Liquidity Regulation and the Implementation of Monetary Policy

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Background

- Basel III introduces a framework for liquidity regulation
  - objective: ensure banks hold a more liquid portfolio of assets, limit maturity mismatch
- Two components:
  - Liquidity Coverage Ratio (LCR)
    - establishes minimum holding of high-quality liquid assets
  - Net Stable Funding Ratio (NSFR)
    - establishes minimum amount of funding from “stable” sources
- Implementation:
  - LCR: 3-year phase-in began in Jan 2015
  - NSFR: begins in Jan 2018

Definition

$$LCR = \frac{\text{Stock of unencumbered high}-\text{quality liquid assets}}{\text{Net cash outflows in a 30}-\text{day stress scenario}} = \frac{HQLA}{NCOF}$$

- *HQLA:* cash, reserves, govt. bonds, certain other securities
- *NCOF* Scenario: partial loss of retail deposits, significant loss of wholesale funding, contractual outflows from a 3-notch ratings downgrade, and substantial calls on off-balance sheet exposures

- Requirement:

$$HQLA \geq NCOF$$

or

$$LCR \geq 100\%$$

Question

- How might the LCR affect monetary policy *implementation*?
  - that is, the process by which a central bank steers market interest rate(s) toward some target
- Many central banks target the interest rate on interbank loans

  ... of reserve balances (a high-quality liquid asset)
- If the LCR changes the demand for such loans,
  - it seems likely to change the structure of market interest rates
- Want to understand:
  - how the LCR is likely to affect interbank interest rates
  - whether these effects could, in some circumstances, impair a CB's ability to move the interest rate to target

What we do

- Develop a simple model to analyze this issue
  - goal is to identify *possible side effects* of the LCR
- Begin with a standard model of interbank lending
  - introduce an LCR requirement
  - ask: how does it change equilibrium interest rates?
- Results:
  - tends to push the overnight rate **down** and term rates **up**
  - effect depends critically on the **form** of central bank operations
    - bonds vs. other assets; counterparties; purchases vs. repos
- Conclusion:
  - LCR may make implementing monetary policy more challenging

The Model

A baseline model (no LCR)

- Three stages: $t = 0,1,2$
- Continuum of banks ($i \in [0,1]$), a central bank, and others
  - each begins with a balance sheet

Bank i

Assets		Liabilities	
Loans	L_0^i	Deposits	D_0^i
Bonds	B_0^i		
Reserves	R_0^i	Equity	E_0^i

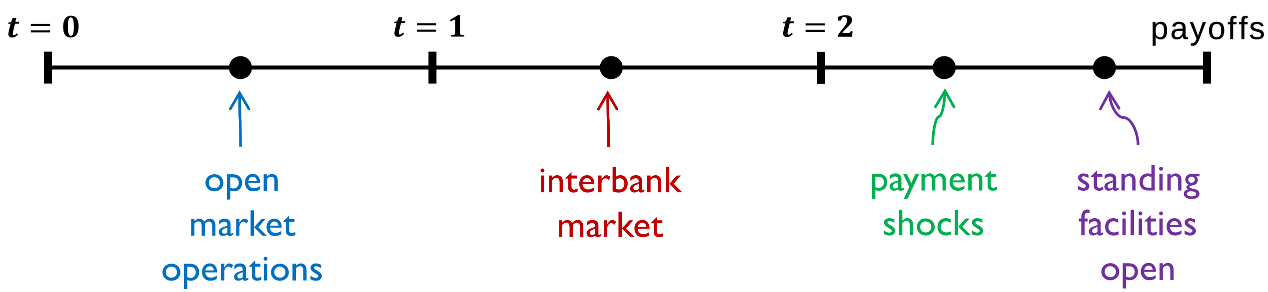
Central Bank

Assets		Liabilities	
Loans	L_0^{CB}	Reserves	R_0
Bonds	B_0^{CB}		

Other investors

Assets		Liabilities	
Loans	L_0^h	Equity	E_o^h
Bonds	B_0^h		
Deposits	D_0		

- Timeline:



Bank i

Assets		Liabilities	
Loans	L_1^i	Deposits	$D_1^i - \varepsilon^i$
Bonds	B_1^i	Borrowing	$\Delta^i + X^i$
Reserves	$R_1^i + \Delta^i - \varepsilon^i + X^i$	Equity	E_0^i

- Banks are risk neutral
- Must satisfy a reserve requirement:

$$R_1^i + \Delta^i - \varepsilon^i + X^i \geq K^i$$

- Profit:

$$\pi^i(\varepsilon^i) = r_L L_2^i + r_B B_2^i - r_D D_2^i + r_K K^i$$

$$-r\Delta^i + r_R(R_1^i + \Delta^i - \varepsilon^i + X^i - K^i) - r_X X^i$$

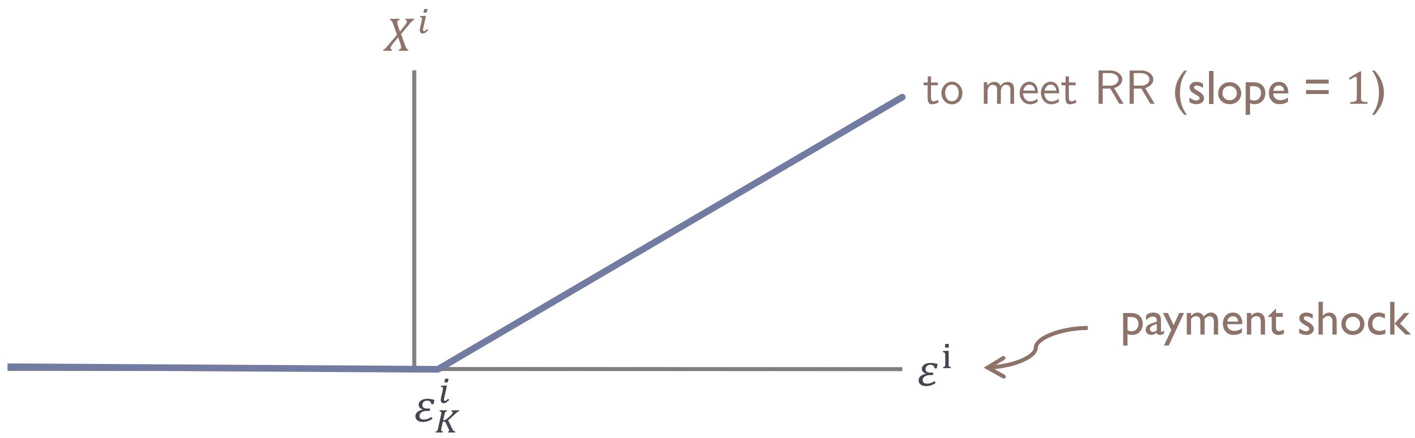
where

- r_R = interest rate at CB's deposit facility (excess reserves)
- $r_X > r_R$ is the rate at the CB's lending facility

Demand for interbank loans

- Using the reserve requirement:

$$R_1^i + \Delta^i - \varepsilon^i + X^i \geq K^i$$



  - where $\varepsilon_k^i \equiv R^i + \Delta^i - K^i$

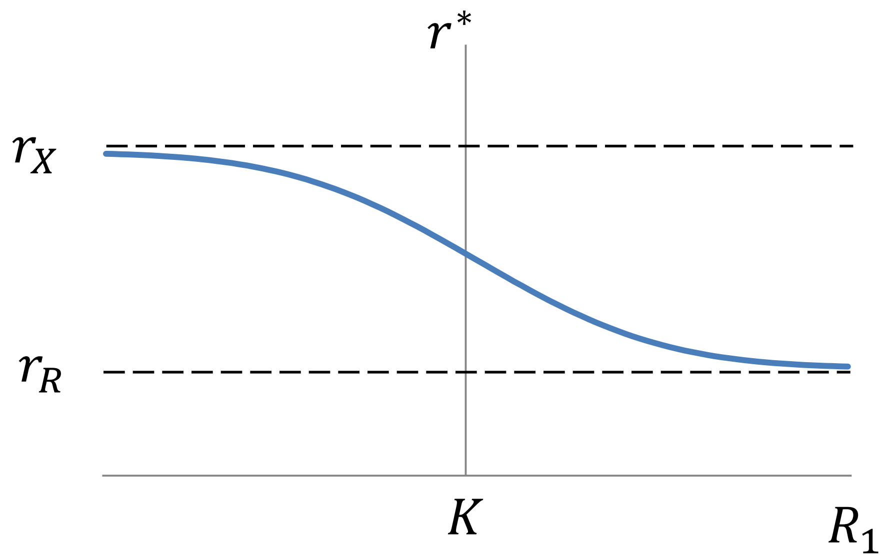
- Bank i will choose Δ^i so that:

$$r = r_R\left(\text{prob}\left[\varepsilon^i < \varepsilon_K^i\right]\right) + r_X\left(\text{prob}\left[\varepsilon^i > \varepsilon_K^i\right]\right)$$

Equilibrium

- Net interbank lending $= 0 \quad \Rightarrow \quad \varepsilon_K^* = R_1 - K$

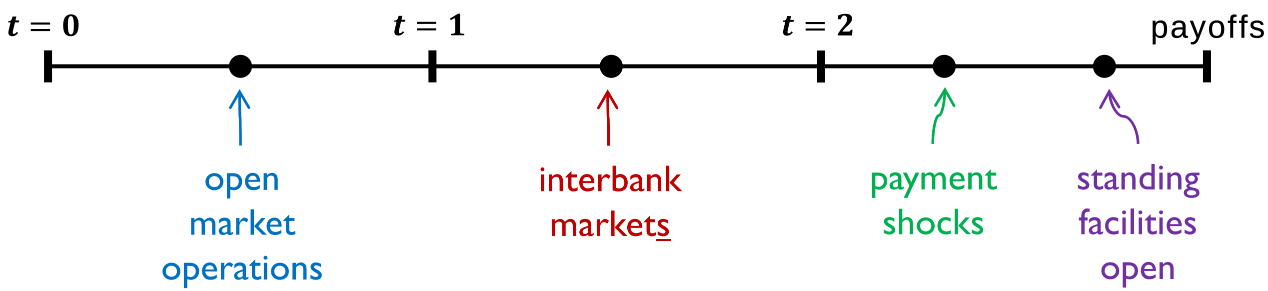
$$r^* = r_R(\text{prob}[\varepsilon < \varepsilon_K^*]) + r_X(\text{prob}[\varepsilon > \varepsilon_K^*])$$



- Notes:
  - r^* depends only on aggregate excess reserves
  - distribution of R_1^i and other balance sheet items is irrelevant
  - implication: effect of an OMO depends only on size of the operation

Liquidity Requirements

- Expand the model to include two interbank markets
  - interpret as overnight vs. term loans
  - both markets open at the same time



Bank i

Assets		Liabilities	
Loans	L_1^i	Deposits	$D_1^i - \varepsilon^i$
Bonds	B_1^i	Borrowing	$\Delta^i + \Delta_T^i + X^i$
Reserves	$R_1^i + \Delta^i + \Delta_T^i - \varepsilon^i + X^i$	Equity	E_0^i

Introducing the LCR requirement

- In the model:
  - bonds and reserves are high-quality liquid assets
  - loans = all other assets
- Requirement:

$$LCR = \frac{B_1^{\mathrm{i}} + R_1^{\mathrm{i}} + \Delta^{\mathrm{i}} + \Delta_T^{\mathrm{i}} - \varepsilon^{\mathrm{i}} + X^{\mathrm{i}}}{\theta_D\left(D_1^{\mathrm{i}} - \varepsilon^{\mathrm{i}}\right) + \Delta^{\mathrm{i}}} \geq 1 \qquad \left\{ = \frac{HQLA}{NCOF} \right\}$$

- Runoff rates for different types of liabilities:
  - deposits: θ_D $(3\%, 5\%, \text{or } 10\%)$
  - overnight borrowing: 100%
  - term borrowing: 0%
  - borrowing from central bank: 0%

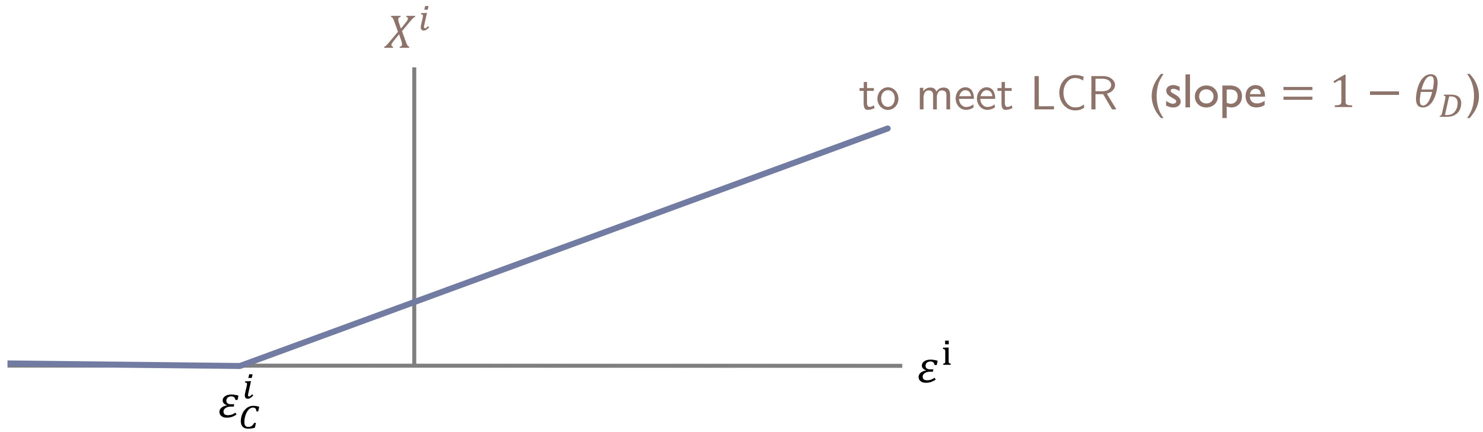
(paper: two markets with $\theta_a \neq \theta_b$)

(see paper for $\theta_X > 0$)

- Repeating:

$$\frac{B^{\mathrm{i}} + R^{\mathrm{i}} + \Delta^{\mathrm{i}} + \Delta_T^{\mathrm{i}} - \varepsilon^{\mathrm{i}} + X^{\mathrm{i}}}{\theta_D (D^{\mathrm{i}} - \varepsilon^{\mathrm{i}}) + \Delta^{\mathrm{i}}} \geq 1$$

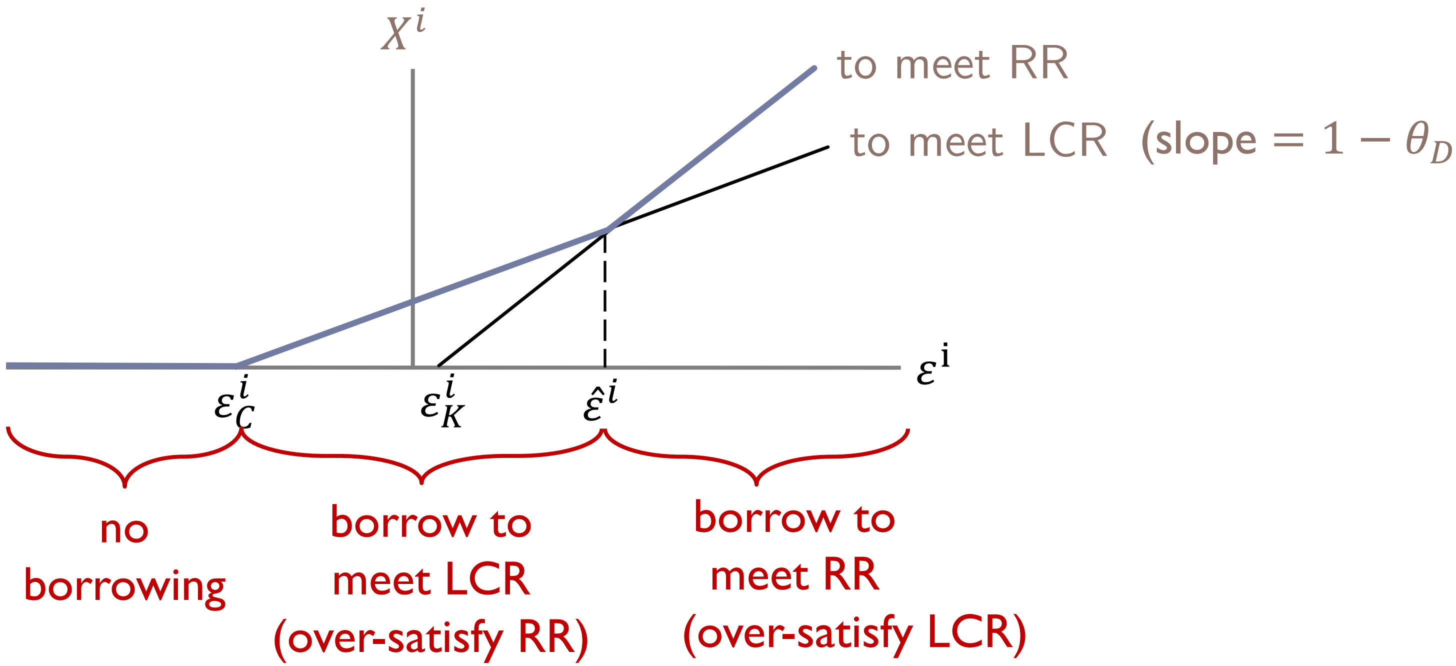
DW borrowing for LCR purposes:



- where $\varepsilon_C^i \equiv \frac{B^i + R^i + \Delta_T^i - \theta_D D^i}{1 - \theta_D}$

notice: the two Δ^i terms cancel out

Total DW borrowing



In equilibrium:

$$r^* = r_R(prob[\varepsilon < \hat{\varepsilon}^*]) + r_X\, prob[\varepsilon > \hat{\varepsilon}^*]$$

$\hat{\varepsilon}^* > \varepsilon_K^* \Rightarrow$ overnight rate lower

$$r_T^* = r^* + (r_X - r_R)prob[\varepsilon_C^* < \varepsilon < \hat{\varepsilon}^*]$$

a premium emerges

Results

- If the LCR is a binding concern in some states of nature (that is, if $\varepsilon_C^* < \varepsilon_K^*$):

  1. the overnight rate r^* is **lower** than in the standard model
  2. the term rate r_T^* is **higher** than in the standard model

     $\Rightarrow$ difference is a <u>regulatory premium</u>

- In addition, open market operations change banks' LCR position (that is, change $\mathrm{B}_1, \mathrm{R}_1, D_1 \Rightarrow \text{change } \varepsilon_C^*$)
  - direction, size of change depend on how operation is structured

  $\Rightarrow$ effect of an operation on (r^*, r_T^*) depends on how it is structured

    - next: examine OMOs in detail

Open Market Operations

Balance sheet effects of an OMO

- Central bank chooses size of purchases z_L, z_B

Central Bank

Assets		Liabilities	
Loans	${L_0}^{CB} + z_L$	Reserves	$R_0 + z$
Bonds	${B_0}^{CB} + z_B$		

- Effect on bank balance sheets depends on counterparites (α_L, α_B)

Banking system

Assets		Liabilities	
Loans	$L_0 - \alpha_L z_L$	Deposits	$D_0 + (1-\alpha_L)z_L + (1-\alpha_B)z_B$
Bonds	$B_0 - \alpha_B z_B$		
Reserves	$\underbrace{R_0 + z}_{= R_1}$	Equity	E_0

OMOs (1): Purchases of HQLA from banks

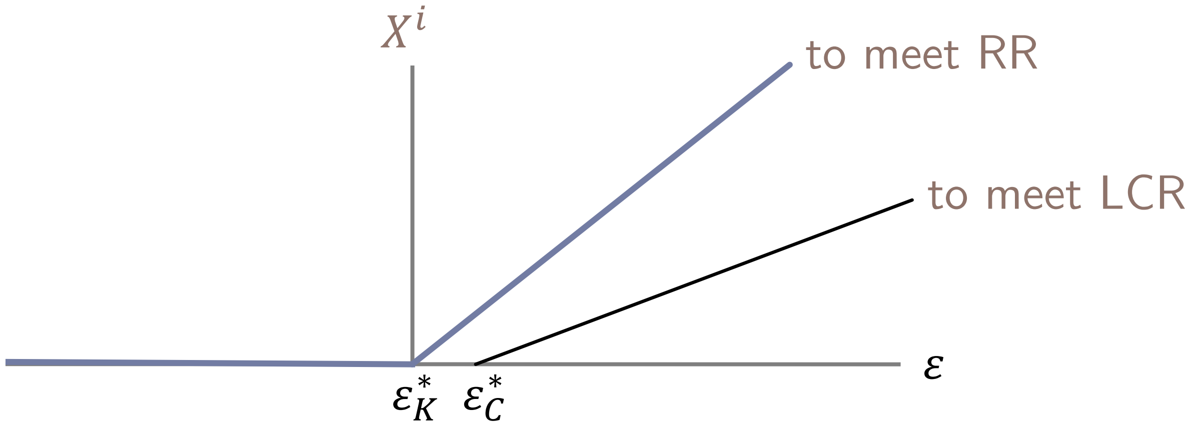
- Suppose $z_B > 0 = z_L$ and $\alpha_B = 1$
- Operation leaves the LCR of the banking system unchanged:

Assets		Liabilities	
Loans	L_0	Deposits	D_0
Bonds	$B_0 - z$		
Reserves	$R_0 + z$	Equity	E_0

$$\Rightarrow LCR_1 = \frac{B_0 - z + R_0 + z}{\theta_D D} = LCR_0$$

  - the likelihood of a bank violating its LCR constraint is unchanged
  - but the likelihood of violating its reserve requirement falls
    - $\Rightarrow$ regulatory premium must increase

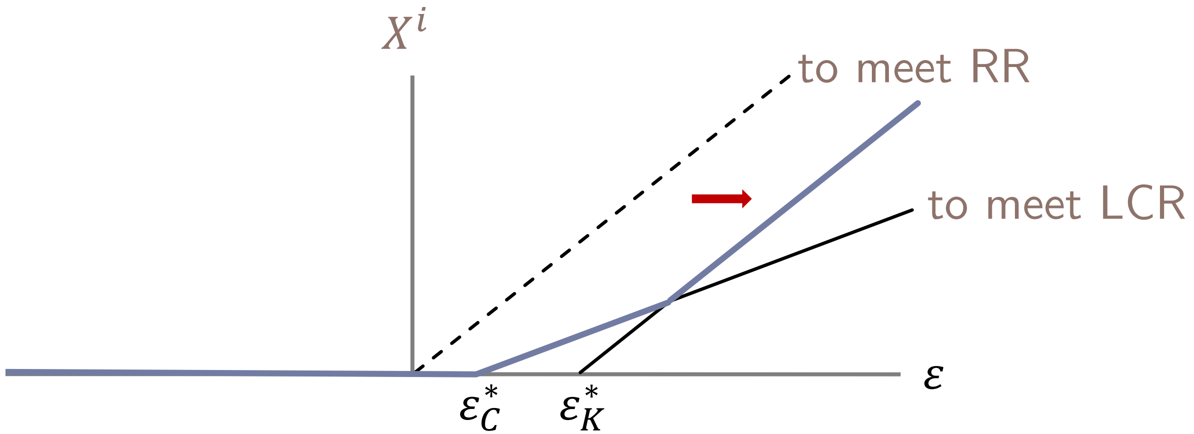
- Start from a situation where the LCR is never a binding concern:



same r^* as with no LCR

no premium

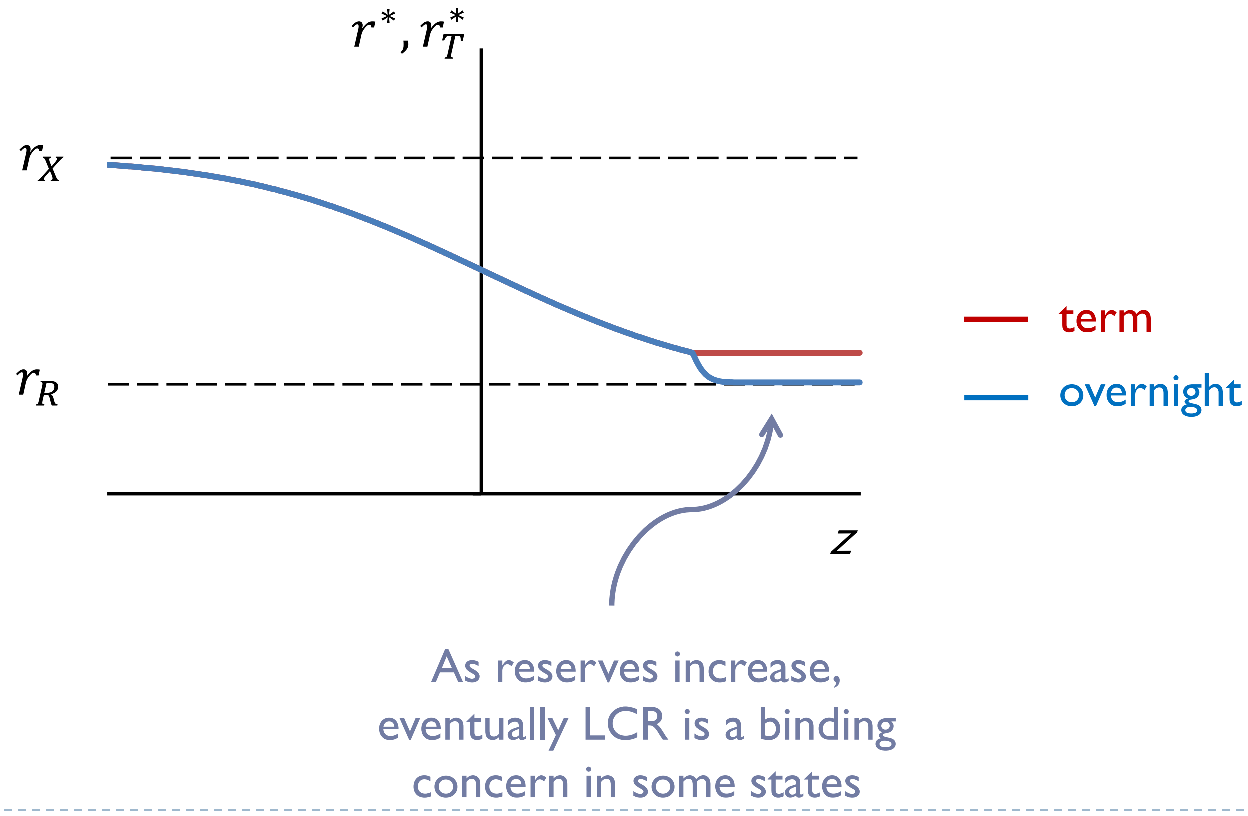
- When central bank buys bonds:



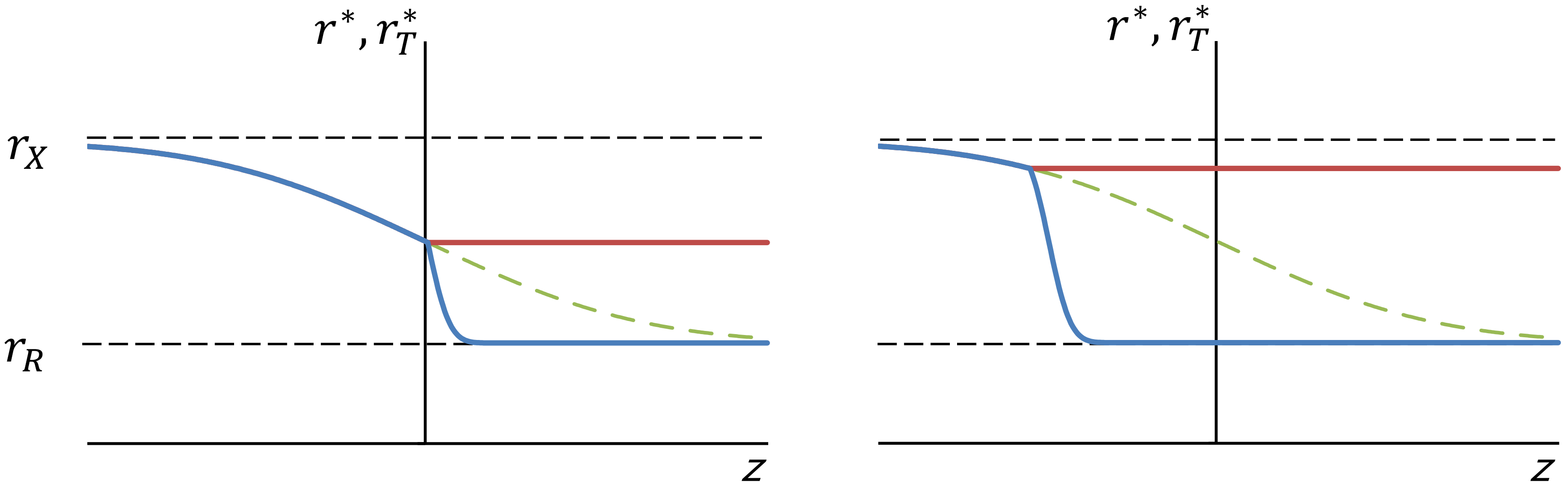
r^* falls more than in the standard model

a premium arises

- Effect of open market operations on equilibrium interest rates
  - assuming initial LCR of the banking system is well above 100%



- If the initial LCR of the banking system is lower:



- Results:
  - adding reserves tends to create a term premium
  - overnight rate becomes highly responsive to z
  - term rate becomes unresponsive to z

OMOs (2): Purchases of non-HQLA from banks

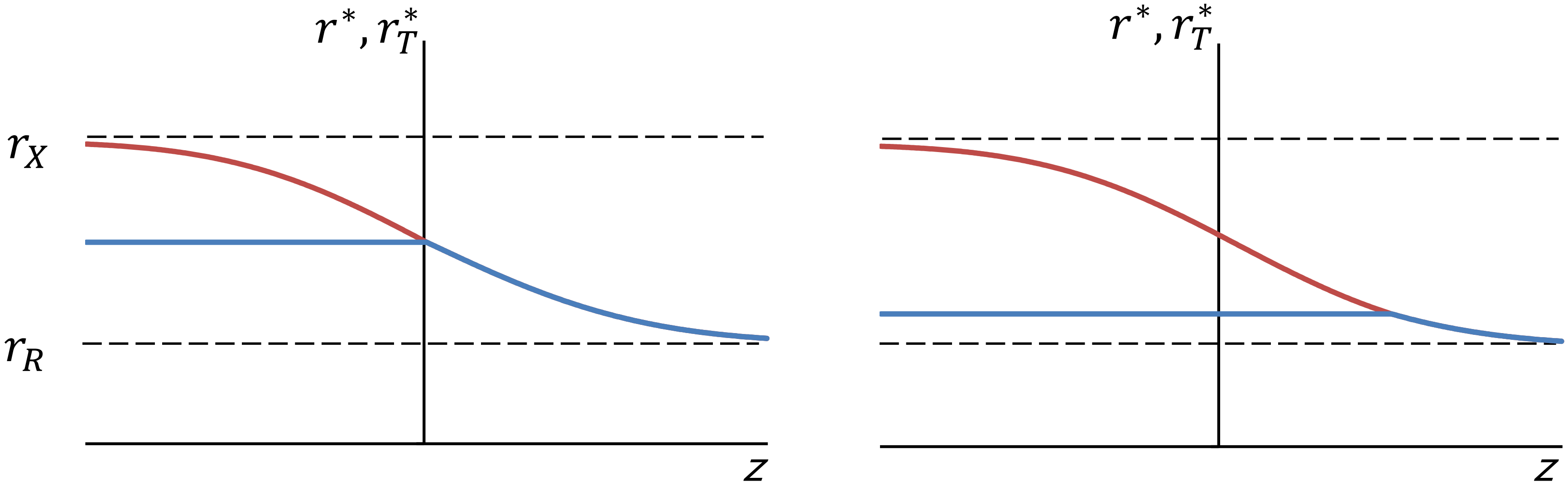
- Suppose $z_L > 0 = z_B$ and $\alpha_L = 1$
- This operation raises the LCR of the banking system:

Assets		Liabilities	
Loans	$L_0 - z$	Deposits	D_0
Bonds	B_0		
Reserves	$R_0 + z$	Equity	E_0

$$\Rightarrow LCR_1 = \frac{B_0 + R_0 + z}{\theta_D D_0} > LCR_0$$

  - likelihood of a bank violating its reserve requirement falls (as before)
  - likelihood of violating its LCR requirement falls by more
    - $\Rightarrow$ regulatory premium tends to decrease

- Effect of open market operations on equilibrium interest rates:



- Results:
  - <u>draining</u> reserves tends to create a term premium
  - overnight rate becomes <u>less</u> responsive to z
  - term rate becomes (slightly) <u>more</u> responsive to z

exactly opposite to previous case

OMOs (3): Purchases from non-banks

- Now suppose $\alpha_B = \alpha_L = 0$
- Operation raises the LCR of the banking system:

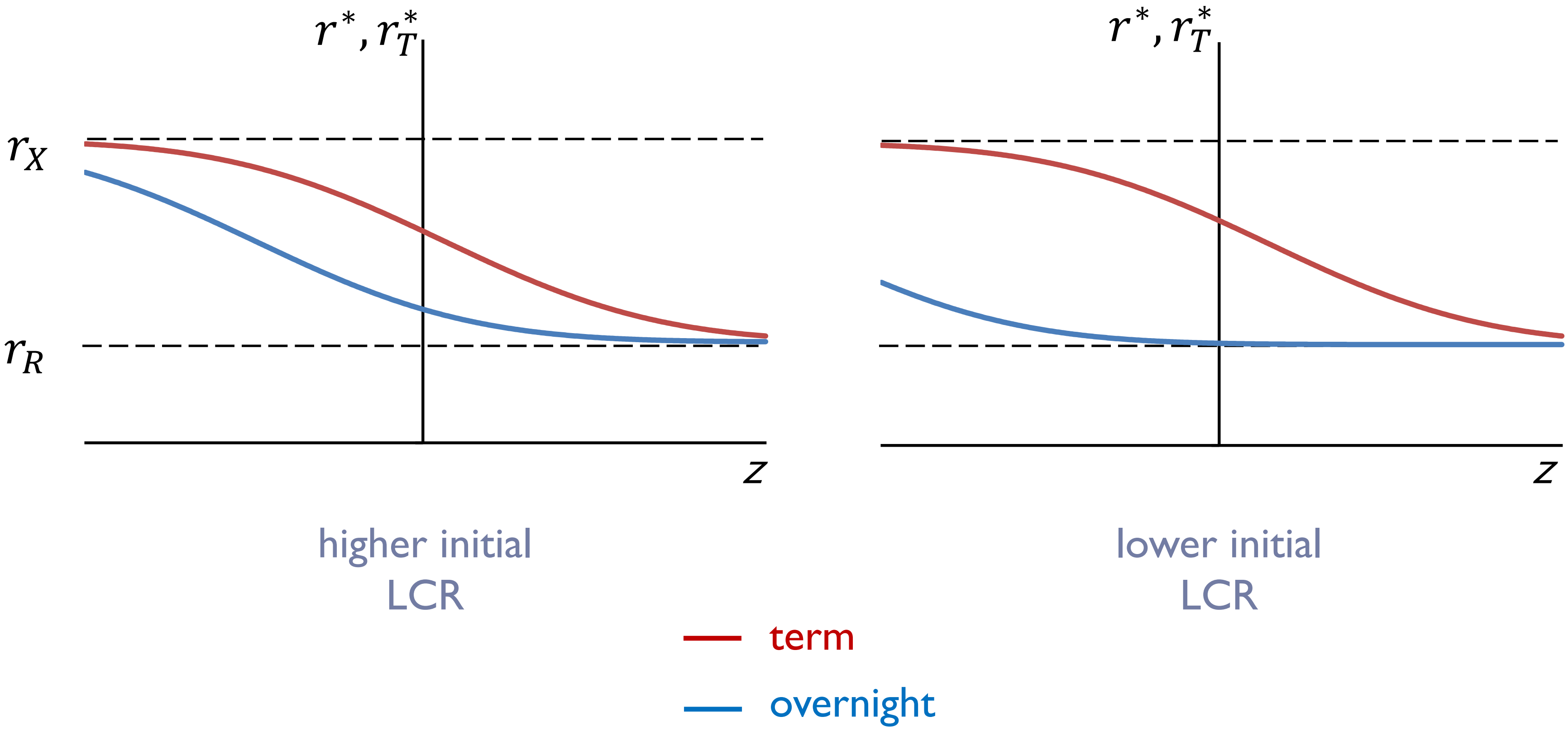
Assets		Liabilities	
Loans	L_0	Deposits	$D_0 + z$
Bonds	B_0		
Reserves	$R_0 + z$	Equity	E_0

$$\Rightarrow LCR_1 = \frac{B_0 + R_0 + z}{\theta_D (D_0 + z)} > LCR_0$$

  - likelihood of a bank violating both requirements falls at the same rate
  - relative importance depends on distribution of payment shock

  $\Rightarrow$ equilibrium term premium may increase or decrease

- Effects of OMOs are a hybrid of the two previous cases:



Summarizing the results

- An LCR pushes the overnight rate down and term rates up
  - a regulatory premium emerges on loans that improve bank's LCR
- The effects of an open market operation depend on the details (which were irrelevant in the standard model)
  - some of these details (α_L, α_B) are outside of central bank's control
- Effects are stronger:
  - with repos/collateralized loans than with outright purchases/sales
  - if runoff rate on CB loans θ_X is positive

$\Rightarrow$ Implementing monetary policy may become significantly more difficult when LCR is fully in effect

Possible adjustments

- Should a CB adjust its framework? If so, how?
  - no definitive answers here
  - but the model highlights some considerations and tradeoffs
- Target rate: overnight rate vs. term (say, 3 month)
  - if regulatory premium is variable, choice becomes more important
  - and makes a stronger argument for a term target?
- Type of operation
  - If targeting the overnight rate, HQLA with banks may work best
  - If targeting a term rate, non-HQLA or with non-banks may be more effective

- Could take steps to mitigate monetary policy effects of LCR
  - set runoff rate for CB loans (θ_X) to zero
  - introduce a bond-lending facility
    - aim to provide “LCR liquidity” separately from “reserve liquidity”
  - create a committed liquidity facility (CLF)
    - sell committed CB credit lines that count as HQLA (Australia)
- Note: each of these may undermine objectives of the regulation
  - want to incentive banks to hold more HQLA
  - but also want to ease any HQLA shortages that arise

  $\Rightarrow$ possible tension between financial stability and monetary policy

- Determining the best approach requires a broader model
  - need to integrate our analysis with the objectives of the regulation

General message:

- Central banks will likely need to pay attention to the LCR when implementing monetary policy
  - need to monitor LCR conditions in same way as reserve conditions
  - and design their operations and facilities with the LCR in mind
- More work is needed:
  - tailoring the analysis to different environments, operating regimes
  - including benefits as well as costs of liquidity regulation
  - studying how other new regulations interact with the effects here

Extra Materials

OMOs (4): Repos of HQLA with banks

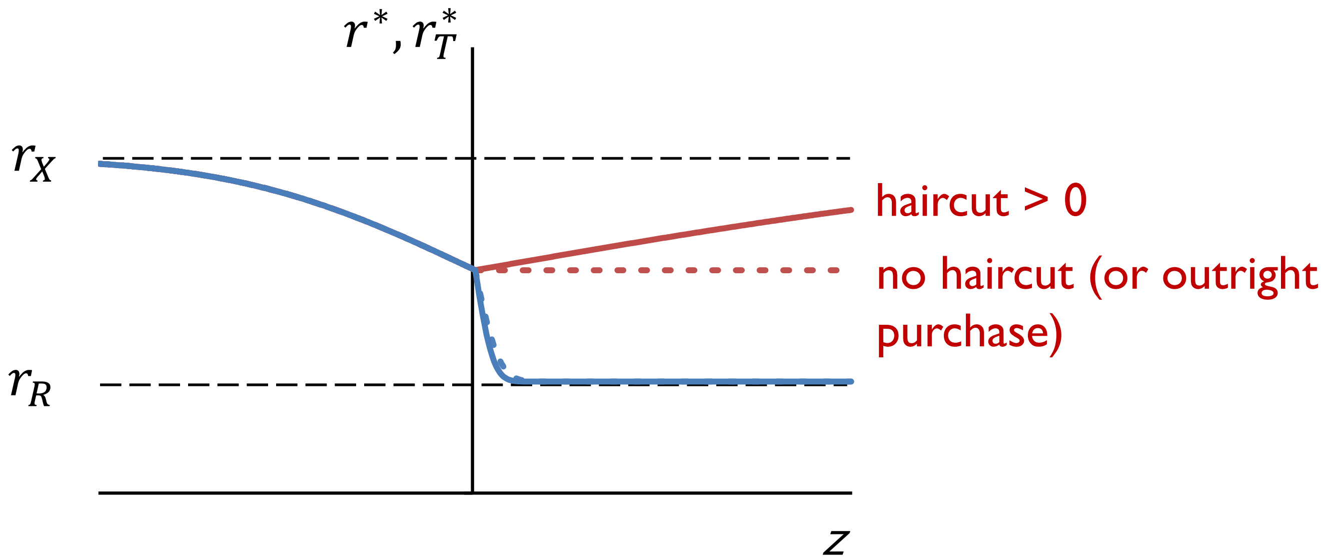
- Next, return to first case: $z_B > 0 = z_L$ and $\alpha_B = 1$
  - but now CB does repo transaction rather than outright purchase
- Operation decreases the LCR of the banking system:

Assets		Liabilities	
Loans	L_0	Deposits	D_0
Bonds	B_0	CB repo	z
- encumb.	$\frac{z}{1-h}$		
Reserves	$R_0 + z$	Equity	E_0

$$\Rightarrow LCR_1 = \frac{B_0 + R_0 - \frac{h}{1-h}z}{\theta_D D_0} < LCR_0$$

- If haircut (h) is zero, effect is same as outright purchases
  - but with a positive haircut ...

- Effect of open market operations via repos (using HQLA)



- Term premium is larger with repos than with outright purchases
  - difference is increasing in the size of the haircut

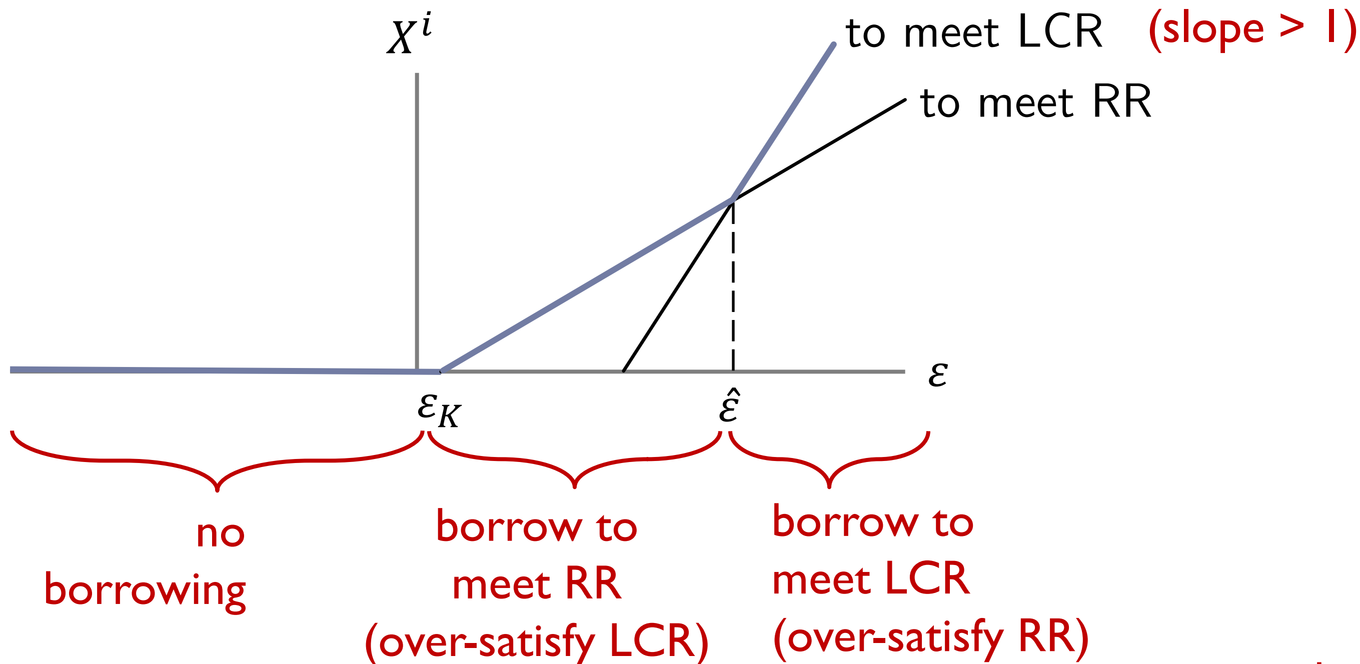
Alternate case: $\theta_X > \theta_D$

- Recall

$$LCR = \frac{B + R + \Delta + \Delta_T - \varepsilon + X}{\theta_D(D - \varepsilon) + \Delta + \theta_X X} \geq 1$$

- LCR rules allow local supervisors to set $\theta_X = 0$ (our baseline case) ...
  - ... or higher
  - the original LCR rules (in 2010) required $\theta_X \geq 25\%$
- Analysis above applies to any $\theta_X < \theta_D$
- For $\theta_X < \theta_D$ ...

When $\theta_X > \theta_D$



overnight rate lower

In equilibrium:

$$r^* = r_R(prob[\varepsilon < \varepsilon_K] + prob[\varepsilon > \hat{\varepsilon}]) + r_X\, prob[\varepsilon_K < \varepsilon < \hat{\varepsilon}]$$

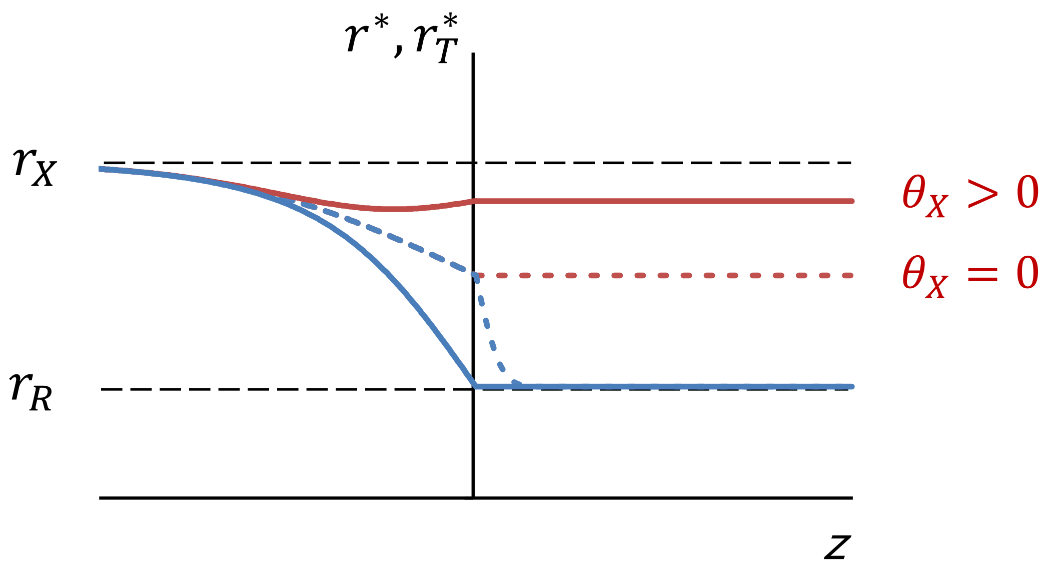
$$r_T = r^* + \frac{r_X - r_R}{1-\theta_X} prob[\varepsilon > \hat{\varepsilon}]$$

premium emerges

same basic pattern …

When $\theta_X > \theta_D$

- Effect of open market operations on equilibrium interest rates
  - assuming initial LCR of the banking system is 100%

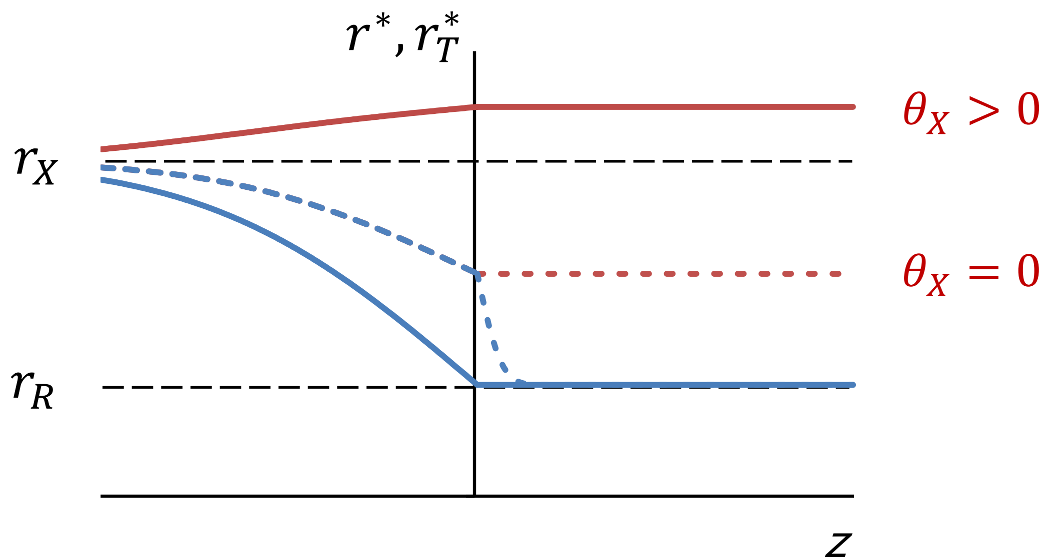


… but effects are magnified

- Effects highlighted above become stronger as θ_X increases

When $\theta_X > \theta_D$

- If θ_X is large enough, the term interest rate can rise above r_X:



  - because $1 of term funding can save a bank from borrowing

$$\frac{1}{1-\theta_X} > 1$$

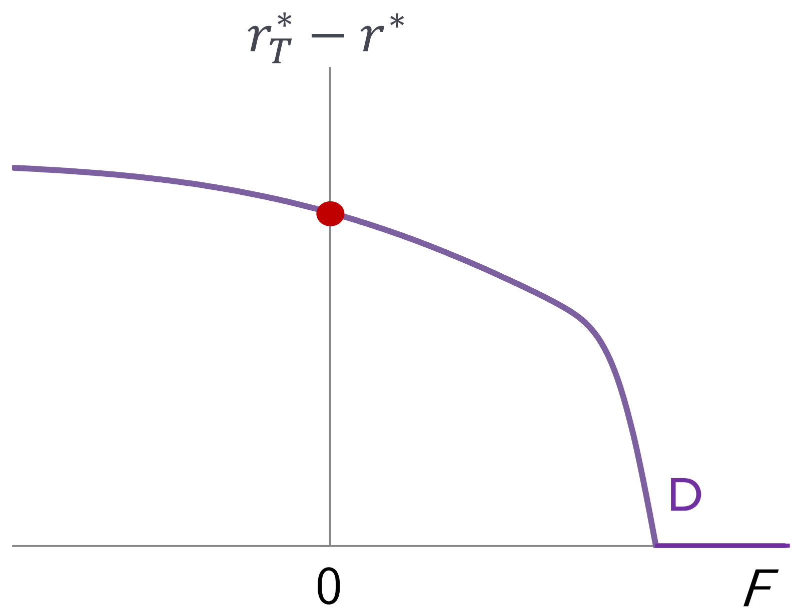
  from the discount window

Shadow banks

- The LCR requirement applies only to (some) commercial banks
- If $r_T^* > r^*$, profit opportunity for anyone not subject to the LCR:
  - lend at the term rate,
  - borrow at the overnight rate and roll over the loan each day
- Doing so may be costly
  - it raises institution's leverage, funding costs
- Let F = net activity by non-banks in these markets
  - assume balance sheet cost $\phi(F)$ is weakly increasing
- No arbitrage ⇒ $\phi(F^*) = r_T^* - r^*$

- Market clearing conditions become:

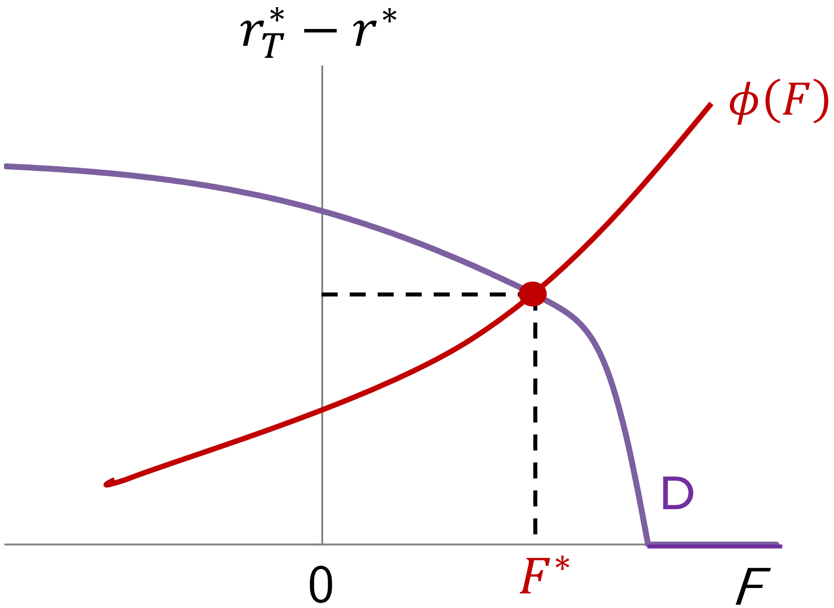
$$\int_0^1 \Delta^i di = F \quad \text{and} \quad \int_0^1 \Delta_T^i di = -F$$



OMOs shift curve right/left

- Analysis above was based on $F = 0$

- Lending by shadow banks:



Raises financial stability concerns?

- Mitigates the term premium …
  - by moving maturity transformation outside of commercial banks
- OMOs have less impact on term premium, but … will change F^*