Self-fulfilling fire sales and central bank backstops

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Motivation

- "Dash for cash" in March 2020 → CBs provided market backstop
  - More recently, LDI crisis
- Asset purchases for financial stability
- "Moral hazard" concerns

What we do

- Investor fear of future liquidity shocks + dealers' inability to intermediate (e.g., Duffie 2020)

  $\rightarrow$ Market run dynamics (in spirit of Bernardo & Welch 2004)

- Add to standard setup:
  - Endogenous portfolio choice
  - CB providing market backstop
    - Choose size of purchase facility and purchase price

Preview of results

- Self-fulfilling fire sale when economic fundamentals are sufficiently weak
- Credible CB commitment to provide "aggressive" backstop can eliminate self-fulfilling fire sales without need for actual purchases
- "Moral hazard" only problematic when backstop is less aggressive

Bond funds

- Three dates $t = 0, 1, 2$
- Continuum of risk neutral funds of measure 1
- Funds' initial endowment: x units of bonds and $1 - x$ units of cash
- Cash returns 1 in each period
- Bonds return $R > 1$ at $t = 2$ but cannot be liquidated before
- Hit by liquidity shock at $t = 1$ with probability q

Dealers

- Dealers intermediate in bond market
- Purchase bonds at discounted price

$$p = \begin{cases} R - \delta_L & \text{bond holdings} \leq K \\ R - \delta_H & \text{bond holdings} > K \end{cases}$$

where $\delta_L < \delta_H$

Payoffs

- At $t = 0$ can either sell bonds or hold
- Let s be the proportion of funds choosing "sell"
- Payoffs are

$$u(\text{sell}, s, K) = R - \delta_L$$

$$u(\text{hold}, s, K) = \begin{cases} q(R - \delta_L) + (1 - q)R & \text{if } sx \leq K \\ q(R - \delta_H) + (1 - q)R & \text{if } sx > K. \end{cases}$$

Finding best response

- Payoff gain from selling

$$\pi(s, K) = \begin{cases} -(1-q)\delta_L & \text{if } sx \le K \\ q\delta_H - \delta_L & \text{if } sx > K. \end{cases}$$

- Dominant strategy to hold if $q\delta_H \le \delta_L$ or $x \le K$
- Otherwise best response depends on fund's belief about s

Uncertain dealer capacity

- Eliminate multiple equilibria via global games
- Prior distribution K is uniformly distributed on $[0, 1]$
- At $t = 0$, each fund i observes private signal

$$z_i = K + \varepsilon_i$$

where ε_i is uniform on $[-\varepsilon, \varepsilon]$.

Equilibrium with switching strategy

- Funds follow strategy of form

$$\text{Action} = \begin{cases} \text{Hold} & \text{if } z_i > z^* \\ \text{Sell} & \text{if } z_i \leq z^* \end{cases}$$

- Can then derive the density of s conditional on z_i

Unique threshold equilibrium via global games

- Let $\varepsilon \to 0$. If $q\delta_H > \delta_L$ and $x > K$, there is an equilibrium where all funds hold if $K > K^*$ and all funds sell if $K < K^*$ where

$$K^* = \left[\frac{q\delta_H - \delta_L}{q(\delta_H - \delta_L)}\right] x \equiv \alpha x.$$

Sketch of proof

- Comparative statics on K^*

1. $\uparrow q \to \uparrow K^*$
2. $\uparrow \delta_H \to \uparrow K^*$
3. $\uparrow x \to \uparrow K^*$

Endogenising portfolio choice

- Before funds receive private signals can choose x
- Assume cost of variance in portfolio $c(x) = \gamma x^2$
- Focus on an equilibrium where ex-ante probability of fire sale > 0

Optimal portfolio choice

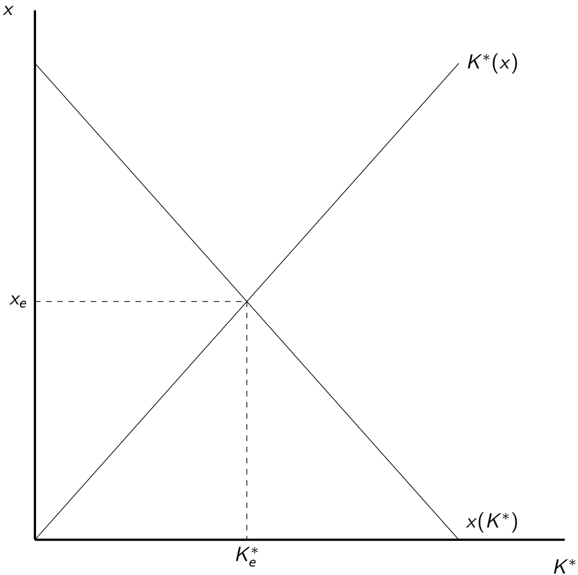
- If funds can choose x optimally, can show that

$$x = \frac{R - \delta_L(q + K^*(1-q))}{2\gamma}$$

conditional on K^*

▸ Statement of fund problem

Joint determination of x and K^*



Central bank provision of market backstop

- CB can

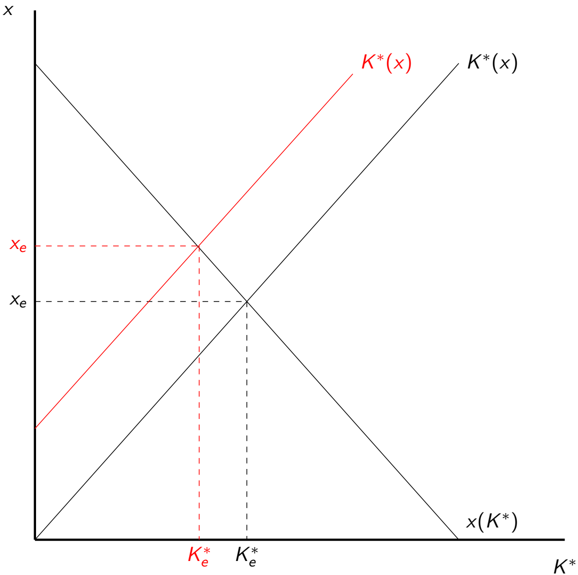
  1. Add to dealer capacity to absorb bonds
     - Total capacity is $K + K_{CB}$
  2. Set price for purchasing bonds
     - Price is $R - \delta_{CB}$ where $\delta_{CB} \in (\delta_L, \delta_H]$

Policy implications

- If CB can credibly **commit** to set δ_{CB} low enough *and* K_{CB} high enough then it can
  - Eliminate self-fulfilling fire sales
  - Avoid purchasing any bonds
- If δ_{CB} and K_{CB} such that fire sales are not ruled out then
  - Backstop policy does reduce probability of fire sales
  - But effectiveness undermined because funds respond by holding more bonds ("moral hazard")

Full statement of Proposition

An increase in K_{CB} when K_{CB} small

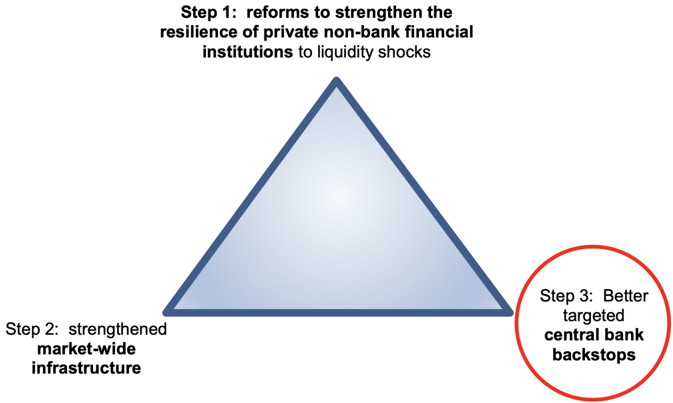


Potential problems with central bank backstops

- Market expectations

- Costs of central banks holding assets

Alternative policies



Hauser (2021), From Lender of Last Resort to Market Maker of Last Resort via the dash for cash: why central banks need new tools for dealing with market dysfunction. Reuters, London, 7 January 2021.

Concluding remarks

- Stylised model designed to draw out many high-level policy implications
- Several other design issues model is silent on
  1. Which assets to buy?
  2. How to unwind purchases?
  3. Repo tool vs outright purchases?
  4. What if asset purchases conflict with monetary policy?

Appendix

Proposition 1: Multiple equilibria

- An equilibrium with $\tilde{\delta} = \delta_L$ always exists.
- If (i) $q\delta_H > \delta_L$ and (ii) $x > K$ both hold, then a second equilibrium exists with $\tilde{\delta} = \delta_H$.
- Sketch of proof
  - Funds sell if

$$p_0 > qp_1(\tilde{\delta}) + (1 - q)R$$

  - Use $p_0 = R - \delta_L$ (liquidity inversion) and $p_1 = R - \tilde{\delta}$ to rewrite as

$$q\tilde{\delta} > \delta_L$$

  - If $\tilde{\delta} = \delta_L \ldots$ if $\tilde{\delta} = \delta_H \ldots$

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Proposition 2: Sketch of proof

- Density of s conditional on z^* is uniform over $[0, 1]$
- Fund with signal z^* believes fund faces no stress if $s < z^*/x$ so probability of no stress is z^*/x
- Probability of stress if $1 - z^*/x$
- Can compute expected payoff gain to selling
- z^* (alternatively, K^*) must set expected payoff gain to zero

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Fund problem

$$\max_{x \in [0,1]} \quad (1 - x)$$
$$+ x \left[K^*(R - \delta_L) + (1 - K^*)(q(R - \delta_L) + (1 - q)R)\right]$$
$$- \gamma x^2$$

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Proposition 4: The CB as a MMLR

Theorem

Let $\varepsilon \to 0$. Suppose that $q\delta_H > \delta_L$ and $x > K$. If $K + K_{CB} > x$ and $q\delta_{CB} \leq \delta_L$, then funds have a dominant strategy to hold. If $q\delta_{CB} > \delta_L$, then there is an equilibrium where all funds hold if $K > \tilde{K}^*$ and all funds sell if $K < \tilde{K}^*$ where

$$\tilde{K}^* = \begin{cases} \left[\frac{q\delta_{CB} - \delta_L}{q(\delta_{CB} - \delta_L)}\right] x & \text{if } K + K_{CB} > x \\ \left[\frac{q\delta_H - \delta_L}{q(\delta_H - \delta_L)}\right] x - \left[\frac{\delta_H - \delta_{CB}}{\delta_H - \delta_L}\right] K_{CB} & \text{if } K + K_{CB} < x. \end{cases}$$

$\tilde{K}^*$ is decreasing in K_{CB} and increasing in δ_{CB}.

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