Unconventional Monetary Policy and Funding Liquidity Risk

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Motivation

- Money markets are key to bank liquidity management
  ▷ allows to mitigate funding shocks when holding illiquid assets
- Access to money markets may be impaired due to lack of collateral
  ▷ associated with high risk premia and drop in asset prices
- Striking for shadow banks as they lack access to central bank liquidity
  ▷ motivation for unconventional monetary policy (Bernanke, 2009)

This Paper

Research Question:

How can funding liquidity risk affect asset prices? What can the central bank do about it in the presence of shadow banks?

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Model:

We add liquidity management to an asset pricing model with heterogenous banks

- Banks face idiosyncratic funding shocks while holding illiquid securities
- Banks trade in money markets subject to collateral constraints
- The central bank decides on the size and composition of its balance sheet

Results

- When bank capital is low, a vicious cycle between declining asset prices and funding risks arises.
- Liquidity injection policy help alleviate stresses in the traditional banking sector but fail to reach to the shadow banking sector.
- Asset purchase policy (LSAP) decreases the stock of funding risks through a general equilibrium effect and therefore has a larger reach.

If the shadow banking sector is large, LSAP is necessary to stabilize asset prices.

Contribution to the Literature

- **Macro-banking with fire-sales** (He, Kang, and Krishnamurthy, 2010; Brunnermeier and Sannikov, 2013; Gertler and Kiyotaki, 2015; Gertler, Kiyotaki, and Prestipino, 2017)

  → funding risk affects asset prices through the stochastic discount factor of intermediaries rather than aggregate cash flows

- **Macro-finance with monetary policy** (He and Krishnamurthy, 2013; Brunnermeier and Sannikov, 2014; Silva, 2017)

  → LSAP stabilize asset prices by decreasing aggregate funding risks rather than redistributing wealth to banks or risks to households.

- **Shadow banking**: (Vishny, 2013; Plantin, 2015; Moreira and Savov, 2017; Huang, 2018; Ordonez, 2018)

  → focus on lack of access to central bank liquidity instead of regulatory arbitrage

MODEL

Environment

Intermediary asset pricing

- random supply of Lucas Trees $dS_t/S_t = \mu dt + \sigma dZ_t$ with dividend flow a
- limit to bank equity issuance $\rightarrow$ incomplete markets for aggregate risk

Liquidity management

- idiosyncratic funding shocks
- collateralized money markets
- fire sale of securities at a cost λ

Shadow banks without access to central bank

Monetary Policy

The central bank has three policy tools $\{\underline{m}_t, \underline{\phi}_t, \underline{\nu}_t\}$:

- **liquidity injection:** supply of reserves $\underline{m}_t$
- **discount window:** provide lower haircuts $\alpha_t \to \alpha_t + \underline{\phi}_t$
- **asset purchase:** purchase of securities $\underline{\nu}_t$ but lower expertise $\underline{a} < a$

subject to the balance sheet constraint:

$$\underline{\nu}_t + \underline{b}_t = \underline{m}_t$$

The central bank is not subject to funding liquidity risk

STATIC RESULTS

$\triangleright$ Analytical solution when dynamics are shut down ($\eta_t = \eta$ and $\overline{\eta}_t = \overline{\eta}$)

$\triangleright$ Epstein-Zin utility functions with risk aversion γ, intertemporal elasticity of substitution ζ, and time preference ρ

Benchmark without Any Friction

In the absence of any friction ($\lambda = 0$, $\eta + \overline{\eta} = 1$), prices are given by:

$$q = \frac{a}{\rho - (1 - \zeta^{-1}) \left(\mu - \frac{\gamma}{2} \qquad \sigma^2 \qquad \right)}$$

Benchmark without Liquidity Risk

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▷ **Neutrality of Monetary Policy Instruments**

In the absence of money market frictions ($\lambda = 0$), any change in the monetary policy decision set $\{\underline{m}_t, \underline{\phi}_t, \underline{\nu}_t\}$ has no effect on any equilibrium variables.

Prices with No Central Bank

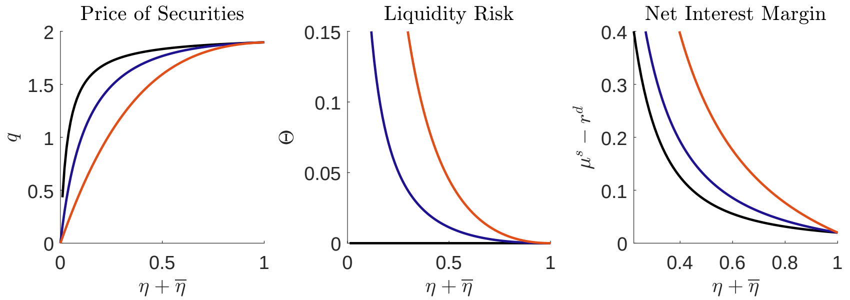
In an economy without asset purchase $\underline{\nu} = 0$, without reserves $\underline{m} = 0$, and without discount window facility $\underline{\phi}_t = 0$, prices are given by:

$$q = \frac{a}{\rho - (1 - \zeta^{-1})\left(\mu - \frac{\gamma}{2}\frac{1}{\eta + \overline{\eta}}\left(\sigma^2 + \Theta^2\right)\right)}$$

where

$$\Theta = \lambda(1 - \eta - \overline{\eta}) - \lambda\alpha$$

No Central Bank with Moderate and Large Amount of Funding Risk



No funding liquidity risk in black ($\lambda = 0$), moderate amount of funding liquidity risk in red ($\lambda = 0.3$), large amount of funding liquidity risk in blue ($\lambda = 0.6$)

Prices with Positive Supply of Reserves $\underline{m}$

In an economy without asset purchase $\underline{\nu} = 0$ and without a discount window facility $\underline{\phi} = 0$, prices are given by:

$$q = \frac{a}{\rho - (1 - \zeta^{-1})\left(\mu - \frac{\gamma}{2}\frac{1}{\eta + \overline{\eta}}\left(\sigma^2 + \Theta(\underline{m})^2 + \Omega(\underline{m})\right)\right)}$$

where

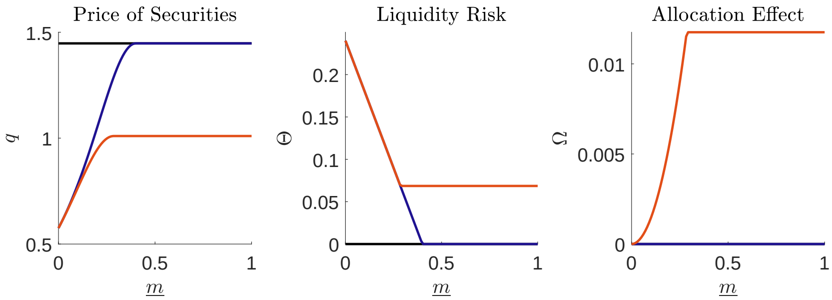
$$\Theta(\underline{m}) = \lambda(1 - \eta - \overline{\eta} - \underline{m}) - \lambda\alpha \qquad \text{if } \underline{m} \leq \underline{m}^\star$$

$$\Omega(\underline{m}) = \frac{\underline{m}^2(1-\alpha)^2\lambda^2}{\sigma^2 + (1-\alpha)^2\lambda^2}\frac{\overline{\eta}}{\eta}\sigma^2 \qquad \text{if } \underline{m} \leq \underline{m}^\star$$

where $\underline{m}^\star$ is the level of liquidity satiation for regular banks:

$$\underline{m}^\star = (1 - \eta - \overline{\eta} - \alpha)\frac{\sigma^2 + \lambda^2(1-\alpha)^2}{\sigma^2 + \lambda^2(1-\alpha)^2 + \sigma^2\frac{\overline{\eta}}{\eta}}$$

Supply of Reserves with Small and Large Shadow Banking Sector



No funding liquidity risk in black ($\alpha = 0$, $\eta = 0.05$, $\overline{\eta} = 0.05$); with small shadow banking sector in blue ($\alpha = 0.6$, $\eta = 0.08$, $\overline{\eta} = 0.02$); with large shadow banking sector in red ($\alpha = 0.6$, $\eta = 0.02$, $\overline{\eta} = 0.08$)

Prices with Large Scale Asset Purchases $\underline{\nu}$

In an economy without a discount window facility $\underline{\phi} = 0$ and $\underline{\nu} = \underline{m} > 0$, prices are given by:

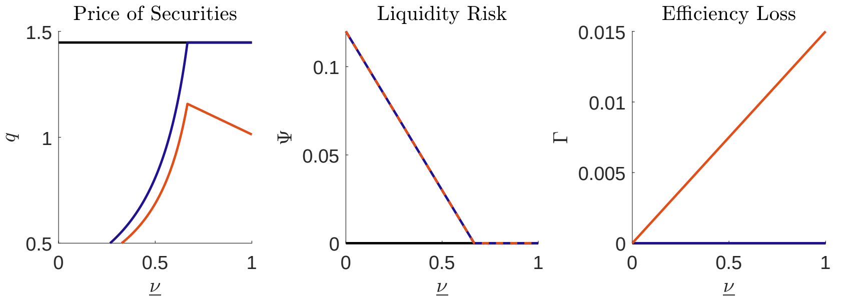
$$q = \frac{a - \underline{\nu}(a - \underline{a})}{\rho - (1 - \zeta^{-1}) \left(\mu - \frac{\gamma}{2} \frac{1}{\eta + \overline{\eta}} \left(\sigma^2 + \Theta(\underline{\nu})^2 \right) \right)}$$

where

$$\Theta(\underline{\nu}) = \lambda(1 - \eta - \overline{\eta} - \underline{\nu}) - \lambda\alpha(1 - \underline{\nu}) \qquad \text{if } \underline{\nu} \leq 1 - \eta - \overline{\eta}$$

and $\Theta(\underline{\nu}) = 0$ otherwise

Large Scale Asset Purchases



No funding liquidity risk in black ($\lambda = 0$); without efficiency loss in blue ($\alpha = 0.6$, $\underline{a} = a$); with efficiency loss in red ($\alpha = 0.8$, $a - \underline{a} = 0.01$)

DYNAMIC RESULTS

- $\triangleright$ Numerical solution with dynamics in the state variables η_t and $\overline{\eta}_t$
- $\triangleright$ Endogenous collateral constraint to pin down $\alpha(\eta_t, \overline{\eta}_t)$

Collateral Constraint $\alpha(\eta_t, \overline{\eta}_t)$

To borrow \$1, the required amount of collateral χ satisfies:

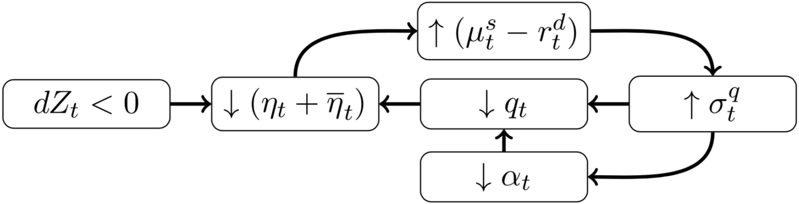
$$\mathbb{P}\left[\chi_t \exp\left(\mu_t^s - (\sigma_t^s)^2/2 + \sigma_t^s(Z_{t+1} - Z_t)\right) \leq 1\right] = p.$$

Thus, the proportion of available collateral α_t per unit of risky asset is given by

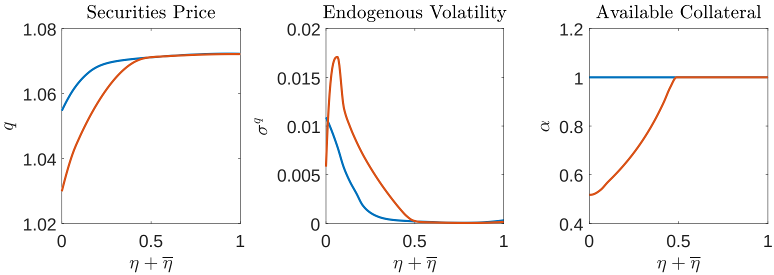
$$\alpha_t = \kappa^\chi \exp\left(\Phi^{-1}(p)\,\sigma_t^s + \mu_t^s - (\sigma_t^s)^2/2\right)$$

where κ^χ is the fraction of securities that can be used as collateral

Collateral Scarcity Spiral



Collateral Scarcity Spiral



No amplification in blue ($\alpha_t = 1$) and endogenous collateral constraint in red

▷ Brunnermeier and Pedersen (2009) in general equilibrium

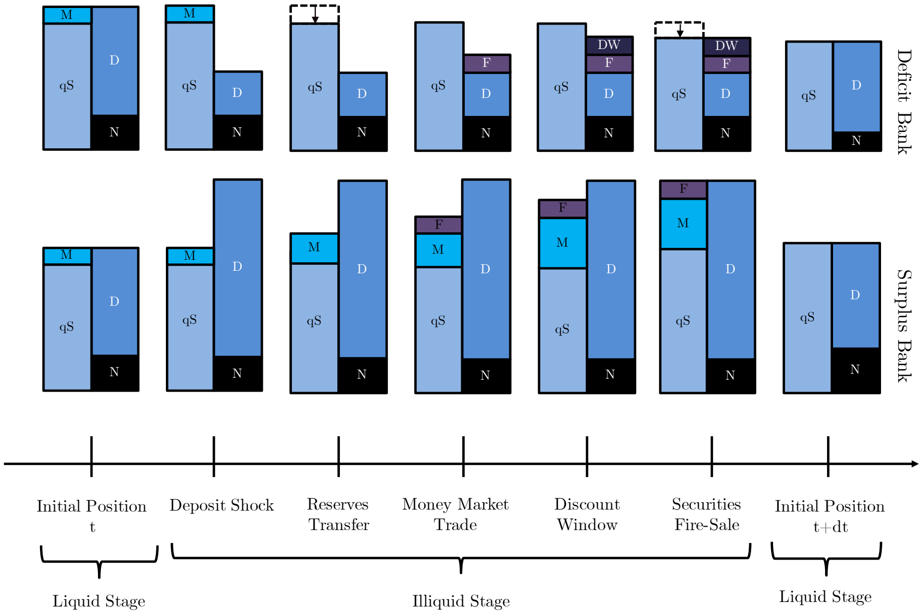
Conclusion

- When bank capital is low, an endogenous haircut spiral between declining asset prices and funding risks arises

- Liquidity injection policy help alleviate stresses in the traditional banking sector but fail to reach the shadow banking sector

- Asset purchase policy (LSAP) decreases the stock of funding risks through a general equilibrium effect and therefore has a larger reach

If large shadow banking sector, LSAP may be necessary to stabilize asset prices


M
qS
D
N
DW
F
Deficit Bank
Surplus Bank
Initial Position t
Deposit Shock
Reserves Transfer
Money Market Trade
Discount Window
Securities Fire-Sale
Initial Position t+dt
Liquid Stage
Illiquid Stage
Liquid Stage