14.7999	21.6987***	11.1949
					(4.09)	(1.38)	(1.57)	(3.89)	(1.42)
cons	-4.2589***	0.6949***	2.8649***	5.9458***	-1.0769	-1.2469	1.9390	1.6968	-1.2461
	(-4.63)	(2.99)	(11.11)	(8.90)	(-1.06)	(-1.28)	(1.53)	(1.41)	(-1.23)
R^2	0.306	0.226	0.010	0.166	0.252	0.445	0.382	0.373	0.444
N	130	130	128	130	130	130	128	130	128

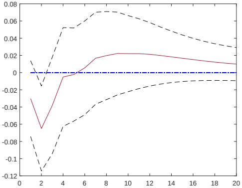
$\rightarrow$ Effects more pronounced for longer maturities (H4)

Evidence from LCH - VAR

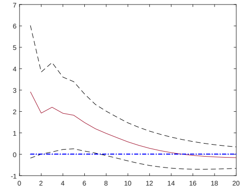
$$\mathbf{y}_t = a + \sum_i^3 (\mathbf{C}_i \mathbf{y}_{t-i} + d_i X_{t-i}) + u_t, \quad u \sim (\mathbf{0}, \Sigma)$$



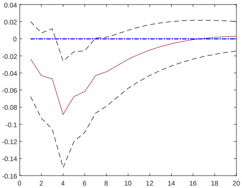
(c) *IM* on *Basis*



(d) *Flex_Ratio* on *Basis*



(e) *Libor_Spread* on *Basis*



(f) *IRS_Net_Vlm* on *Basis*

Evidence from LCH - Dealer Panel

$$DealerBasis_{it} = a + b \cdot Collateral_{it} + c \cdot Flex\_Ratio_{it} + d \cdot CreditRisk_{it} + v_i + u_{it}$$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	dealer basis	**dealer basis**	**dealer basis**	**dealer basis**	**dealer basis**	**dealer basis**	**dealer basis**	**dealer basis**	**dealer basis**	**dealer basis**
IM	1.5228***					1.4425***	1.4282***	1.1179***		1.0780**
	(4.13)					(3.65)	(3.89)	(3.29)		(2.97)
AbsCumNetVlm		0.0032***							0.0026**	0.0023**
		(5.04)							(2.47)	(2.29)
Flex_Ratio			-0.7061***			-0.3930	-0.5399*	-0.5423**	-0.5257*	-0.5733**
			(-2.96)			(-1.69)	(-1.98)	(-2.52)	(-2.11)	(-2.90)
CDS				0.0175***		0.0148***		0.0156***	0.0136***	0.0124***
				(4.16)		(3.86)		(3.89)	(3.53)	(3.44)
Equity					-36.0861***		-26.9507***	-12.5804	-18.9771*	-13.3534
					(-4.25)		(-3.06)	(-1.21)	(-1.84)	(-1.33)
cons	0.2842	0.6243***	1.3220***	-0.4285	3.2075***	-0.7103**	2.2214***	0.3011	1.1737	0.4497
	(1.62)	(8.48)	(11.96)	(-1.31)	(6.05)	(-2.61)	(3.41)	(0.29)	(1.35)	(0.49)
R^2	0.045	0.052	0.008	0.062	0.056	0.104	0.104	0.130	0.124	0.144
N	2585	2722	2722	1736	1733	1655	1652	1468	1549	1468

→ Effects of *IM*, *AbsCumNetVlm*, *Flex_Ratio* persist in the dealer panel

→ Individual dealer credit risk (*CDS*) and capital structure (*Equity*) impacts the basis

→ Support for the debt overhang hypothesis in Andersen et al (2019)

Conclusions & some thoughts

- Fragmenting clearing is costly in terms of collateral and can lead to price distortions...
- ...which in turn re-distribute wealth and likely have substantial (negative) welfare effects
- CCPs as prime examples of natural monopolies
  - $\rightarrow$ Large economies of scale
- Discussion relevant for current policy initiatives such as the proposed EU location policy

Thank you!