

(In)efficient repo markets

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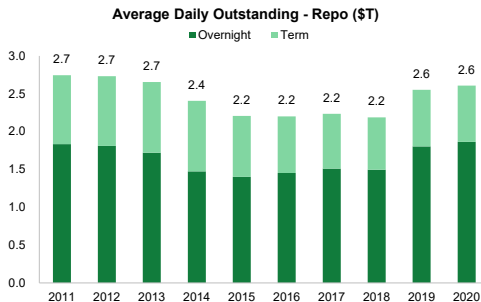
Repo markets: Efficiency vs. resilience

Fact 1 Repo is important short-term funding market (daily outstanding repo $> \$2T$)

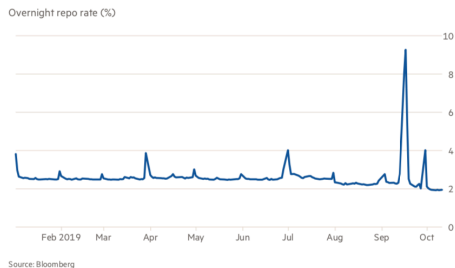
Fact 2 Repo runs are recurrent phenomenon (Duffie (2020), He et al. (2021))

Fact 3 Repo market structures differ in efficiency & resilience (Mancini et al. 2016)

Fact 4 Repo markets reliant on liquid collateral in crisis times (Infante & Saravay 2020)



(a) Repo market size (SIFMA 2021)



(b) Repo blowup (FT 2019)

Our paper

- ▶ Research questions
 - ▶ What are the trade offs between different repo market structures?
 - ▶ What is the optimal repo market design?
 - ▶ What is the role of collateral across different markets?
- ▶ Existing repo market structures trade off
 - ▶ Efficient resource allocation
 - ▶ Resilience to runs
- ▶ Both trading & clearing mechanisms impact tradeoff
- ▶ Non-anonymous trading + central clearing w/ **two-tiered guarantee fund**
 - ▶ Liquidity fund (or collateral upgrade) → **Illiquidity mutualization**
 - ▶ Default fund → **Default loss mutualization**

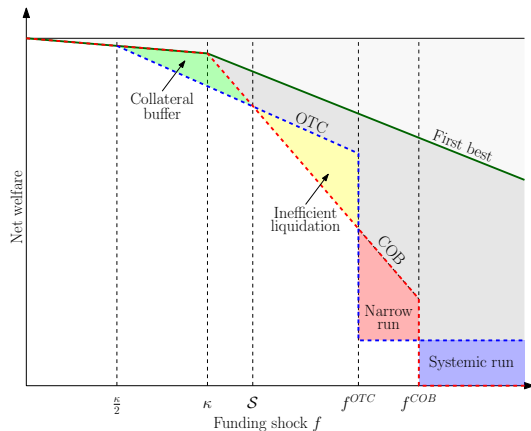
Repo trading & clearing mechanisms affect welfare

- ▶ Existing repo markets combine different trading & clearing mechanisms

Trading \ Clearing	direct	central
non-anonymous	OTC repo market (bilateral & tri-party U.S. customer repo)	Clearinghouse (reform proposals, e.g., Duffie (2020))
anonymous	COB without novation (MTFs with ex-post name give-up)	CCP = COB + novation + default fund (GCF Repo & FICC DVP via e.g. BrokerTec, EUREX, LCH.Clearnet)

- ▶ COB = Anonymous non-discriminatory repo pricing
- ▶ Novation = CCP becomes legal counterparty
- ▶ Default fund = Insurance against borrower default

#1 Repo trading mechanism affects efficiency & resilience



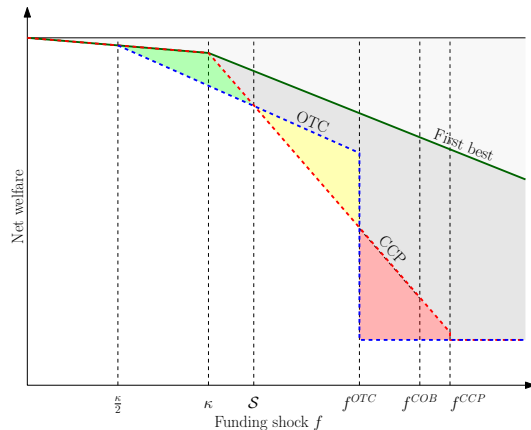
Collateral buffer: Anonymity provides insurance to L -type since collateral buffers shock

Inefficient liquidation: Anonymity forces inefficient liquidation of H -type assets

Narrow run: Run on L -type borrowers

Systemic run: Run on L - & H -type borrowers (market failure)

#2 Central clearing improves resilience, not efficiency



- ▶ **Novation** excludes low-quality borrowers → *Systemic run* can be averted
- ▶ **Default fund** provides insurance → Repo market absorbs larger funding shocks

#3 Improving repo market design

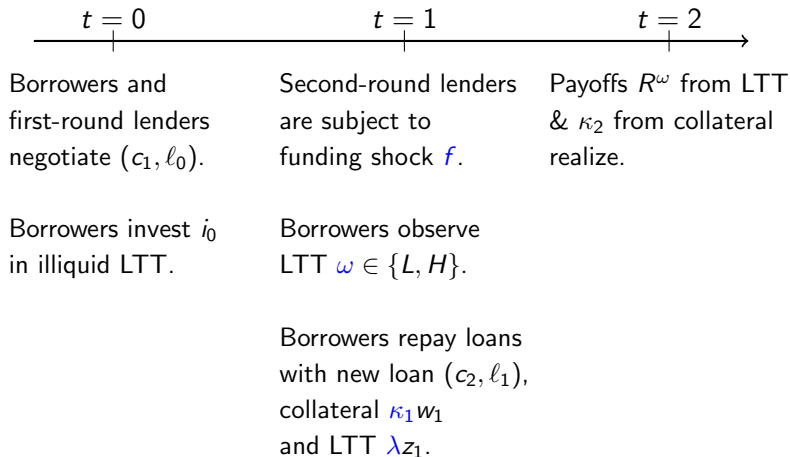
1. **Central clearing** of bilateral & tri-party trades (Duffie, 2020)
 - ▶ Improves run resilience, but not resource allocation
2. **Hybrid trading** in centrally-cleared markets
 - ▶ Switch from anonymous to non-anonymous trading when funding becomes tight improves resource allocation
3. **Two-tiered guarantee fund** is privately optimal market solution

Liquidity fund	Default fund
Collateral transfers support illiquid yet solvent borrowers	Profit transfers repay lenders of defaulting borrower
Collateral liquidated before LTT → Improves resource allocation	→ Increases run resilience

Model

- ▶ 3-period model of incentive-based runs at rollover stage
- ▶ 2 borrowers have ex-ante identical, ex-post heterogeneous long-term technologies (LTT) for which they need financing
- ▶ Maturity mismatch: LTT is financed with short-term loans
- ▶ Demand-side **asymmetric info** & supply-side **funding scarcity**
 - ▶ Borrowers learn over time their technology's quality $R^\omega \geq 1$, $\omega \in \{L, H\}$, where $Pr(R^H) = \beta$
 - ▶ $2m$ lenders are subject to funding shock $f \geq 0$ with prob α
- ▶ Risk-free asset can be used as collateral $\kappa_t k_0$
- ▶ **Pecking order**: Liquidation of collateral is cheaper than LTT
 - ▶ Illiquid LTT has firesale value $\lambda \in (0, 1) < \text{collateral quality } \kappa_1$

Timeline



The rollover decision

Repayment condition:

$$- \underbrace{\ell_0 c_1}_{\text{initial loan}} + \underbrace{\ell_1}_{\text{new loan}} + \underbrace{\kappa_1 w_1}_{\text{collateral}} + \underbrace{\lambda z_1}_{LTT} = 0$$

Borrower:

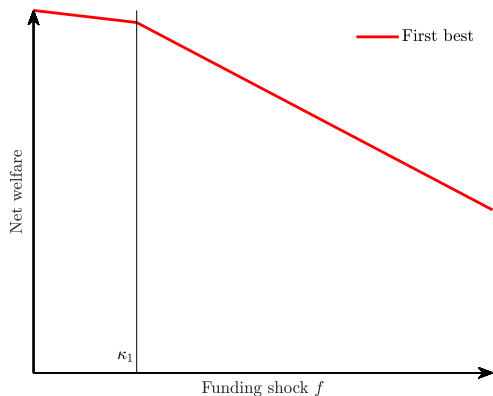
$$R^\omega(i_0 - z_1) - c_2 \ell_1 + \kappa_2(k_0 - w_1) \geq 0$$

Second-round lenders:

$$c_2 \geq 1$$

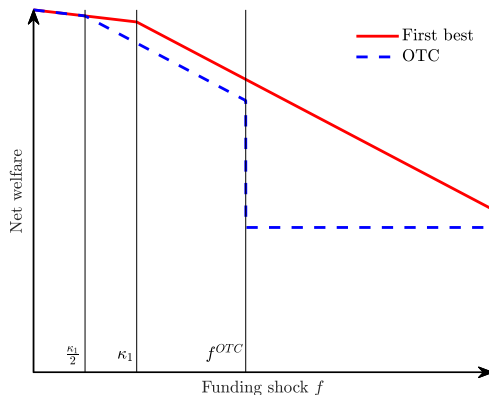
Ex-post net welfare = borrowers' profit + lenders' profit

First best solution



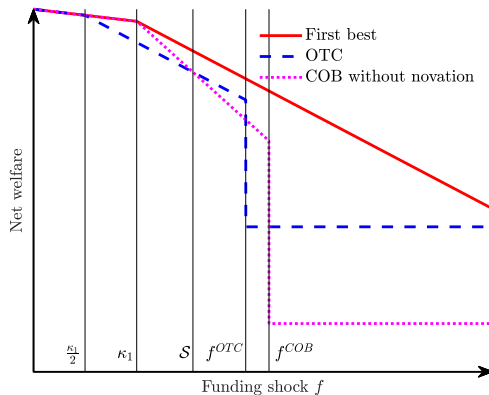
- ▶ Pecking order due to illiquidity discounts
- ▶ All collateral liquidated at κ_1
- ▶ Welfare decreases in funding shock f depending on liquidation of collateral vs LTT

Constrained FB: Non-anonymous OTC



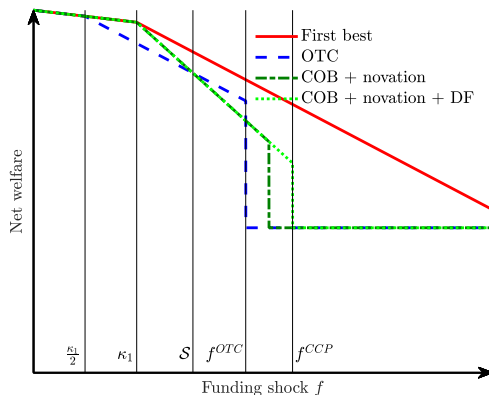
- ▶ Inefficient liquidation of L -type LTT beyond collateral $\frac{\kappa_1}{2}$
- ▶ **Narrow run** on L -type for $f \geq f^{OTC} = \frac{R^L - 1}{R^L - \lambda} \frac{\lambda}{2} + \frac{R^L}{R^L - \lambda} \frac{\kappa_1}{2}$
- ▶ Decentralized non-anonymous trading puts burden of funding shock on low-quality borrowers

Pooling equilibrium: Anonymous COB



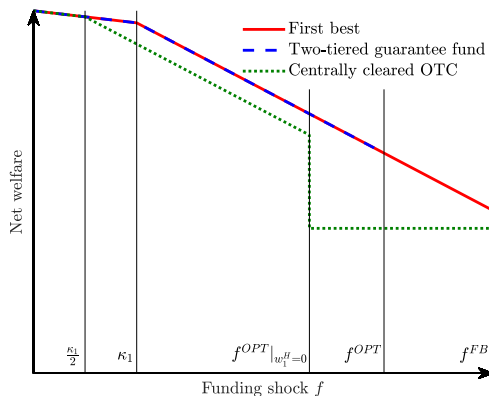
- ▶ One-fits-all loan in anonymous market has bright & dark side
 - ▶ Anonymity provides **insurance** for $f \leq \kappa_1$, but reduce total revenue due to **inefficient liquidation** of H 's LTT for $f > \mathcal{S}$
 - ▶ Leads to **systemic run** for large funding shocks $f \geq f^{CCP}$
 - ▶ $\mathcal{S} = \left(\frac{R^H}{\lambda} - \frac{\kappa_2}{\kappa_1} \right) \frac{\kappa_1 \lambda}{R^H - R^L}$ increases in illiquidity $1/\lambda$ & quality κ_1

$$\text{CCP} = \text{COB} + \text{novation} + \text{default fund}$$



- ▶ **Novation** prevents systemic runs
- ▶ **Default fund** increases resilience to narrow runs
- ▶ OTC market dominates CCP over range $f \in (S, f^{OTC})$

Two-tiered guarantee fund

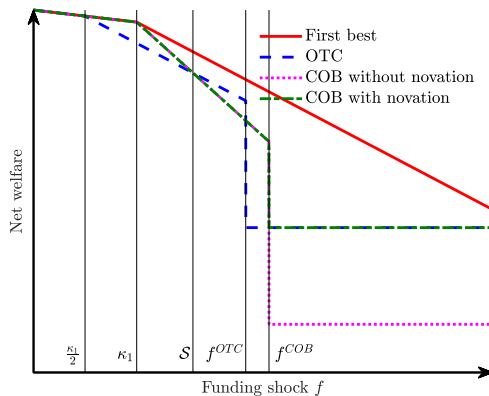


- ▶ Participants transfer both safe collateral & risky assets into **escrow accounts**
- ▶ Collateral transfer resembles collateral upgrade by ECB & Fed (Carlson & Macchiavelli, 2018)

Conclusion

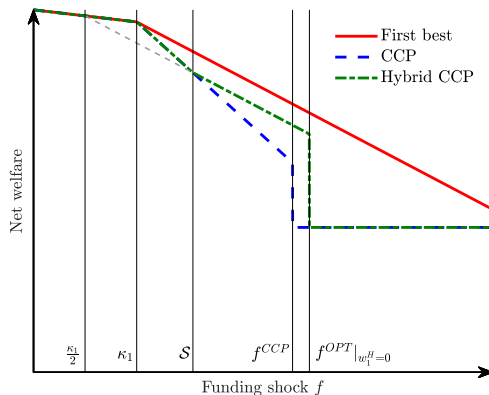
- ▶ Repo markets trade off efficient allocation of liquidity with resilience to runs
- ▶ Trading & clearing mechanisms impact allocation-resilience tradeoff
 - ▶ Common mechanisms are inefficient & welfare rankings depend on funding tightness
 - ▶ Clearing OTC markets centrally & hybrid trading in CCP markets improve welfare
 - ▶ Welfare is maximized with a two-tiered guarantee fund
- ▶ Liquid collateral improves allocation & resilience to runs
- ▶ Model helps to reconcile the convenience yield puzzle (He et al. 2021)

Novation



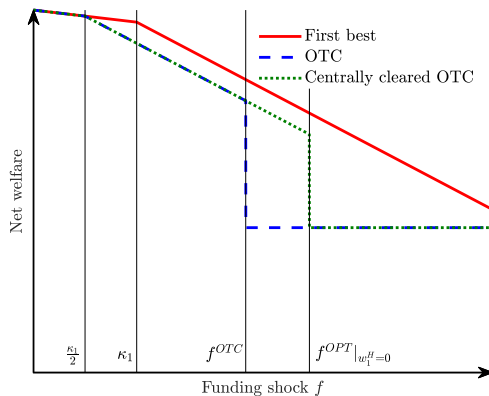
- **Novation** excludes insolvent borrowers
 - Prevents systemic runs
 - No effect on resource allocation nor on run threshold

Repo market reform #1: Hybrid trading in a CCP



- ▶ Alternative reform is to modernize trading mechanism
- ▶ Switch from anonymous to non-anonymous trading at \mathcal{S}
 - ▶ Similar to upstairs market for equities
- ▶ Improves resource allocation for $f > \mathcal{S}$

Repo market reform #2: Centrally cleared OTC



- ▶ Central clearing of repos improves run resilience
- ▶ But, central clearing leaves resource allocation unaffected!

Collateral quality and run resiliency

CCP market's resilience to run is more sensitive to collateral quality than OTC market's resilience when LTT is illiquid

- ▶ Recall, $f^{OTC} < f^{CCP}$: Might expect that marginal increase in collateral value would benefit borrowers in OTC market most
- ▶ *Not true when LTT is illiquid!* In CCP markets, high-quality borrower is forced to partially liquidate LTT, which is the most valuable asset in the economy, and hence its liquidation is particularly costly

Collateral convenience yield

- ▶ Why is an asset used as collateral instead of being sold on the spot market (Parlatore, 2019; Madison, 2020)?

In OTC markets, when a run becomes likely, ex-ante convenience yield **increases (decreases)** in the funding shock if expected borrower quality is **low (high)**

- ▶ GFC: Expected borrower quality was low due to large positions in ABS on banks' balance sheets
- ▶ Covid-19: Banks were better capitalized & had higher creditworthiness than during GFC
- ▶ Support for empirical evidence showing that convenience yield increased during GFC & decreased in Covid-19 (He et al. 21)

Collateral scarcity and negative NPV

“Market participants have voiced concerns that in anonymous CCP markets low-quality borrowers can hide amongst high-quality borrowers.” (Financial Times, July 7, 2013 & January 8, 2018)

Collateral has a skin in the game effect which prevents risk hoarding in anonymous COB markets

Literature

- ▶ Optimal opacity: Dang et al. (2017), and Goldstein and Leitner (2018) – *no runs*, Bouvard et al. (2015) – *different LTT*
- ▶ Maturity mismatch & runs: Diamond and Dybvig (1983), Postlewaite and Vives (1987), Allen and Gale (1998) Goldstein and Pauzner (2005) – *no asymmetric information*
- ▶ Interbank market: Heider et al. (2015), Martin et al. (2014a, b) and Brunnermeier and Pedersen (2009) – *no CCP*
- ▶ CCP: Kuong and Maurin (2021) – *moral hazard & monitoring*

Contribution:

- (i) Ex-post heterogeneous borrowers in maturity mismatch model
- (ii) Naturally, question arises of allocation vs. resilience tradeoff
- (iii) Derive optimal repo market structure