Payments, Credit & Asset Prices

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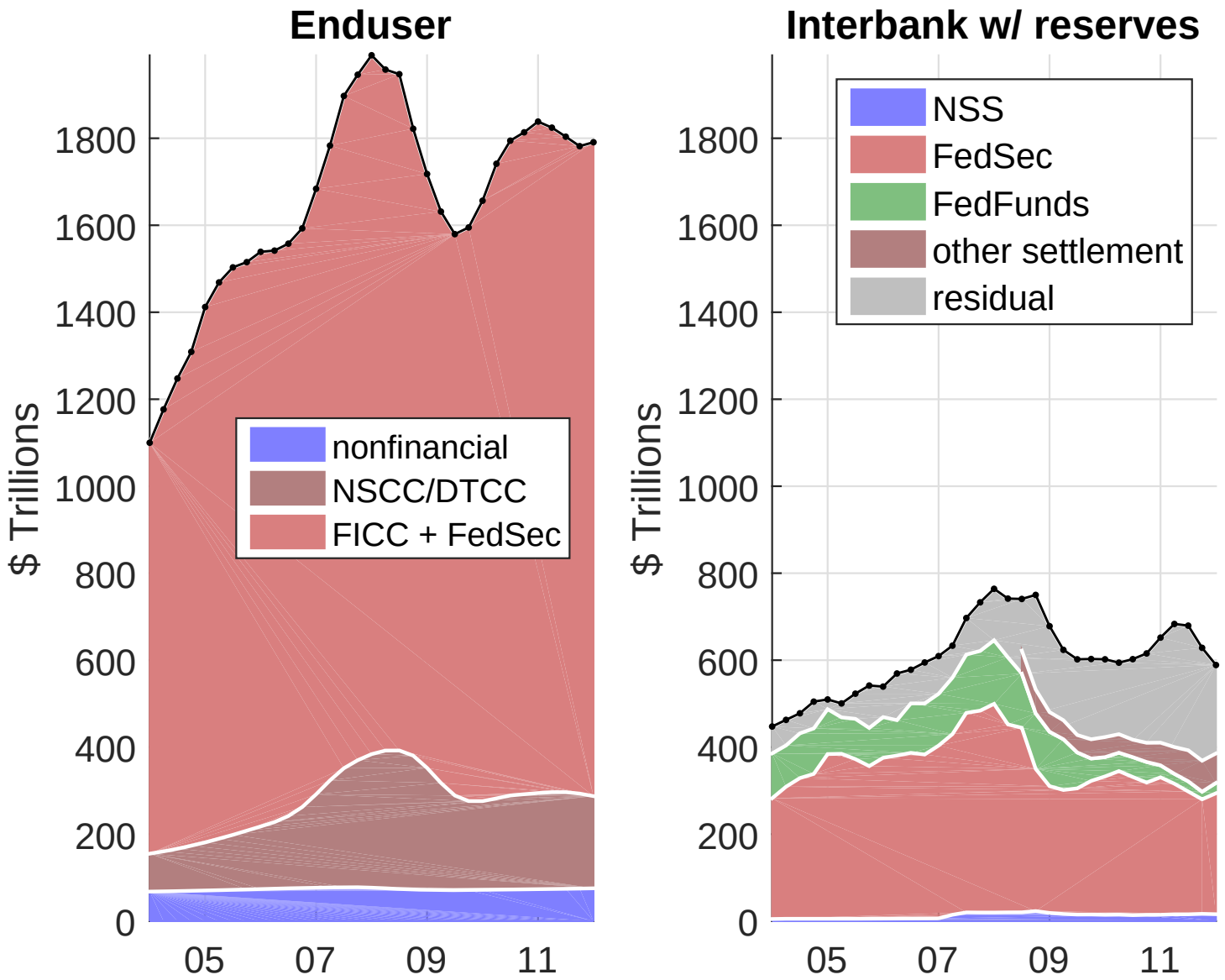
Dollar payments; quarterly at annual rates



Simple model of payments & asset pricing

- Endusers = households & institutional investors
  - pay for goods & assets with payment instruments = inside money
  - payment instruments = deposits, MMF shares, credit lines
- Banks handle enduser payment instructions
  - make interbank payments with reserves = outside money
  - liquidity management: hold reserves or rely on interbank credit?
  - capital structure: liquidity benefit vs leverage cost of pmt instruments
- Government issues debt & reserves, trades in assets

$\Rightarrow$ Questions

- Interaction asset markets vs payment system
- How does policy affect asset prices & nominal price level
- What does an efficient payment system look like?

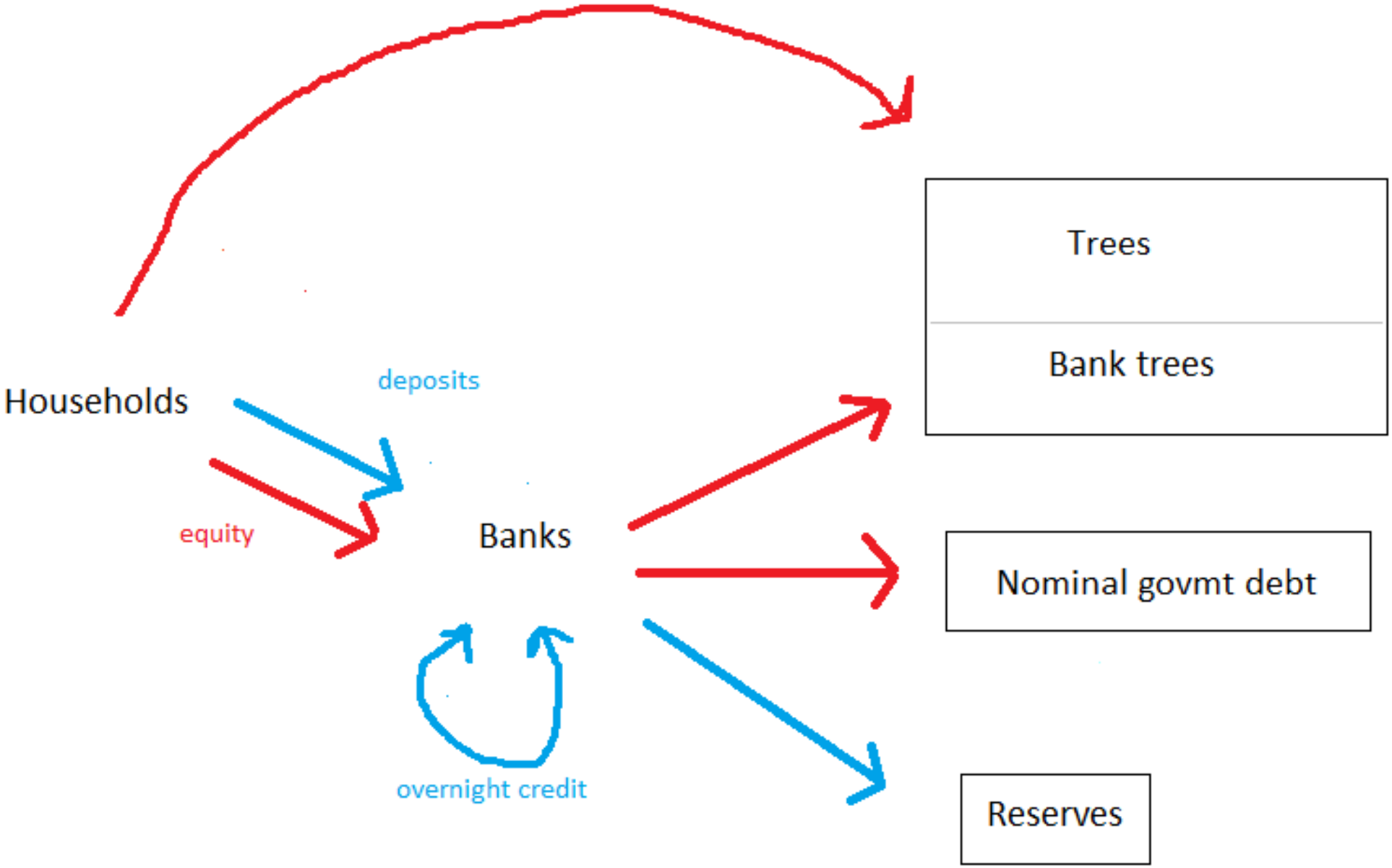
Determination of prices

- Nominal price level: $PT = \bar{v}(D + L)$
  - bank supply of inside money $D + L$
  - T includes institutional investor trades
  - inflation follows from growth rate of nominal govmt liabilities
- Opportunity cost of payment instruments
  - inside money in enduser layer: depends on bank leverage, liquidity cost
  - reserves in bank layer: depends on real return set by government
- Intermediary asset pricing
  - banks' valuation high if collateral scarce
    - ★ endogenous market segmentation
    - ★ e.g. short interest rate priced only by banks
  - active traders' valuation high if inside money cheap

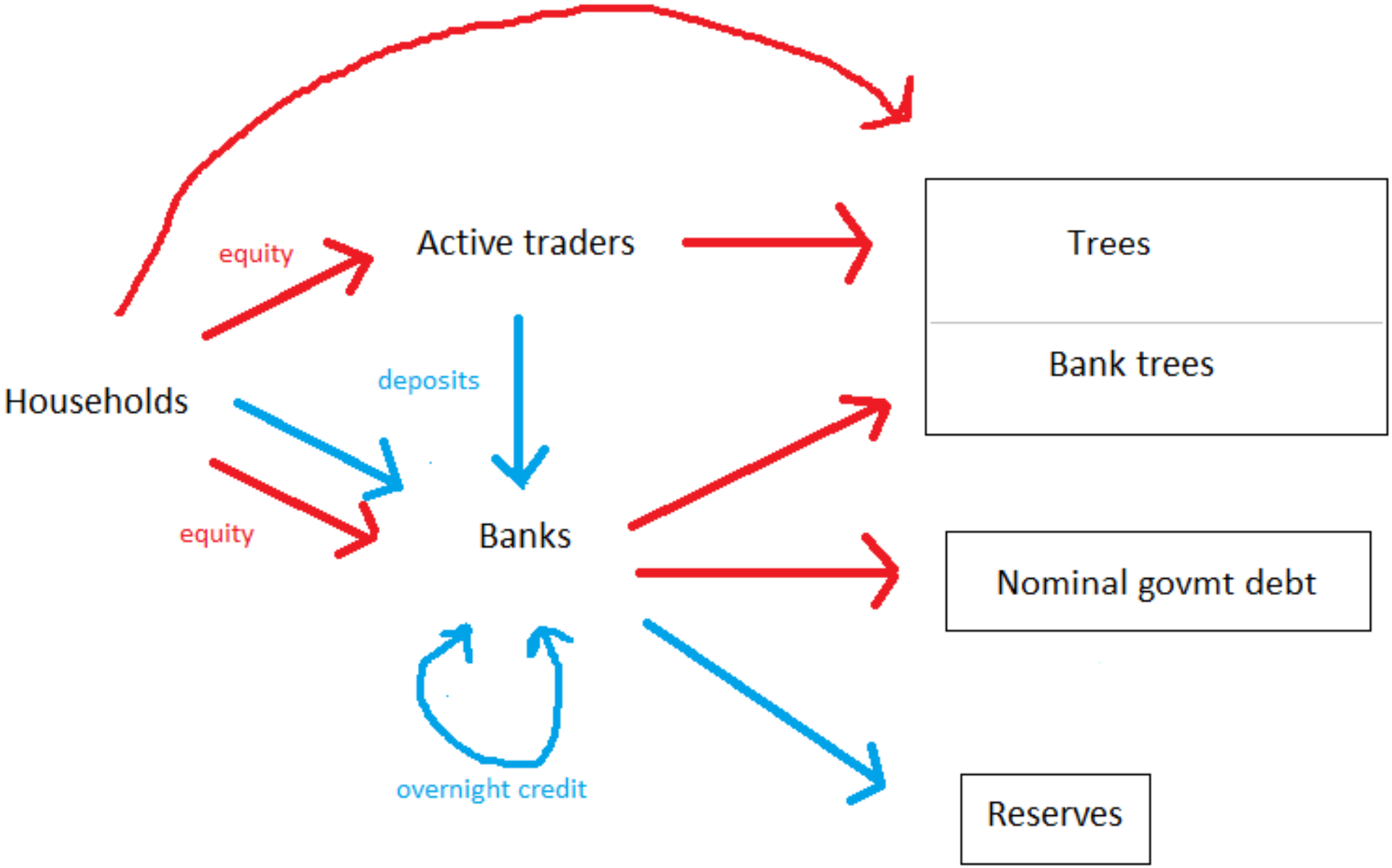
Related Literature

- asset pricing with constrained investors
  Lucas 90, Kiyotaki-Moore 97, Geanakoplos 00, He-Krishnamurthy 12, Buera-Nicolini 14, Lagos-Zhang 14, Bocola 14, Moreira-Savov 14
- monetary policy & financial frictions
  Bernanke-Gertler-Gilchrist 99, Curdia-Woodford 10, Gertler-Karadi 11, Gertler-Kiyotaki-Queralto 11, Christiano-Motto-Rostagno 12, Brunnermeier-Sannikov 14, Jakab-Kumhof 15
- banks & liquidity shocks
  Diamond-Dybvig 83, Bhattacharya-Gale 87, Allen-Gale 94, Holmstrom-Tirole 98, Bianchi-Bigio 14, Drechsler-Savov-Schnabl 14
- multiple media of exchange
  Freeman 96, Williamson 12, 14, Rocheteau-Wright-Xiao 14, Andolfatto-Williamson 14, Chari-Phelan 14, Lucas-Nicolini 15
- interest on reserves
  Sargent-Wallace 85, Hornstein 10, Kashyap-Stein 12, Woodford 12, Ireland 13, Cochrane 14, Ennis 14

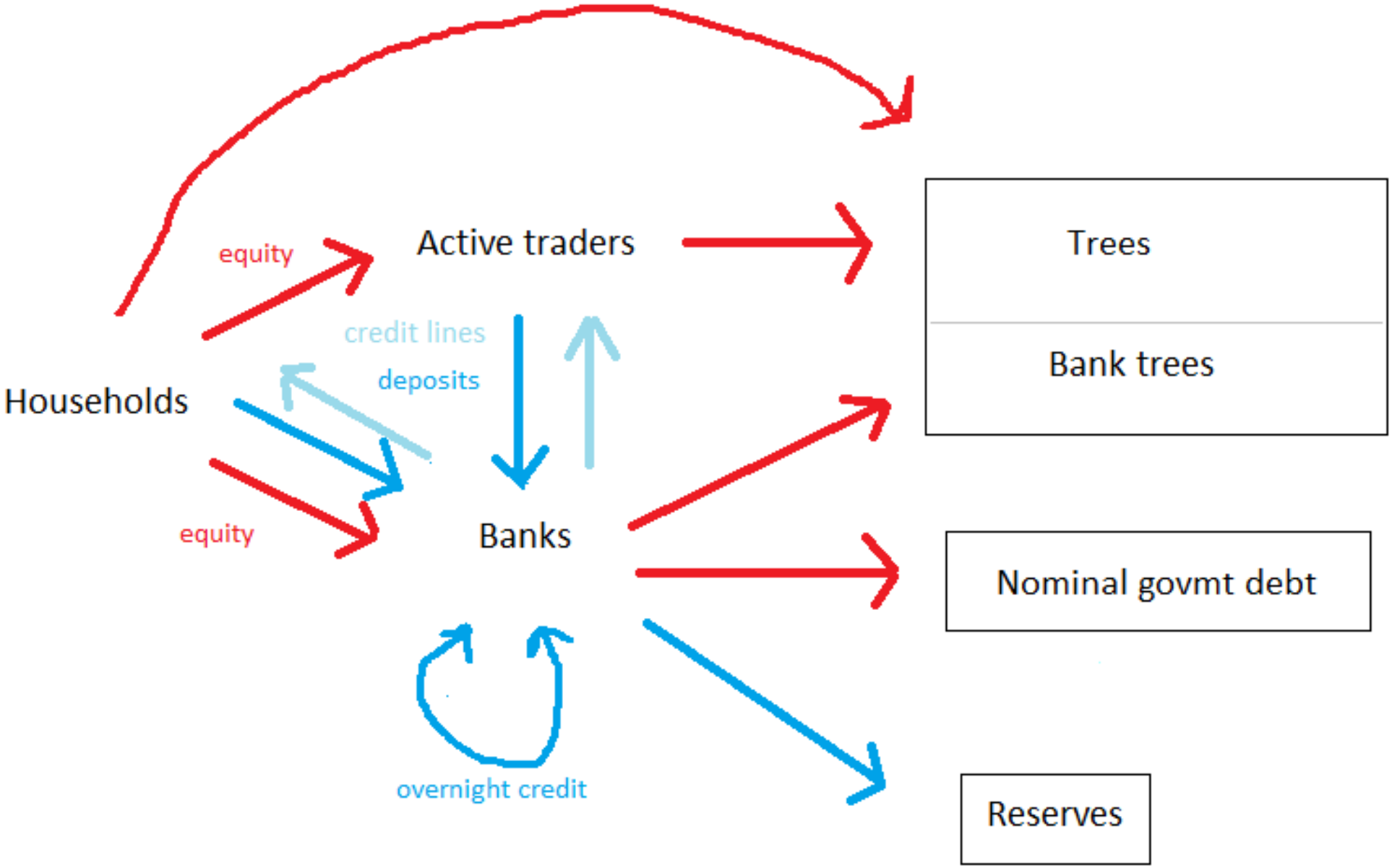
Baseline: only goods transactions require inside money



Extension: asset trades also require inside money



Inside money: deposits & credit lines



Model: enduser layer

- Constant aggregate output
  - mass one of trees, each yields x units of fruit as dividend
  - labor income
- Households
  - risk neutral with discount rate δ
  - can invest in trees, deposits, short credit, bank equity
  - cannot borrow or hold reserves (= numeraire)
- Payments
  - consumption s.t. deposit-in-advance constraint $PC \leq D$
  - equilibrium deposit rate i_D low enough so constraint binds
  - for now: only goods payments
- Capture uncertainty about tree by low payoff expectations
  - households act as if they believe payoffs x decline by s percent
  - can be derived as ambiguity premium (Ilut-Krivenko-Schneider 2015)

Bank layer

Assets		Liabilities	
M	Reserves	Deposits	D
F^+	Fed funds lending	Fed funds borrowing	F^-
B	Govmt bonds	Equity	
$Q^b\theta$	Bank trees		

- Banks owned by households, maximize shareholder value
- nominal shareholder payout

$$\underbrace{M(1+i_R)}_{\text{reserves}} - M' + \underbrace{F\,(1+i)}_{\text{short lending}} - F' + \underbrace{(Q^b + Px)\theta}_{\text{bank trees}} - Q^b\theta' - \underbrace{D\,(1+i_D)}_{\text{deposits}} + D' + \text{leverage costs}$$

- short lending $F = F^+ + B - F^-$
- constant returns & costless adjustment of equity

Bank liquidity management

- Liquidity shocks
  - bank enters with deposits D, reserves M
  - $\tilde{\phi} D$ = net funds sent to other banks (or received if $\tilde{\phi} < 0$)
  - $\tilde{\phi}$ iid across banks, cdf G, $E[\tilde{\phi}] = 0$

- Bank liquidity constraint

$$\tilde{\phi} D \leq \underbrace{M}_{\text{reserves}} + \underbrace{F^{-\prime}}_{\text{overnight credit}}$$

  - threshold rule: borrow overnight iff $\tilde{\phi} > M/D =: \phi$
  - if reserves large relative to deposits, $F^- = 0$ (*abundant liquidity*)

- Optimal liquidity ratio
  - higher opportunity cost of reserves $i - i_R \geq 0 \Rightarrow$ lower ϕ
  - if $i = i_R$, indifferent between short bonds & reserves

Bank capital structure

- Leverage costs
  - resource cost per unit of real debt
  - strictly increasing & convex in leverage ℓ = debt / risk weighted assets
  - lower weight $\rho(s)$ on risker assets
- Optimal leverage
  - issue debt until

    marginal cost of debt = marginal benefit of collateral $\kappa(\ell)$
  - bank Euler equation $\delta = i - \pi + \kappa(\ell)$
  - higher $i \Rightarrow$ collateral is cheap, hold more collateral

    $\Rightarrow$ lower leverage ℓ

Bank optimal choices

Assets		Liabilities	
M	Reserves	Deposits	D
F^+	Fed funds lending	Fed funds borrowing	F^-
B	Govmt bonds	Equity	
$Q^b\theta$	Bank trees		

Banks choose two key ratios

1. Liquidity ratio

$$\phi = \frac{M}{D}$$

2. Collateral ratio

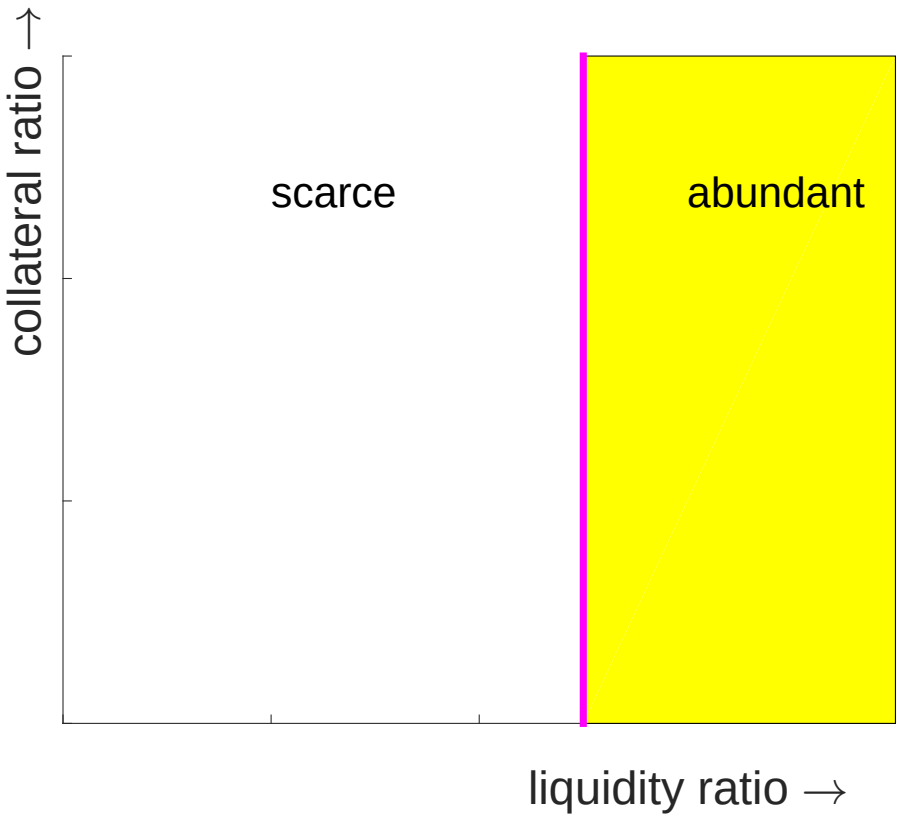
$$\ell^{-1} = \frac{M + F^+ + B + \rho(s)Q^b\theta}{D + F^-}$$

Equilibrium

- Government
  - fix path of nominal liabilities M_g, B_g and reserve rate i_R
  - lump sum transfers adjust to satisfy budget constraint
  - has leverage cost $c_g(\ell_g)$, where $\ell_g = (M_g + B_g)/$ tax base
- Market clearing
  - goods, reserves, overnight credit, deposits, trees
- Steady state equilibria
  - constant output and growth rate of $M, B =$ inflation
  - neutrality: price level $\propto$ reserves
  - reduce to 2 equations in (ϕ, ℓ)
  - comparative statics
  - after unanticipated shock, new steady state reached after one period

Steady state equilibria with goods trade only

- plot collateral and liquidity ratio

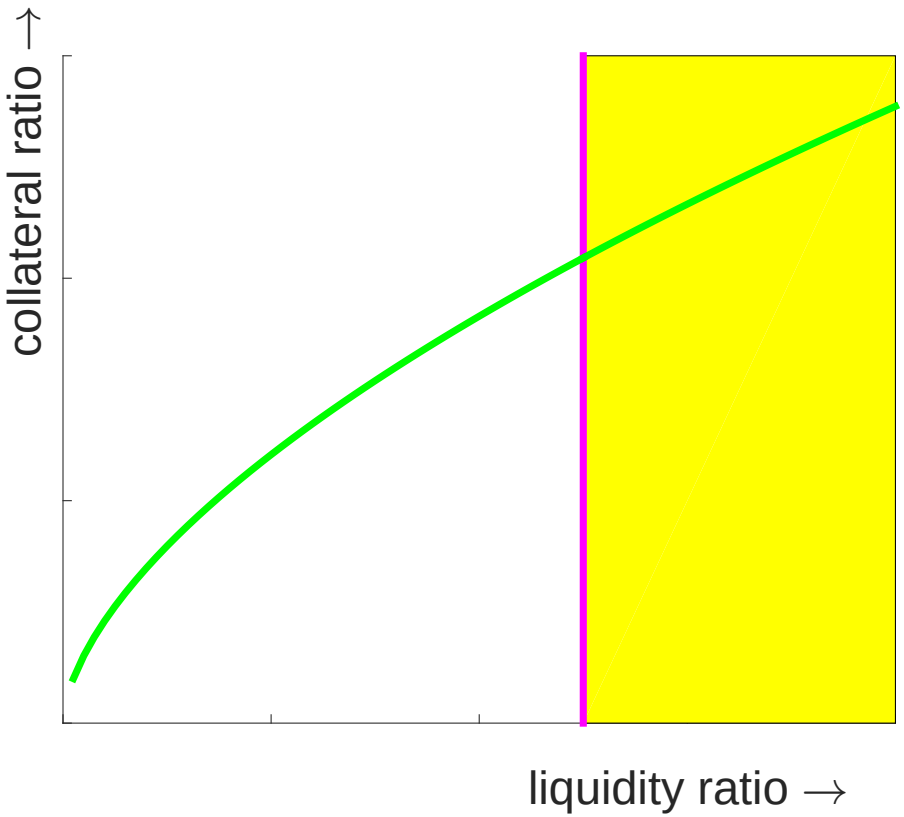


- scarce reserves
  = banks borrow reserves
  if large withdrawal
  (US before 2008)

- abundant reserves
  = banks never borrow
  (US since 2008)

Capital structure curve

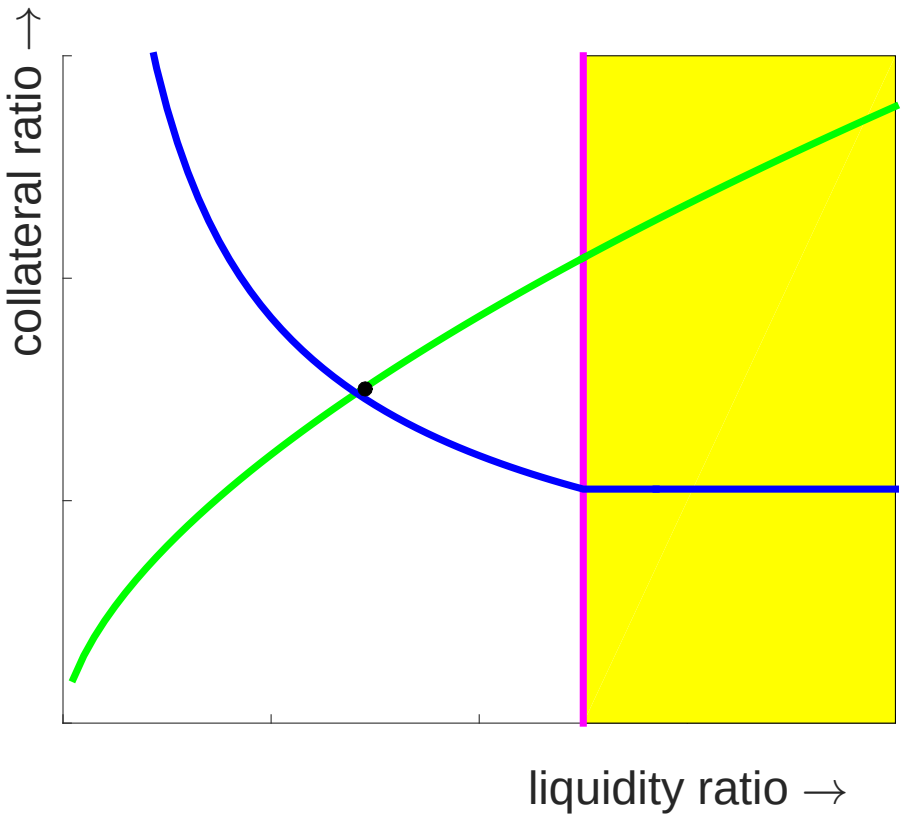
- what collateral is needed to handle transactions T given reserves?
- slopes up: more reserves, more collateral



- depends on gov policy because government changes collateral mix
- steeper with larger share of nominal assets in collateral

Liquidity management curve

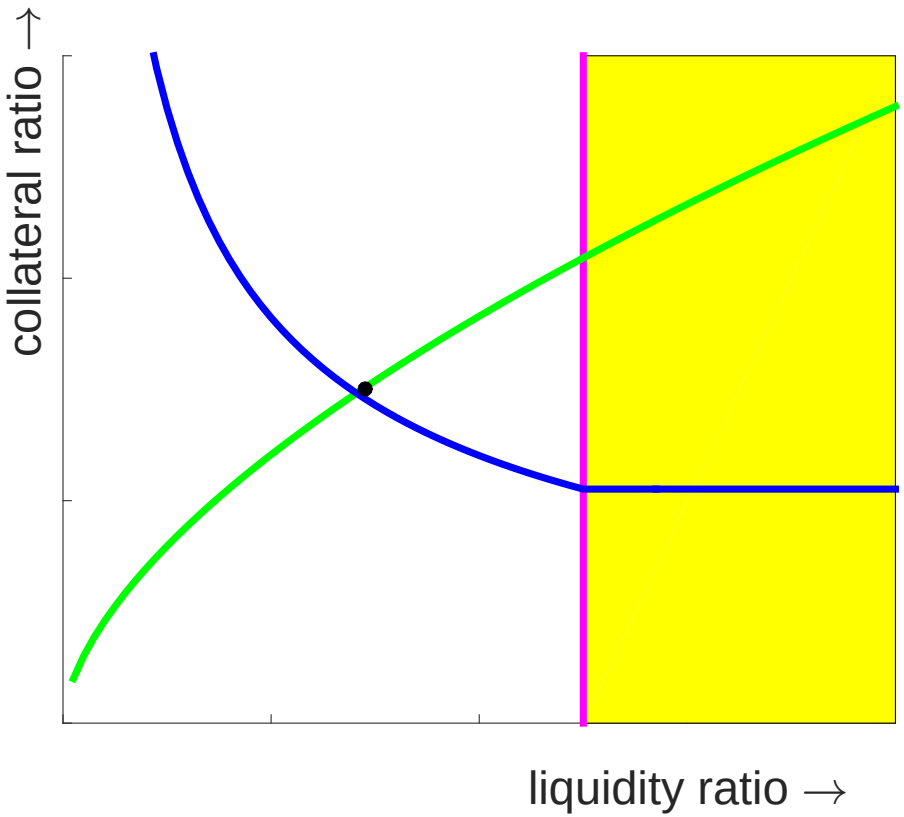
- what collateral holdings maintain return on equity given reserves?
- slopes down: reserves are taxed intermediate input, less collateral



- bank's money demand
  low reserves
  high opp costs $i - i^R$
  high interest rate i
  collateral cheap
  $\Rightarrow$ hold more collateral
- gov chooses i^R, π
- abundant reserves:
  $i = i_R$ is upper bound on collateral prices

Equilibrium

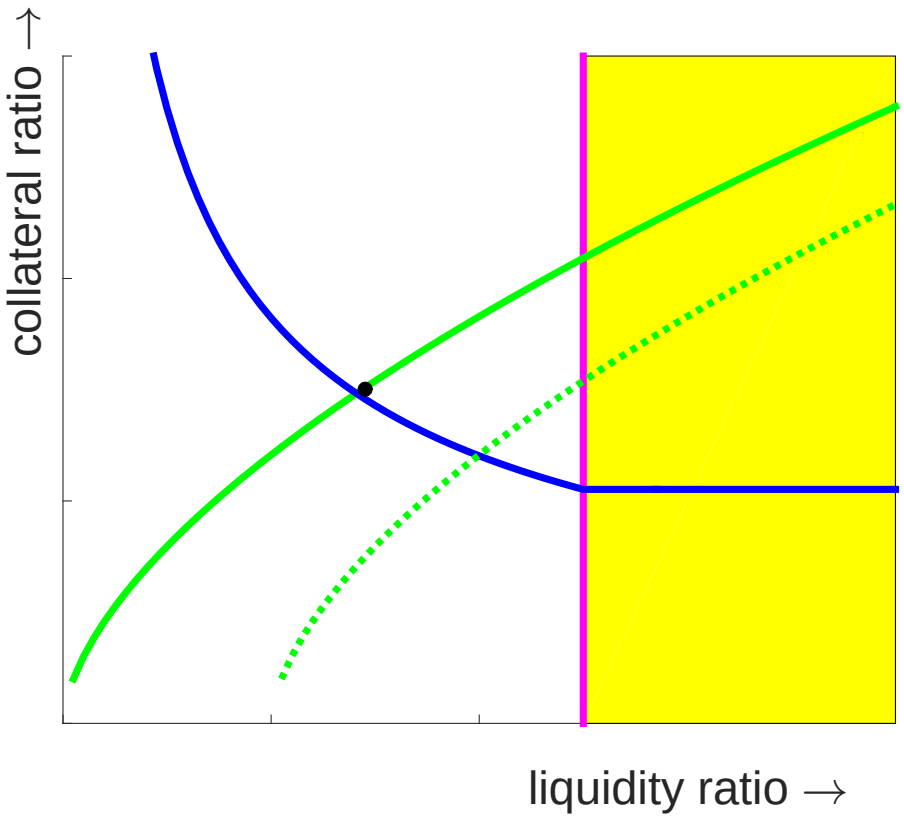
- intersection of the CS and LM curves
- determines equilibrium collateral and liquidity ratios



- also determines equilibrium interest rate and Fed funds credit
- read price level from $PT = D = M/\phi$
- could be in scarce or abundant reserves region

Shifts in capital structure curve

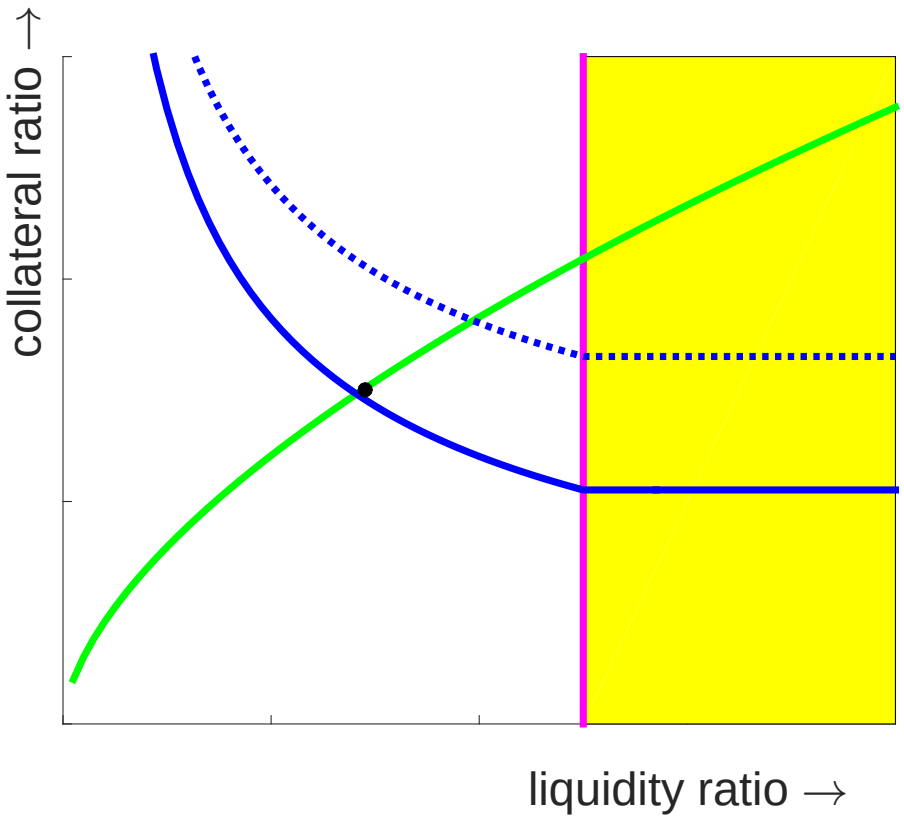
- shifts down: less collateral in banking system



- open market purchase = fewer bonds
- increase in uncertainty about bank trees
- new steady state: lower real interest rate inflationary/deflationary
- large shift makes reserves abundant

Shifts in liquidity management curve

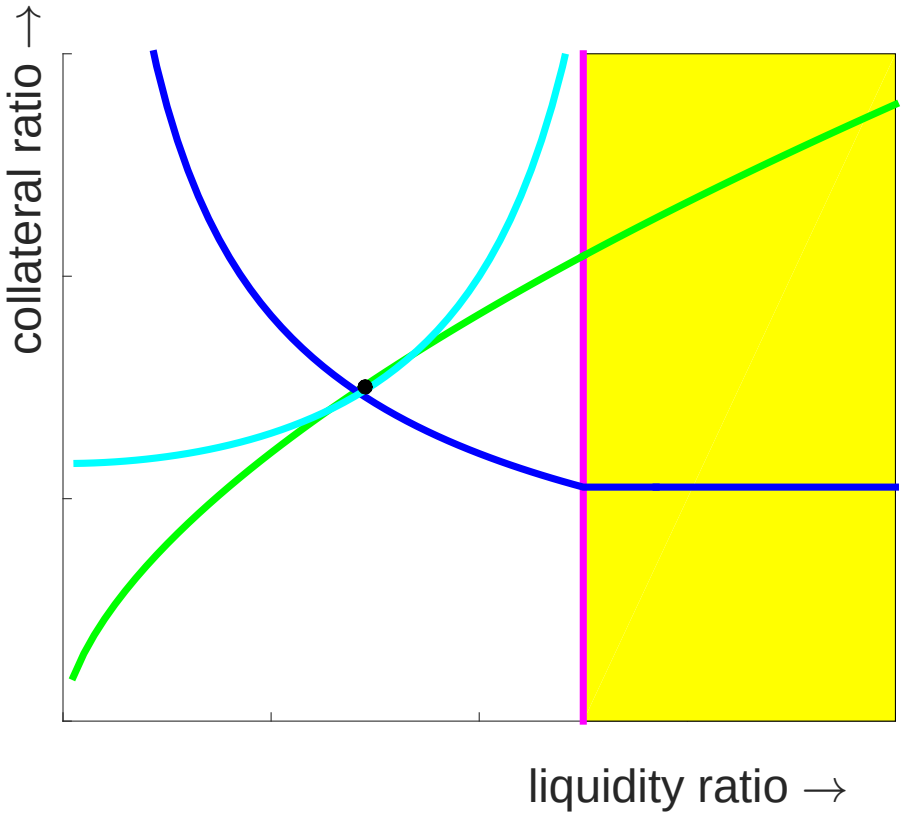
- shifts up: higher real return on reserves
- lower tax on reserves: can afford to hold more collateral and still maintain return on equity



- higher interest on reserves or lower growth rate of nominal reserves
- new steady state real rate increases deflationary
- large shift makes reserves abundant, policy tools: unconventional monetary policy, real return on reserves

Optimal policy

- Minimize total cost of leverage = move towards origin
- Trade off bank vs government leverage



- abundant reserves optimal only if government borrowing cheap
- select optimal equilibrium by picking real return on reserves

Active traders

- Competitive firms owned by household
  - issue equity, invest in deposits & subset of trees
  - each firm optimistic about one tree,
    perceive lower uncertainty s than households and other traders
  - identity of favorite tree within subset changes with probability $\hat{\nu} \leq 1$
  - all trades must be paid with deposits or intraday credit
- budget constraint ($z = 1$ if identity of favorite tree changes)

$$z\hat{Q}\theta' = I + \hat{D}$$

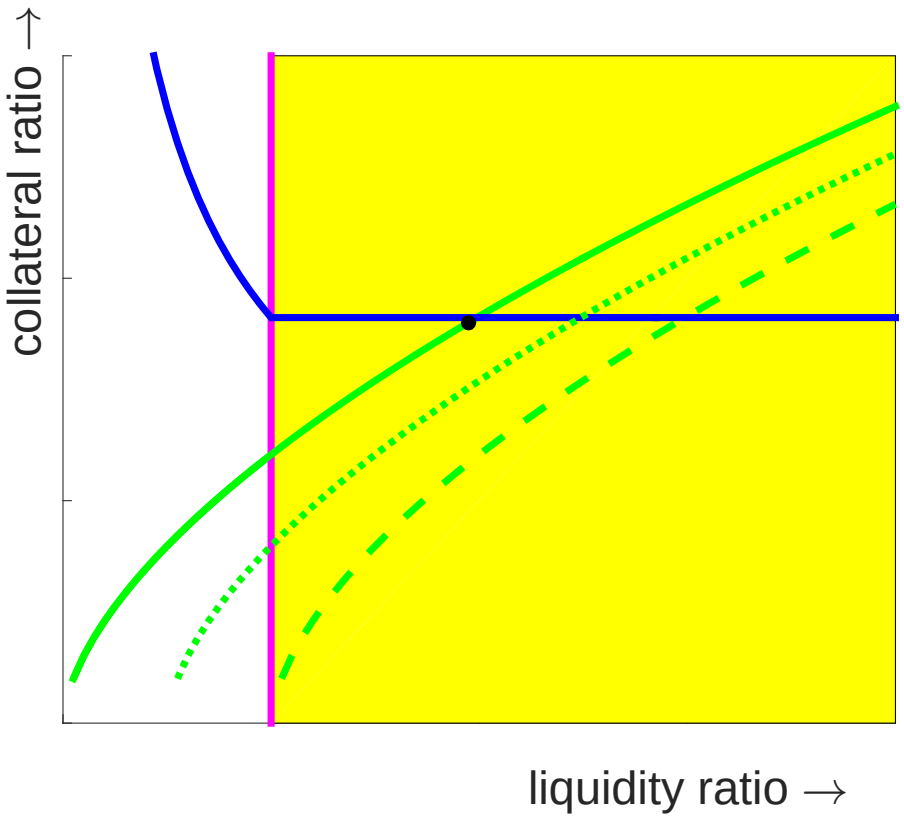
- limit on intraday credit

$$I \leq \hat{\gamma}\hat{D}$$

  limit binds if $i_D - \pi < \delta$

Increase in uncertainty with active traders

- Shift down: bank collateral worth less
- Shift up: lower demand for inside money from active traders



- forces on price level:
  less inside money supply
  less inside money demand
- details of financial structure matter!

Summary of main results

- Interaction securities markets vs payment system
  - value of banks' collateral $\rightarrow$ supply of inside money
  - value of institutional investor trades $\rightarrow$ demand for inside money
- Government policy tools
  1. set real return on reserves = tax on intermediate input
  2. change mix of collateral by issuing or trading securities
  - both affect collateral & liquidity benefits on assets
    - ★ permanent effects on real asset prices
    - ★ policy stance cannot be summarized by interest rates alone
- Scarce vs abundant reserves?
  - select by setting interest on reserves, nominal liabilities
  - optimal policy depends on government vs bank leverage costs