

Payments, Credit, and Asset Prices  
by  
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Discussion

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- Summary
- The Model
- Comments
- Conclusion

## Summary

- ▶ Great Recession witnessed big changes in Monetary Policy: (i) low (zero) nominal interest rates, (ii) CB asset purchases (QE), (iii) growth in CB balance sheets, (iv) increase in amount of reserves held by banks, (iv) increase in interest on reserves, (v) persistent low inflation (vi) persistent low (negative) real rates,
  
  - ▶ Develop an equilibrium model of monetary economy with two payment layers:
    - (i) consumption good and asset transactions by agents using bank deposits (inside money),
    - (ii) interbank settlements using cash reserves (outside money).
  
  - ▶ In model monetary policy has two distinct levers
    - (i) interest on reserves,
    - (ii) short-term government bond issuance.
  
  - ▶ They affect banks' decision to hold bonds and risky assets and to issue deposits via (i) balance-sheet leverage and (ii) deposit-withdrawal liquidity constraints.
- ⇒ Model has potential to explain:
- ▶ How monetary policy choices with respect to outside money (reserves) affects inside money (deposits) creation and inflation.
  - ▶ How monetary policy affects asset prices (and vice-versa).

## Setup

- ▶ Risk-neutral consumers with time-discount rate ( $\delta$ ) face a CIA constraint ( $PC \leq D^h$ ). They receive an exogenous endowment ( $\Omega$ ) and own the banks (dividends).

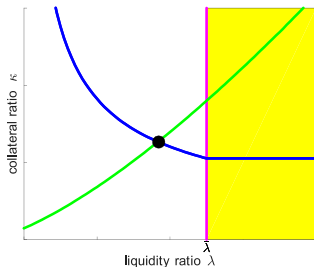
→ only hold deposits in equilibrium (risk-neutral, no-shorting):  $i^D - \pi = \delta - \gamma$ .

- ▶ Banks hold reserves ( $M$ ), overnight interbank lending ( $B$ ), and risky assets (trees  $Q$ ), which they fund with deposits ( $D$ ), overnight interbank borrowing ( $F$ ), and equity.
  - ▶ incur (real) leverage cost  $c(\kappa)(D + F)$ , convex and decreasing in the collateral ratio  $\kappa = \frac{M + \rho Q + B}{D + F}$
  - ▶ face CIA constraint  $e^\pi c(\kappa)(D + F) \leq D^b$  ( $D^b$  held at other banks on asset side?).
  - ▶ hit by random (deposit redemption) shocks  $\tilde{\lambda}D$  (assume  $\tilde{\lambda} \leq \bar{\lambda}$ ), which have to be paid with overnight interbank borrowing  $F = \tilde{\lambda}D - M$  if liquidity ratio  $\lambda = \frac{M}{D}$  is insufficient.
- ▶ Government issues reserves, borrows overnight in interbank market ( $B^g$ ), and chooses the interest rate on reserves ( $i^R$ ). It incurs a (real) leverage cost ( $c(\frac{P\Omega}{M+B^g})$ ), which has to be paid using inside money subject to a CIA constraint.
- ▶ Study steady-state equilibrium with constant  $\Omega$ ,  $Y$ , where Government issues reserves and bonds on constant growth path  $\frac{M_{t+1}}{M_t} = g$ , holding a constant reserve-to-bond ratio  $B_t^g / M_t = b$ .

# Equilibrium

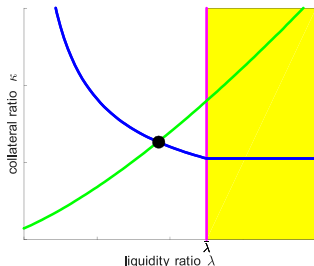
- ▶ Market clearing:
  - ▶ Goods market (and binding CIA):  $P_t Y = D_t$
  - ▶ Aggregate overnight credit:  $\frac{F_t}{D_t} = \int_{\lambda}^{\bar{\lambda}} (\bar{\lambda} - \lambda) dG(\bar{\lambda}) := f(\lambda)$
  - ▶ Interbank borrowing:  $B_t = F_t + B_t^g$ .
- ▶ SS with constant  $\lambda = \frac{M_t}{D_t}$  implies  $M, D, P$  grow at same rate and  $\pi = g$ .
- ▶ Using Bank FOC, in SS equilibrium:
  - (i)  $i^B - \pi = \delta - mb(\kappa)$
  - (ii)  $i^T - \pi = \delta - \rho mb(\kappa)$
  - (iii)  $i^B - i^R = \underbrace{(1 - G(\lambda))}_{\text{prob } F \geq 0} (mc(\kappa) - mb(\kappa))$   
 where **marginal collateral benefit**  $mb(\kappa) = -\frac{\partial c(\kappa)(D+F)}{\partial(M+\rho Q+B)}$  and **cost**  $mc(\kappa) = \frac{\partial c(\kappa)(D+F)}{\partial(D+F)}$ .
- ▶ (i) + (iii):  $g + \delta - i^R = (1 - G(\lambda))mc(\kappa) + G(\lambda)mb(\kappa)$  (Liquidity Managt Curve)
- ▶ Aggregate collateral  $\kappa = \frac{\lambda(1+b)+\rho\nu(\kappa)/Y+f(\lambda)}{1+f(\lambda)}$  (Capital Structure Curve)
- ▶ Thus SS equilibrium is solution of two equations in two unknowns  $(\kappa, \lambda)$  given policy choices  $i^R, b, g$  and exogenous  $Y, \rho$  (**risk-weight  $\rho$  policy choice?**)

## Results



- ▶ Two types of equilibria:
  - ▶ Scarce reserves (if  $\lambda < \bar{\lambda}$ ): Then  $G(\lambda) < 1$  and  $i^B > i^R$
  - ▶ Abundant Reserves (if  $\lambda > \bar{\lambda}$ ): Then  $G(\lambda) = 1$  and  $i^B = i^R$  (liquidity trap).
- ▶ Can analyze effects of policy shifts  $(i^R, b)$  on equilibrium
- ▶ Increasing the interest on reserves  $i^R$  shifts up LMC and leaves CSC unchanged.
  - ▶ Leads to higher SS  $(\kappa, \lambda)$ .
  - ▶ (real) Returns on risky assets  $(i^B - \pi, i^T - \pi)$  increase and risky asset prices drop (less valuable as collateral).
  - ▶ There is a lower money multiplier  $(1/\lambda)$ , i.e., less inside money creation.

# Results



- ▶ Increasing the bond-reserve ratio  $b$  (e.g., via open market operations) shifts up CSC and leaves LMC unchanged:
  - ▶ If liquidity is scarce, this leads to higher  $\kappa$  (lower asset prices and higher returns) and lower  $\lambda$  (higher money multiplier).
  - ▶ If liquidity is abundant, then there is no effect on  $\kappa$  (liquidity trap).
- ▶ Consider many different policy experiments and extensions of the model in the paper:
  - ▶ Nominal collateral assets,
  - ▶ Credit lines as alternative payment instruments
  - ▶ Carry traders
  - ▶ Active traders
  - ▶ Netting
  - ▶ Uncertainty premium shocks on risky collateral assets, ...

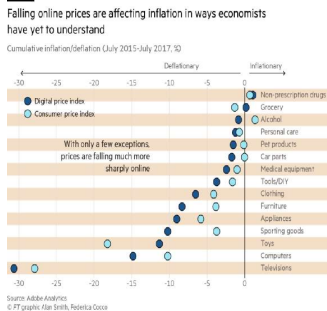
## General comments

- ▶ Micro-foundation of the leverage-cost functions?
  - ▶ All results hinge crucially on the (real) leverage cost functions of Banks and Govt.
  - ▶ In current setting it is optimal to set  $b = 0$  since bonds and reserves offer same collateral advantages but reserves offer liquidity benefits.
  - ▶ If Government cost of issuing reserves is small, then optimal to live in very abundant reserve case to avoid all costs.
- ▶ Bank leverage and aggregate consumption?
  - ▶ In the model higher bank leverage typically implies higher (real) leverage costs and less real consumption for households.
  - in a production economy where banks leverage helps finance new projects, might expect bank leverage to be positively related to aggregate output.
- ▶ Bank leverage and Solvency?
  - ▶ In the model abundant reserves lead to interbank lending 'freeze.'
  - ▶ During crisis, interbank lending freeze due to solvency concerns required CB to provide more outside liquidity.
- ▶ Why do we need banks?
  - ▶ In the model, banks only serve as a (costly) technology to transform outside money (reserves) into inside money (deposits).
  - Chicago plan or Swiss "Vollgeld" proposal (Bacchetta and Perazzi (2017)) or Electronic Digital currency.



## General comments

- ▶ In steady state inflation is equal to growth rate of reserves.
  - ▶ Interesting inflation dynamics are limited to 'transitions' (one-period  $\approx$  one day)?
  - ▶ Does not seem to fit the recent history.
- ▶ From FT 2017 article 'America's inflation enigma continues to confound':



- Technological explanation to persistent low inflation despite low unemployment?
  - ▶ 'Technological assumption that a given volume of transactions requires a fixed amount of deposits' supplied by banks.
    - Endogenous velocity?

## Minor Comments and questions

- ▶ Both government and banks hold inside money (i.e., deposits at other banks). Shouldn't these show up on the asset side of banks' balance sheets as well?
- ▶ Why is FOC of households written in terms of marginal utility of wealth  $\gamma_t$ , which is never really defined (derivation of equation 3)? Why not instead write in terms of Lagrange multiplier of the CIA constraint?
- ▶ Notation:  $\gamma$  is also "efficient netting" parameter.
- ▶  $i^L$  on page 17 not defined, correspond to model solved in appendix .
- ▶  $dj$  in budget constraints (2) and (9)?
- ▶ Difficult to follow algebra in appendix, which is for different model than main text, but refers to some equations therein.
- ▶ ...

## Conclusion

- ▶ Interesting paper.

⇒ Model has potential to explain:

- ▶ How monetary policy choices with respect to outside money (reserves) affects inside money (deposits) creation and inflation.
- ▶ How monetary policy affects asset prices (and vice-versa).
  
- ▶ Result hinge crucially on leverage costs of banks vs. Govt: micro-foundation?
  
- ▶ Would benefit from careful editing (especially algebra/proofs).