Liquidity, liquidity everywhere, not a drop to use

Why flooding banks with central bank reserves may not expand liquidity

- Viral V Acharya (NYU Stern) and Raghuram G Rajan (Chicago Booth)

November 2021

Where did all the liquidity go?

- Unprecedented expansion of central bank balance sheets since the GFC
  - "flooding banks with central bank reserves"

- Effects on economic activity modest, evidence mixed on the working of unconventional channels (such as "portfolio balance")
  - Fabo, Jancokova, Kempf, and Pastor (2021), Diamond, Jiang, and Ma (2021)

- Surprisingly fragile liquidity conditions in money markets
  - Unexpectedly large spikes in repo markets in September 2019:
    - Encumbrances on liquidity, exogenous shrinkage, unwinding of levered trades in Treasuries
  - Dash for cash in March 2020:
    - Corporate credit line drawdowns on banks, lack of adequate market-making

- Liquidity, liquidity everywhere -> Yet bigger liquidity injections in future?
  - Does the ex-ante supply of reserves affect the ex-post demand for them?
  - Liquidity dependence

Traditional view: Exogenous demand for liquidity

Price of Liquidity in Stress =

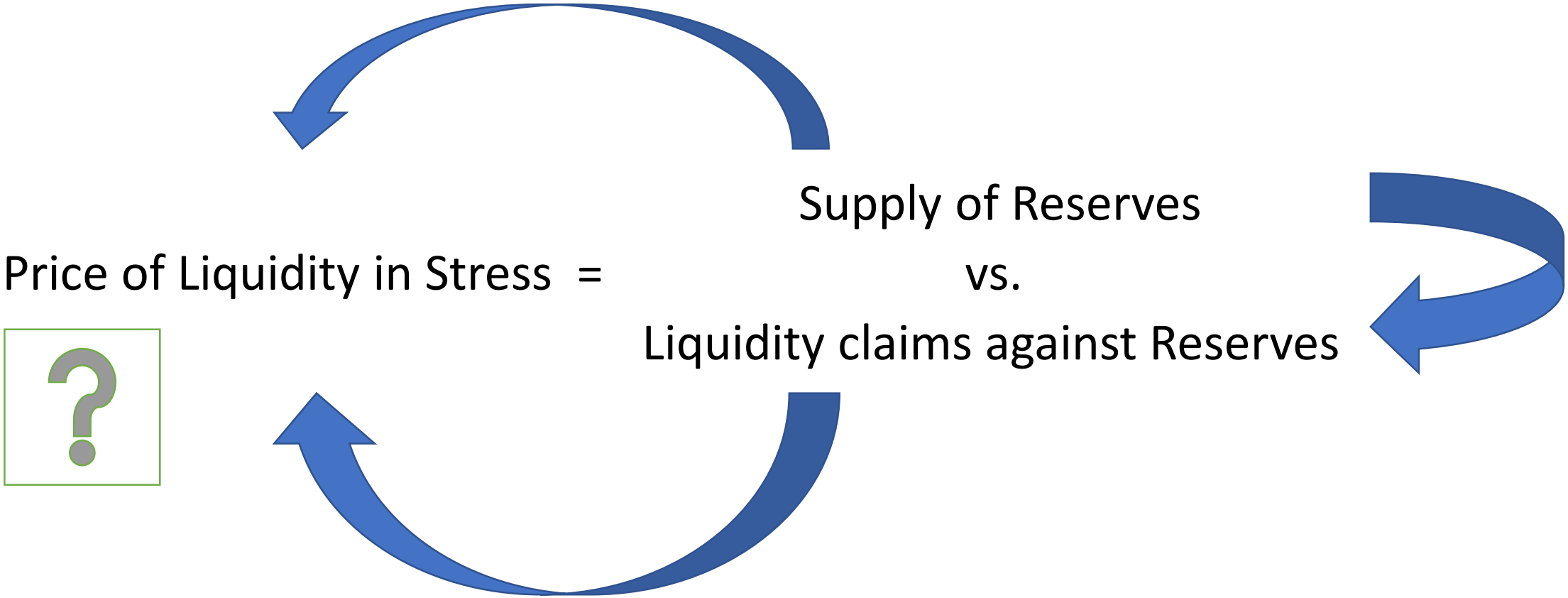
Supply of Reserves

vs.

Exogenous demand for liquidity

- As demand is exogenous, increasing supply of reserves is stabilizing

Liquidity dependence is endogenous to reserves



- <u>Supply of reserves creates its own demand, which can destabilize</u>

Three important considerations

I. *Ex ante*: How are the reserves financed?

- When reserves are injected via asset purchases from non-banks, they typically deposit reserves in banks
- Do banks rebalance these deposits with new equity issuances, or are reserves financed with deposits (and deposit-like) claims?
  - Reserves may also be swapped directly against bank assets; as reserves are short-term in nature, do banks maturity-match their liability structure with more deposits?
  - Or do they readjust liabilities toward the longer term?

- The way reserves are financed matters as <u>demand deposits will be a claim on reserves in future</u>

Some evidence on the financing of reserves

QE III (between September 2012 and October 2014) In million $

Assets		**Liabilities**	
Cash	11,191	Bonds	-112,030
Debt Securities	504,642	Holding company investment	332,381
Loans	804,170	Commercial paper	-86,743
misc	-64,076	Loans	108,019
Repos	-29,398	Miscellaneous	184,540
Reserves	713,351	Insured deposits	-810,496
		Uninsured deposits	2,528,429
	1,939,880		2,144,100

Deposits/Total Liabilities	0.80124
Deposits/(Cash+Securities+ Repos+ Reserves)	1.43187
Deposits/(Repos+Reserves)	2.51177
Uninsured deposits/(Repos+ Reserves)	3.69679
Uninsured deposits/(Uninsured+ insured deposits)	1.47179

Change / Change

Some evidence…

Pandemic (between March 2020 to end 2020) In million $

Assets		**Liabilities**	
Cash	15,843	Bonds	26,083
Debt Securities	1,041,056	Holding company investment	202,606
Loans	289,404	Commercial paper	26,651
misc	272,661	Loans	-227,272
Repos	179,821	Miscellaneous	-125,790
Reserves	1,282,417	Insured deposits	1,317,938
		Uninsured deposits	1,719,650
	3,081,202		2,939,866

Deposits/Total Liabilities	1.03324
Deposits/(Cash+Securities+ Repos+ Reserves)	1.20581
Deposits/(Repos+Reserves)	2.07736
Uninsured deposits/(Repos+ Reserves)	1.17604
Uninsured deposits/(Uninsured+ insured deposits)	0.56612

Change / Change

Three important considerations

II. *Ex post*: Are the reserves free to move around to meet claims?

- Unused liquid reserves are a drain on bank profits – typically their liquidity services are sold so they are “fully” utilized.

- Speculation: reserves may create their own demand by spurring risk-taking and the associated need for margins, central clearing guarantee funds, etc.

- Regulation: liquidity requirements “lock up” reserves in stress scenarios (Diamond and Kashyap, 2016; Vandeweyer, 2019; others)

- Ratcheting: reserves supply creates its own supervisory demand (Nelson, 2019)

Drivers of shrinkage in reserves

- Speculation
  - Barth and Kahn (2021): Build-up of leveraged Treasury positions during 2013 ($200 bln) to 2019 ($800 bln), with a blow-up in March 2020
  - Yankov (2020): LCR announcement in 2010 and implementation starting 2014 coincident with increase in bank credit line provision to shadow banks

- Regulation (intra-day liquidity and resolution-planning requirements):
  - Jamie Dimon, CEO of JP Morgan, on 2019 repo-market "rate spike" episode:

  "[...] we have $120 billion in our checking account at the Fed, and it goes down to $60 billion and then back to $120 billion during the average day. But we believe the requirement under CLAR and resolution and recovery is that we need enough in that account, so if there's extreme stress during the course of the day, it doesn't go below zero." (D'Avernas and Vanderweyer (2021))

Three important considerations

III. *Ex post*: Will banks with free reserves lend them out?

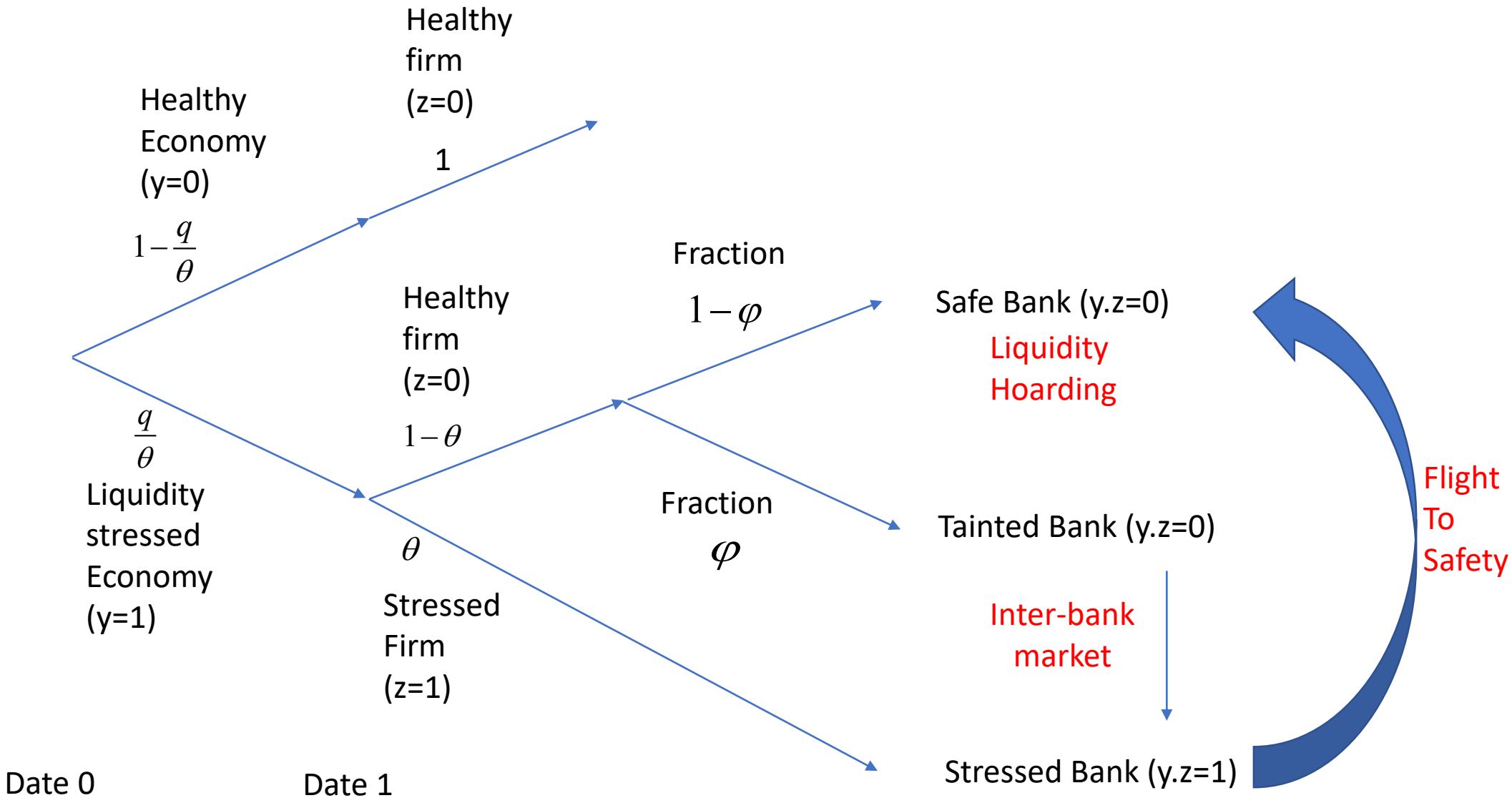
- Fear of “taint” in surplus banks

- Receive flight-to-safety deposits passively, rather than lend out reserves in inter-bank markets actively
  - Acharya and Mora (2015): Only stressed banks sought to raise deposits actively
  - Copeland, Duffie and Yang (2021): High-reserve balance banks delayed inter-bank payments

- Effectively, there can be a “convenience yield” on reserves during times of stress

- Liquidity hoarding: Only some surplus banks will lend and become “tainted”, while others will hoard reserves, be seen as safe, and get “flight-to-safety” deposits.

A Sketch of the Model…



Firm Balance Sheet at Date 0	
Assets	**Liabilities**
I_0	L_0^F
D_0^F	W_0^F
	Net worth

Bank Balance Sheet at Date 0	
Assets	**Liabilities**
$L_0^B + \frac{1}{2}\lambda(L_0^B)^2$	D_0
S_0	e_0
	Net worth

Run to "safe" banks

Firm Balance Sheet at Date 1 if stressed	
Assets	**Liabilities**
I_1	l_1^F
	L_0^F
	Net worth

Rescue investment, Redeposited In "safe" banks

Bank Balance Sheet at Date 1 if bank stressed	
Assets	**Liabilities**
$L_0^B + \frac{1}{2}\lambda(L_0^B)^2$	Possible interbank borrowing = b_1
τS_0	e_1
$l_1^B \quad (= l_1^F)$	e_0
	Net worth

Encumbrance on reserves

Liquidity Demand at date 1

Firm Balance Sheet at Date 0

Assets	Liabilities
I_0	L_0^F
D_0^F	W_0^F
	Net worth

Bank Balance Sheet at Date 0

Assets	Liabilities
$L_0^B + \frac{1}{2}\lambda(L_0^B)^2$	D_0
S_0	e_0
	Net worth

Firm Balance Sheet at Date 1 if healthy

Assets	Liabilities
I_0	L_0^F
D_0^F	W_0^F
	Net worth

Bank Balance Sheet at Date 1 if bank healthy, economy stressed

Assets	Liabilities
$L_0^B + \frac{1}{2}\lambda(L_0^B)^2$	D_0
Interbank loans of up to $e_1 + (1-\tau)S_0$	e_1
	e_0
Reserves of $(S_0 + e_1$ -interbank loans)	Net worth

Liquidity Supply →

Shrinkage of reserves →

"Tainted" Bank

Symmetric Rational Expectations Equilibrium

- The market for term loans clears at date 0 (taking r_1 as given)
- The market for spot loans clears at date 1 at r_1.
- Capital supplies the residual: $e_1 = \alpha_1^{-1} r_1$

$$\left[\varphi(1-\theta)+\theta\right]\alpha_1^{-1} r_1 = \theta\left[I_1 + (D_0 - D_0^F)\right] - \left[\varphi(1-\theta)+\theta\right] S_0(1-\tau)$$

Additional liquidity raised via equity issuances

Firm's Investment demand

Retail Depositor run ("leakage")

Unencumbered liquidity with deficit and tainted banks

- How does the equilibrium rate r_1 change with the level of reserves?

Equilibrium

- The market for term loans clears at date 0 (taking r_1 as given)
- The market for spot loans clears at date 1 at r_1.
- Capital supplies the residual: $e_1 = \alpha_1^{-1} r_1$

$$\left[\varphi(1-\theta)+\theta\right]\alpha_1^{-1} r_1 = \theta\left[I_1 + (D_0 - D_0^F)\right] - \left[\varphi(1-\theta)+\theta\right] S_0(1-\tau)$$

Increases one for one in S0

What matters therefore is whether…

$$\theta > \frac{\varphi(1-\tau)}{\tau + \varphi(1-\tau)}$$

- If inter-bank market shut ($\varphi = 0$), inter-bank rate *always* increases in reserves
- If inter-bank market fully open ($\varphi = 1$), then this is so whenever $\theta > (1-\tau)$

$$\theta < \frac{\varphi(1-\tau)}{\tau + \varphi(1-\tau)}$$

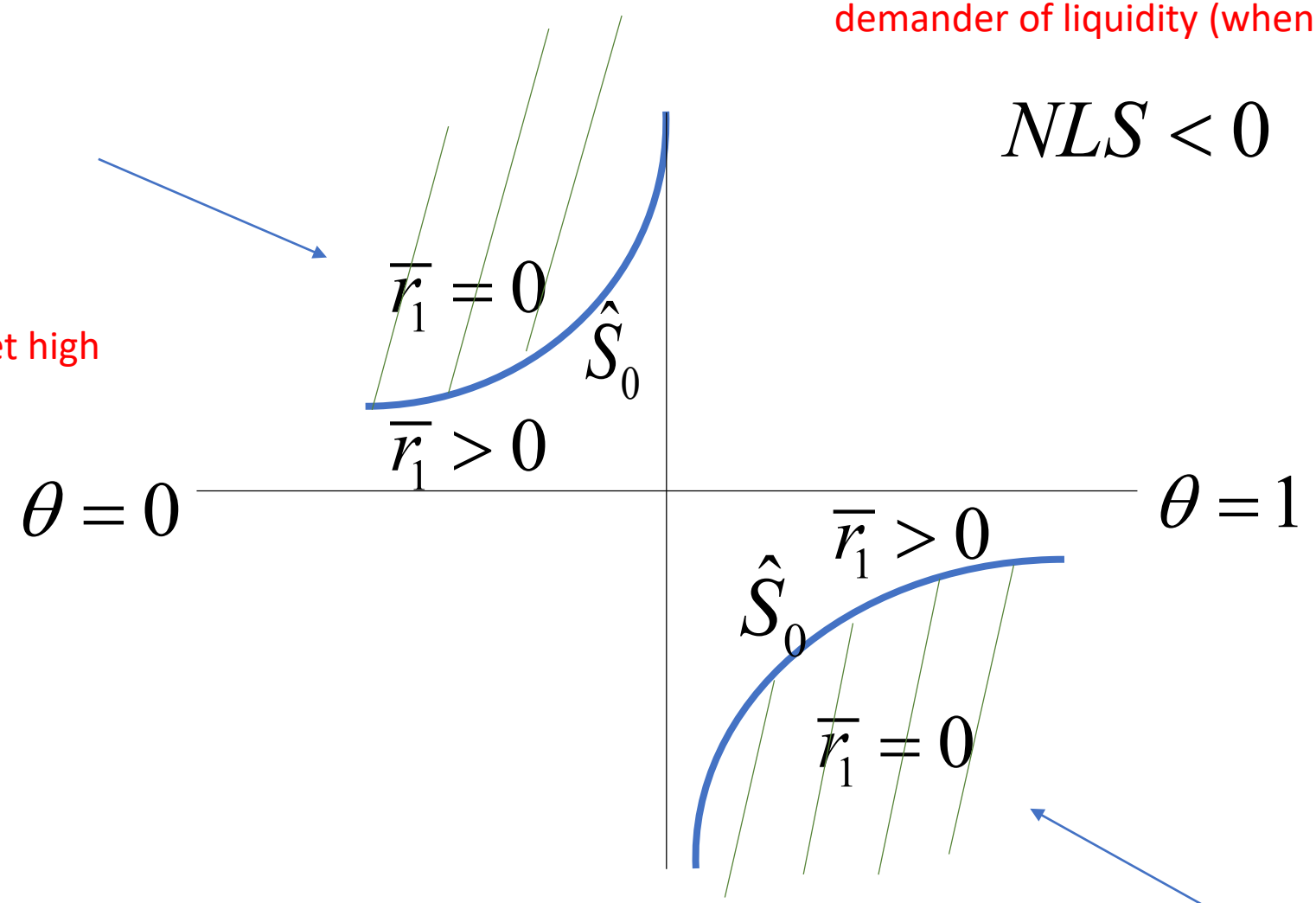
Low aggregate risk,
Low shrinkage,
Low hoarding

Reserves must be set high

Standard Intuition

Corporate sector is a net demander of liquidity (when r_1 = 0)

$$NLS < 0$$



High aggregate risk,
High shrinkage,
High hoarding

Reserves must be set low

Counterintuitive result

$$\theta > \frac{\varphi(1-\tau)}{\tau + \varphi(1-\tau)}$$

Our primary insight

- When liquidity stress materializes the apparent comfort provided by a high level of reserves vanishes
  - Deposits issued to finance reserves demand liquidity (“dash for cash”)
  - Part of the reserves remain encumbered for speculation/regulation purposes
  - Surplus banks may prefer to hoard liquidity to benefit from flight to safety
- Ordinarily, this will mean there is far less spare liquidity than suggested by the simple reserve expansion
- In *extremis*, the higher the reserves issued ex ante, more fragile the money markets and higher the inter-bank rates in stress
  - Adverse real consequences on investments (ex post as well as ex ante)
  - Banks do not internalize these externalities (Lorenzoni, 2008; Stein, 2012)

Does this matter? Yes, alters policy prescriptions

- Seeing ex post stress, some economists recommend
  - More central bank balance-sheet expansion (Copeland, Duffie and Yang, 2021)
  - Lower ex-ante capital requirements, especially against reserves (Liang and Parkinson, 2020)

- What seems sensible ex post could aggravate the problem ex ante.

- Monetary policy and financial stability at conflict in setting the level of reserves?
- Reserve issuance may not crowd out private deposit-like claims, may in fact enhance it, as the evidence shows.
  - Contrast with Stein (2012); Greenwood, Hanson and Stein (2015), (2016).

- Limiting central bank balance-sheet size ("reversal size") may be an important part of its prudent management of financial fragility risks.

Ex-post central bank interventions

- Crowd out private ex-post lending by surplus banks
- Interventions require collateral
  - Eligible collateral? Duration? Maturity matching of assets and liabilities?
  - Stigma in borrowing from the central bank facilities?
- Unsecured interventions
  - In principle, can solve all money-market problems, BUT… typically distort asset prices
- Ex-ante moral hazard
  - Create greater balance sheet illiquidity, insolvency, and herding by banks
    - Acharya, Shin and Yorulmazer (2011), Diamond and Rajan (2012), Farhi and Tirole (2011)

"When Norges Bank keeps reserves relatively high for a period, it appears that banks gradually adjust to this level… With ever increasing reserves in the banking system, there is a risk that Norges Bank assumes functions that should be left to the market. It is not Norges Bank's role to provide funding for banks…If a bank has a deficit of reserves towards the end of the day, banks must be able to deal with this by trading in the interbank market."

Conclusion

Large central bank balance-sheet -> Liquidity dependence of the financial system

Reserves supply creates its own ex-post demand for reserves, limiting the central bank's ability to use balance-sheet size for financial stability and growth

Conflict between monetary policy and financial stability objectives?

Limits on central bank balance-sheet size from financial stability perspective?

Shadow banking and maturity-matching

- What if reserves are allowed to be held by non-banks (RRP facilities)?

- Shadow banks likely to maturity-match assets and liabilities
  - The risk of rollover costs on deposits; higher premia in long-term financing
  - More short-term assets facilitate greater short-term liabilities

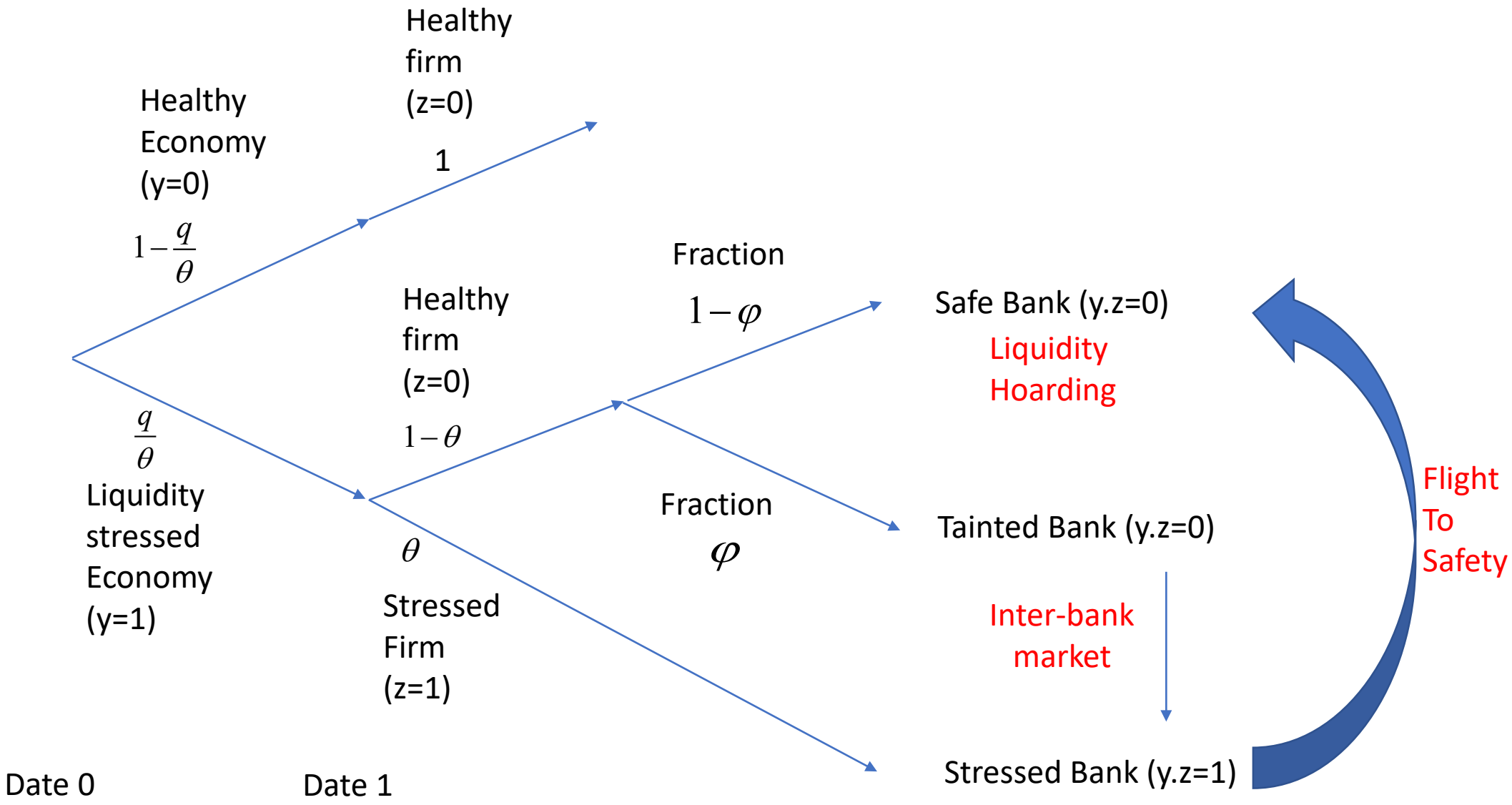
- Simply raising capital requirements on banks may not suffice
- Both reserves and deposit-financing of reserves move to shadows
  - Reinstatement in April 2021 of the Supplementary Leverage Ratio on banks
  - Banks “pushing away” reserves and corporate deposits to money market funds

Model

Firms, Banks, Investors, … Money markets to shuffle around liquidity

Liquidity stress in the economy

- Banks and firms “regionally” or “sectorally” matched
- Firms and banks owners are risk-neutral, expected profit-maximizers
- State of the economy (y)
  - Stress with probability q / θ
  - Some investments may fail at date 2
- State of each bank-firm pair (z)
  - Conditional on stress, with probability θ
  - Unconditionally, w.p. q
- Only a fraction φ of surplus banks supply liquidity to stressed banks
  - Fear of being “tainted” if reserve balances are low; exogenous, but endogenized later
- y and z once resolved are common knowledge to all agents


Healthy
Economy
(y=0)
$1-\frac{q}{\theta}$
Healthy
firm
(z=0)
1
Liquidity
stressed
Economy
(y=1)
$\frac{q}{\theta}$
Healthy
firm
(z=0)
$1-\theta$
Stressed
Firm
(z=1)
θ
Fraction
$1-\varphi$
Fraction
φ
Safe Bank (y.z=0)
Liquidity
Hoarding
Tainted Bank (y.z=0)
Inter-bank
market
Stressed Bank (y.z=1)
Flight
To
Safety
Date 0
Date 1

Firms, Banks, Depositors, Investors

- Firms:

  - Invest at date 0 to obtain returns at date 2 , funded by
    - Firm owners' initial wealth
    - Term loans from banks

  - Place deposits with bank (equivalent to committed line of credit, net of fees)

  - Rescue investment at date 1 with probability *q,* funded by
    - Firm withdrawing its bank deposit
    - Firm borrowing in spot bank loan market

  - Rescue investment repays high return in expectation, making up for loss on initial investment

  - But… non-zero probability of no return (Stein 2012)

Firms, Banks, Depositors, Investors

- Banks:
  - Assets
    - Illiquid term loans
    - Liquid reserves that "shrink/are encumbered" at date 1 (τ, exogenous for now…)
  - Liabilities I: (Unlimited) Uninsured deposits from risk-averse investors at date 0
    - Log-utility investors as in Stein (2012)
    - If they anticipate default at date 2 -> Run at date 1 in case of stress (Acharya-Mora, 2015)
    - Deposits must be paid in full in case of stress at date 1 even when the bank is solvent
    - Runs -> Flight of safety of deposits and rescue loans to fraction $1-\varphi$ of "untainted" surplus banks
  - Liabilities II: (Limited) capital from risk-neutral investors with due-diligence costs
    - At date 1, only stressed and "tainted" surplus banks issue capital
    - "Safe" banks stay passive recipients of flight-to-safety deposits (Acharya and Mora, 2015)

Firms, Banks, Depositors, Investors

- Interest rates
  - Common discount rate is zero throughout, but …
  - Spot bank loans at date 1 to firms are at $1 + r_1 + \gamma$
    > Premium due to compensation for monitoring costs in stress scenario
  - Deadweight costs of capital issuance: $\frac{\alpha_t}{2} e_t^2$ at date 2 due to due diligence, agency
- Date-1 equity issuances transfer reserves from “safe” banks
  - Other assumptions would raise date-1 money-market rate even higher

Firm Balance Sheet at Date 0	
Assets	**Liabilities**
I_0	L_0^F
D_0^F	W_0^F
	Net worth

Bank Balance Sheet at Date 0	
Assets	**Liabilities**
$L_0^B + \frac{1}{2}\lambda(L_0^B)^2$	D_0
S_0	e_0
	Net worth

Run to "safe" banks

Firm Balance Sheet at Date 1 if stressed	
Assets	**Liabilities**
I_1	l_1^F
	L_0^F
	Net worth

Rescue investment, Redeposited In "safe" banks

Bank Balance Sheet at Date 1 if bank stressed	
Assets	**Liabilities**
$L_0^B + \frac{1}{2}\lambda(L_0^B)^2$	Possible interbank borrowing = b_1
τS_0	e_1
$l_1^B \quad (= l_1^F)$	e_0
	Net worth

Encumbrance on reserves

Liquidity Demand at date 1

Firm Balance Sheet at Date 0

Assets	Liabilities
I_0	L_0^F
D_0^F	W_0^F
	Net worth

Bank Balance Sheet at Date 0

Assets	Liabilities
$L_0^B + \frac{1}{2}\lambda(L_0^B)^2$	D_0
S_0	e_0
	Net worth

Firm Balance Sheet at Date 1 if healthy

Assets	Liabilities
I_0	L_0^F
D_0^F	W_0^F
	Net worth

Bank Balance Sheet at Date 1 if bank healthy, economy stressed

Assets	Liabilities
$L_0^B + \frac{1}{2}\lambda(L_0^B)^2$	D_0
Interbank loans of up to $e_1 + (1-\tau)S_0$	e_1
	e_0
Reserves of $(S_0 + e_1$ -interbank loans)	Net worth

Liquidity Supply →

Shrinkage of reserves →

"Tainted" Bank

Firm's problem

- Date 0:

Term loan

$$\underset{L_0^F, D_0^F}{Max}\ (1-q)\left[g_0(I_0)+D_0^F\right]+q\left[g_1(I_1)-l_1^F\left(1+\gamma+r_1\right)\right]-R_0^L L_0^F$$

Spot loan

- Date 1:

$$\underset{l_1}{Max}\ g_1(I_1)-l_1^F\left[1+\gamma+r_1\right]$$

Rescue investment due to illiquidity
(risky at date-2 but no date-1 solvency concerns)

- Budget constraints:

$$\text{s.t. } I_0 = L_0^F + W_0^F - D_0^F \text{ and } I_1 = l_1^F + D_0^F$$

Bank's problem

$$\underset{L_0^B, e_0, e_1}{Max}\; R_0^L L_0^B + S_0 - e_0 - \frac{\alpha_0}{2} e_0^{\,2}$$

Inter-bank position

$$+ E_0\left[-e_1(y,z) - \frac{\alpha_1}{2}\left(e_1(y,z)\right)^2 - (1 + r_1(y)) b_1(y,z) - (1 - yz) D_0 \right]$$

s.t. $D_0 + e_0 = L_0^B + \tfrac{1}{2}\lambda (L_0^B)^2 + S_0$

Term loan costs

Deposits are decided residually based on capital issuance;
It will turn out that deposits increase one for one with reserves

$b_1(y,z) = yzD_0 - yS_0(1-\tau) - e_1(y,z)$ if deficit or tainted bank; exogenous for safe banks

Run

Reserves post shrinkage

Symmetric Rational Expectations Equilibrium

- The market for term loans clears at date 0 (taking r_1 as given)
- The market for spot loans clears at date 1 at r_1.
- Capital supplies the residual: $e_1 = \alpha_1^{-1} r_1$

$$\left[\varphi(1-\theta)+\theta\right]\alpha_1^{-1} r_1 = \theta\left[I_1 + (D_0 - D_0^F)\right] - \left[\varphi(1-\theta)+\theta\right] S_0(1-\tau)$$

Additional liquidity raised via equity issuances

Firm's Investment demand

Retail Depositor run ("leakage")

Unencumbered liquidity with deficit and tainted banks

- How does the equilibrium rate r_1 change with the level of reserves?

Equilibrium

- The market for term loans clears at date 0 (taking r_1 as given)
- The market for spot loans clears at date 1 at r_1.
- Capital supplies the residual: $e_1 = \alpha_1^{-1} r_1$

$$\left[\varphi(1-\theta)+\theta\right]\alpha_1^{-1} r_1 = \theta\left[I_1 + (D_0 - D_0^F)\right] - \left[\varphi(1-\theta)+\theta\right] S_0(1-\tau)$$

Increases one for one in S0

What matters therefore is whether…

$$\theta > \frac{\varphi(1-\tau)}{\tau + \varphi(1-\tau)}$$

- If inter-bank market shut ($\varphi = 0$), inter-bank rate *always* increases in reserves
- If inter-bank market fully open ($\varphi = 1$), then this is so whenever $\theta > (1-\tau)$

Model solution and implications

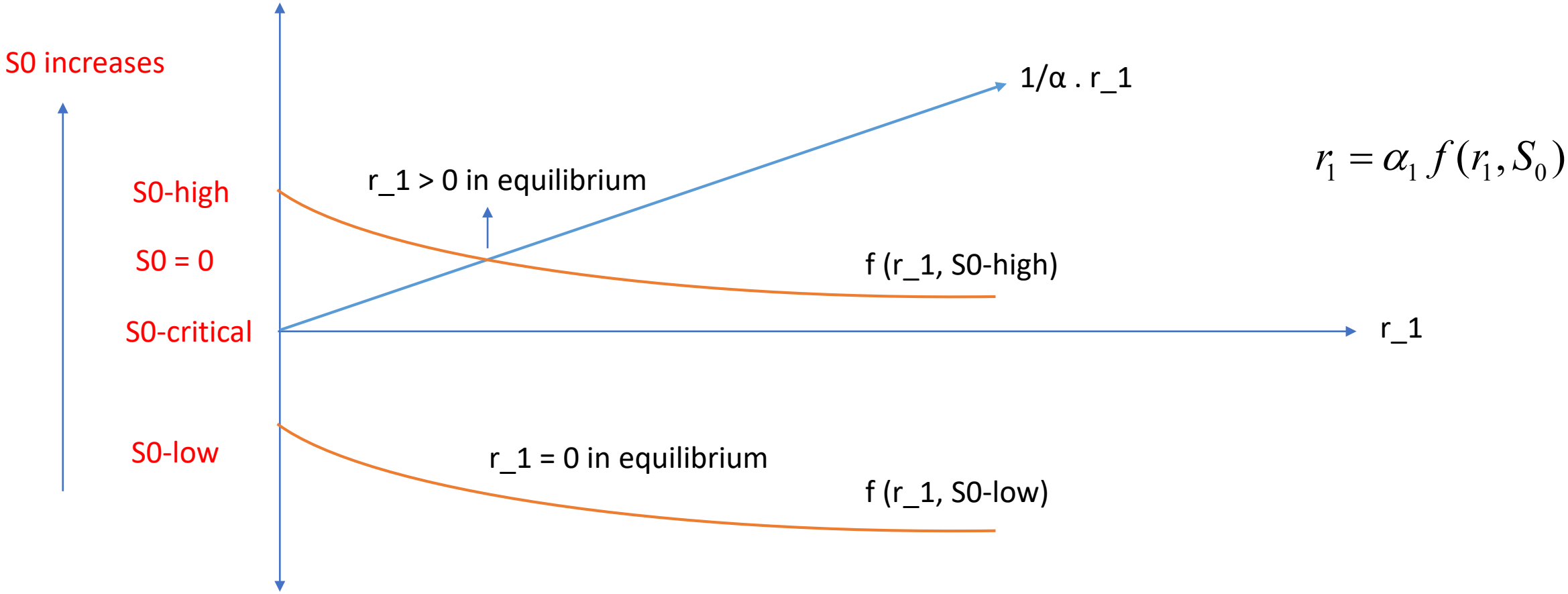
Reserves and financial fragility, market failure, equity capital requirements

When is the money market stressed?

$$\theta > \frac{\varphi(1-\tau)}{\tau + \varphi(1-\tau)}$$

"Counter-intuitive" case: High aggregate risk, high shrinkage, high hoarding

Depositors demand more than the post-shrinkage available reserves



$$r_1 = \alpha_1 f(r_1, S_0)$$

$$\theta < \frac{\varphi(1-\tau)}{\tau + \varphi(1-\tau)}$$

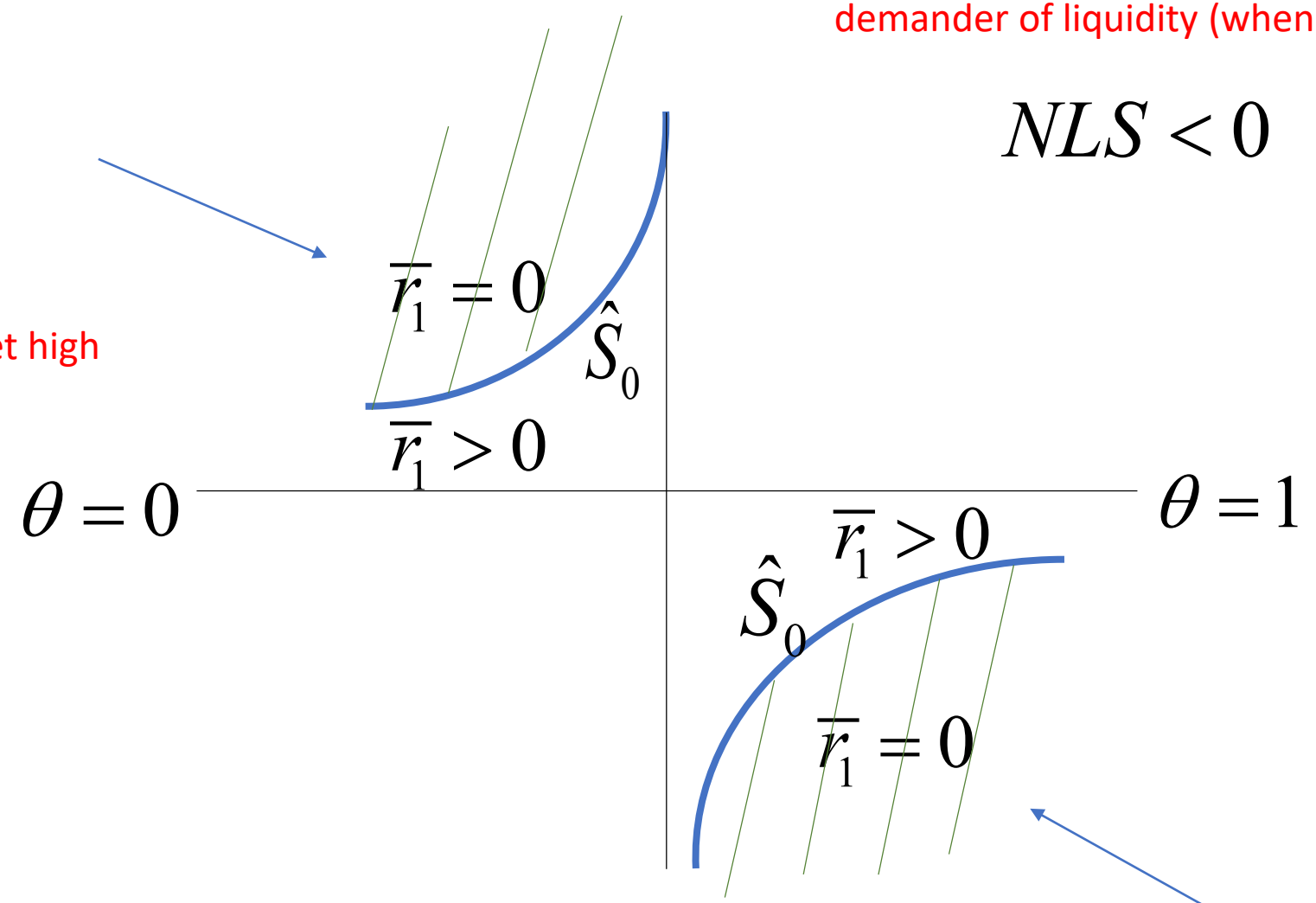
Low aggregate risk,
Low shrinkage,
Low hoarding

Reserves must be set high

Standard Intuition

Corporate sector is a net demander of liquidity (when r_1 = 0)

$$NLS < 0$$



High aggregate risk,
High shrinkage,
High hoarding

Reserves must be set low

Counterintuitive result

$$\theta > \frac{\varphi(1-\tau)}{\tau + \varphi(1-\tau)}$$

Market failure and capital regulation

- The planner would like to keep interbank rates at zero at date 1
- In the case shown above, the planner will choose the level of reserves trading off stability at low aggregate risk with fragility at high risk
- Is there a market failure?

Market failure and capital regulation

- The planner would like to keep interbank rates at zero at date 1
- In the case shown above, the planner will choose the level of reserves trading off stability at low aggregate risk with fragility at high risk
- Is there a market failure?
  - Yes, too many deposits, given the pecuniary externality on interbank rates
  - As reserves increase, there can be too much creation of claims to immediacy
  - Banks do not internalize the effect of their liability structure (or asset encumbrances) on interest rates and real economy (Lorenzoni, 2008; Stein, 2012)
- Conflict between monetary policy and financial stability objectives?
- High reserves need tighter ex-ante capital adequacy
  - Modifies Liang and Parkinson (2020)

Flight to safety and hoarding

Will surplus banks necessarily channel liquidity to the deficient ones?

Altered assumptions

- Recall that flighty deposits migrate to “safe” banks
- Safe banks earn a (small) *convenience yield* δ on extra reserves
  - The value of having liquid assets in case of additional stress
  - A private transfer from other banks’ franchise values to the safe banks
- Unstressed banks to be perceived as “safe” must not get “tainted” by being seen as connected to the stressed banks via inter-bank loans
- However, as liquidity stress rises, interbank rate induces such loans
- What fraction φ of unstressed banks lends? BREAKEVEN RATE
- Can inter-bank markets remain shut altogether ($\varphi = 0$)? AUTARKY
- As $\delta \to 0$, $\varphi \to 1$ and we get the benchmark model as limiting case...

Breakeven rate for inter-bank market to open up

$$V_1^{\varphi}(y=1,z=0)=\left[(r_1-\delta)S_0(1-\tau)+r_1^2/2\alpha_1\right]$$

"Tainted" Bank
Franchise value

$$V_1^{1-\varphi}(y=1,z=0)=\frac{\delta S_0(1-\tau)(\theta+(1-\theta)\varphi)}{(1-\theta)(1-\varphi)}$$

"Safe" Bank
Franchise Value

$$V_1^{\varphi}=V_1^{1-\varphi} \quad \Rightarrow \quad (1-\varphi)=\frac{\delta S_0(1-\tau)}{(1-\theta)\left(r_1 S_0(1-\tau)+r_1^2/2\alpha_1\right)}$$

Breakeven rate r1: $\varphi=0$

Increases in reserves S0

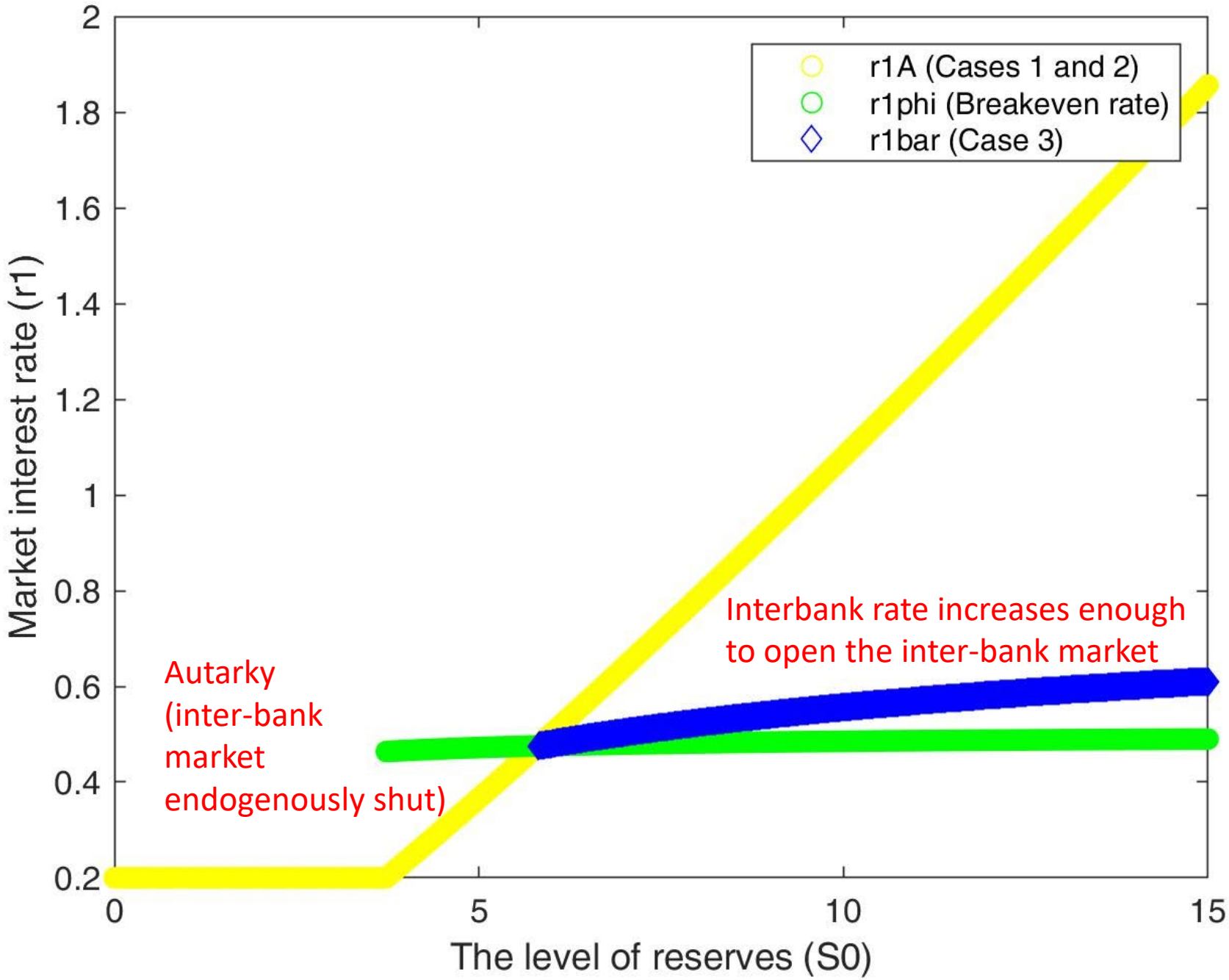
$$\delta = 0.2, \tau = 0.2$$

$$\theta = 0.6 < (1 - \tau)$$

Low reserves:
Banks manage with own funding

Moderate reserves:
Banks need liquidity but inter-bank markets shut (Autarky)

High reserves:
Banks need liquidity and inter-bank markets open up as r1 is attractive



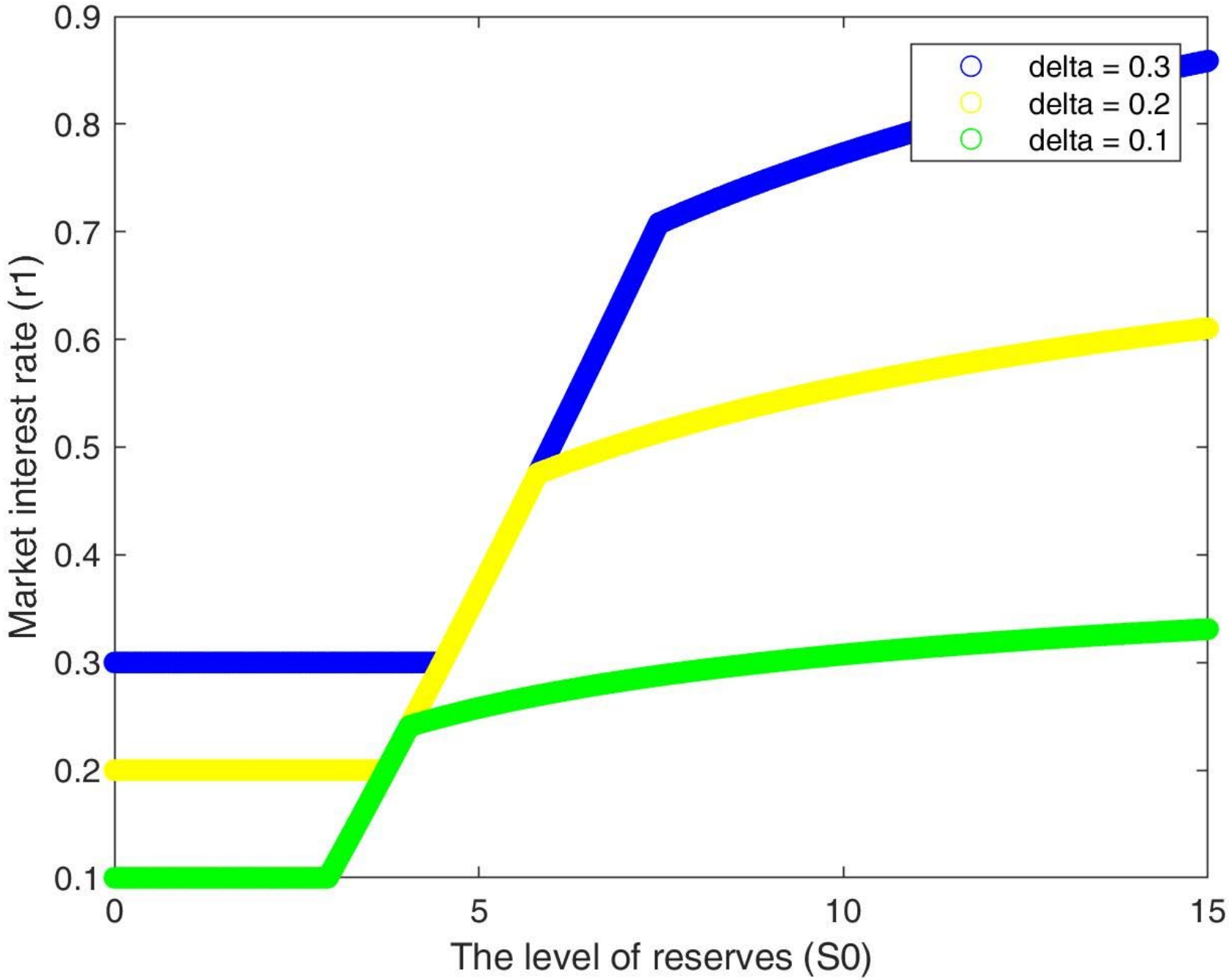
$$\tau = 0.2$$

$$\theta = 0.6 < (1 - \tau)$$

As the convenience yield on reserves increases…

Inter-bank markets remain endogenously shut for longer, and

Inter-bank rates in stress times rise more



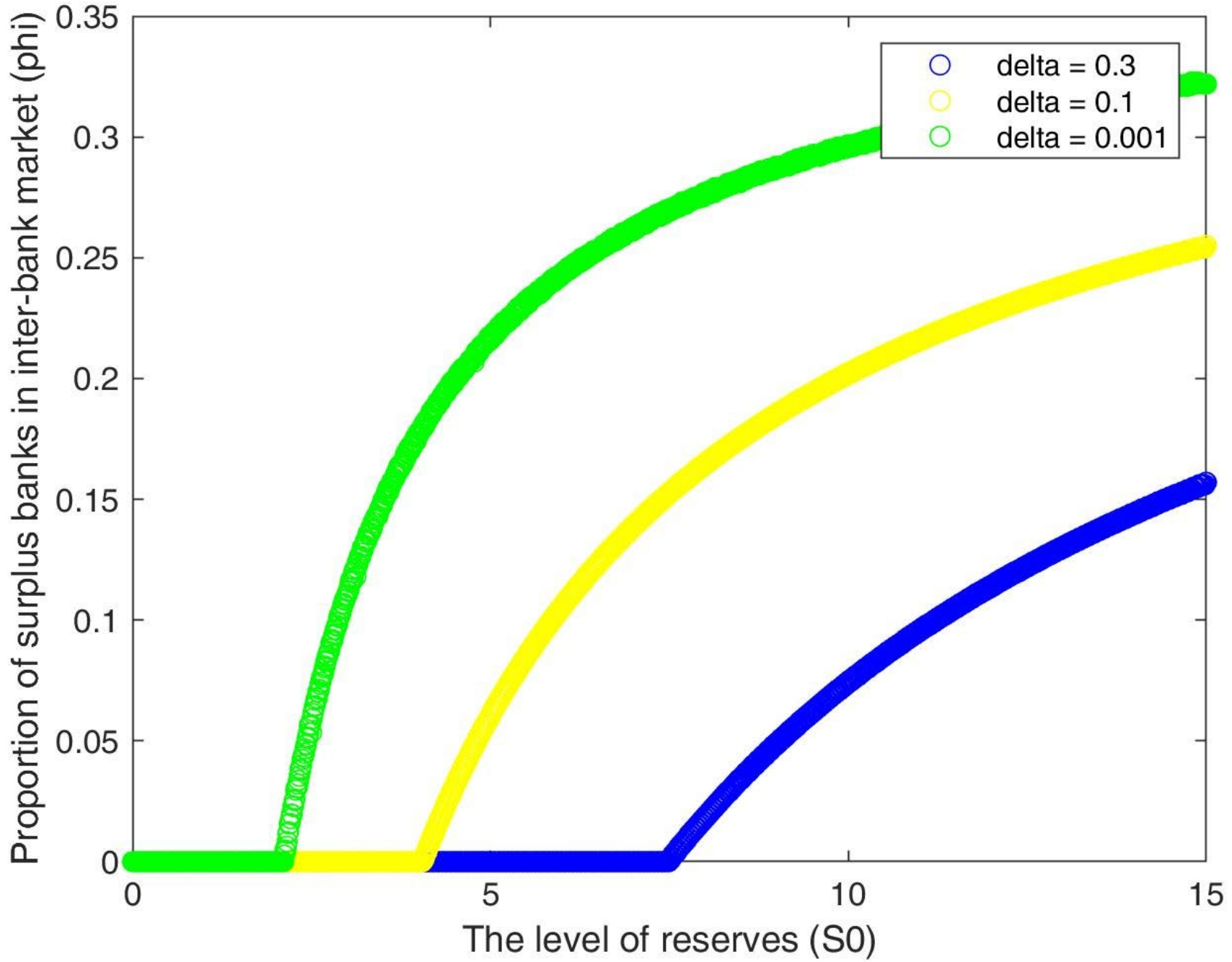
$$\tau = 0.2$$

$$\theta = 0.6 < (1-\tau)$$

As the convenience yield on reserves increases,

More surplus banks hoard, and

The extent of inter-bank liquidity transfer reduces



Implications

- Benchmark model assumed inter-bank markets are always open
- Flight to safety and liquidity hoarding imply this need not be the case

- As reserves increase, inter-bank markets can remain closed for a larger range of parameters as hoarding incentives strengthen when $\delta > 0$
  - Benefits to hoarding safe-to-flight deposits rise
  - Breakeven rate at which inter-bank market opens up rises

- The greater the perceived benefit δ of reserves hoarding during stress, the more likely it is that higher reserves lead to financial fragility

Endogenizing shrinkage of reserves (τ)

- Speculation:

  - Banks must hold some margins against prime-brokerage services
  - Search costs for prime-brokerage services reduce in unencumbered liquidity
  - This way, reserves can get encumbered away from stress-time withdrawals

  - Indeed, stress may necessitate that encumbrance (τ) rise pro-cyclically (in 

  - In practice:
    - CCP initial margins/guarantee funds, often kept at central banks
    - March 2020 Treasury relative trades (Barth and Kahn, 2021) show positions grew from $200 bln in 2013 to $800 bln by 2020, needing significant margins ex post

Speculation (formally…)

$\kappa =$ Margin to be set aside per speculative position

$$\underset{x}{Max} \quad (1-\frac{q}{\theta})[\eta - f]x - \frac{\nu}{2}\frac{x^2}{(S_0 - \kappa\bar{x})}$$

Expected Speculative Return net of Prime-brokerage Fee

Search Costs for Prime-brokerage Services: Increase in Speculative position, Decrease in Unencumbered reserves

$$\Rightarrow \kappa\bar{x} = \frac{S_0\kappa\left(1-\frac{q}{\theta}\right)(\eta - f)}{\nu + \kappa\left(1-\frac{q}{\theta}\right)(\eta - f)} = \tau S_0$$