

Bank Lending in Times of Large Bank Reserves

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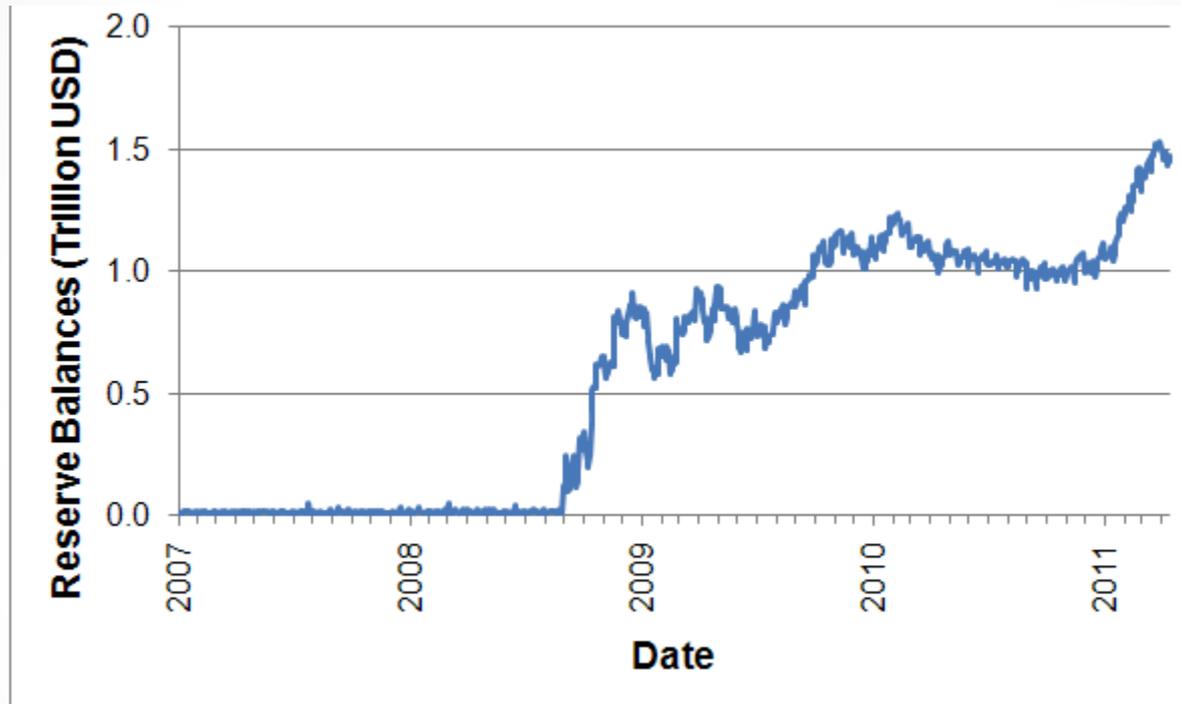
Non-standard monetary policy measures
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* Views expressed in this presentation are those of the authors, and do not reflect the opinions of the Federal Reserve Bank of New York or the Federal Reserve System. The results of this paper are preliminary, and should be treated as such.

Outline

1. **Motivation: Why do reserve levels matter?**
2. Model
3. Equilibrium Quantities
4. Equilibrium Rates
5. Primary Results
6. Conclusion

Large quantity of reserves in the banking system



- There has been a large quantity of reserves since 2009
 - Side effect of the Fed's crisis lending and LSAPs at zero-bound
 - Reserves pay banks an overnight **interest on excess reserves (IOER)**

Concerns about large levels of reserves...

- Claims that reserves will clearly lead to overly expansive bank lending once the economy recovers
- Philadelphia Fed President Charles Plosser:
 - concern "were all those excess reserves to start flowing out into the economy in the form of loans or purchases of other assets"
- Dallas Fed President Richard Fisher:
 - "the Fed must be `wary' of excess reserves sparking an expansion of bank credit"

...and opposite concerns about large reserves

- Banks may face increasing costs in the size of their balance sheet
 - Wrightson ICAP interbank broker:
 - Excess reserves could "clog up bank balance sheets"
 - During the crisis, banks worked to reduce the size of their balance sheets and were slow to raise equity capital
 - Market and regulatory requirements on a bank's capital or maximum leverage ratios
 - Deposit insurance now applied to entire bank balance sheet

What impact do reserves have on bank lending?

Traditional banking model

- Money multiplier

- Bank lending and broad money supply expand based on quantity of reserves because of reserve requirements:

$$\begin{aligned} \text{Aggregate bank lending} &= (\text{aggregate reserves}) \times (\text{moneymultiplier}) \\ &= (\text{aggregate reserves}) \times \left(\frac{1}{\text{reserve requirement (as \% of deposits)}} \right) \end{aligned}$$

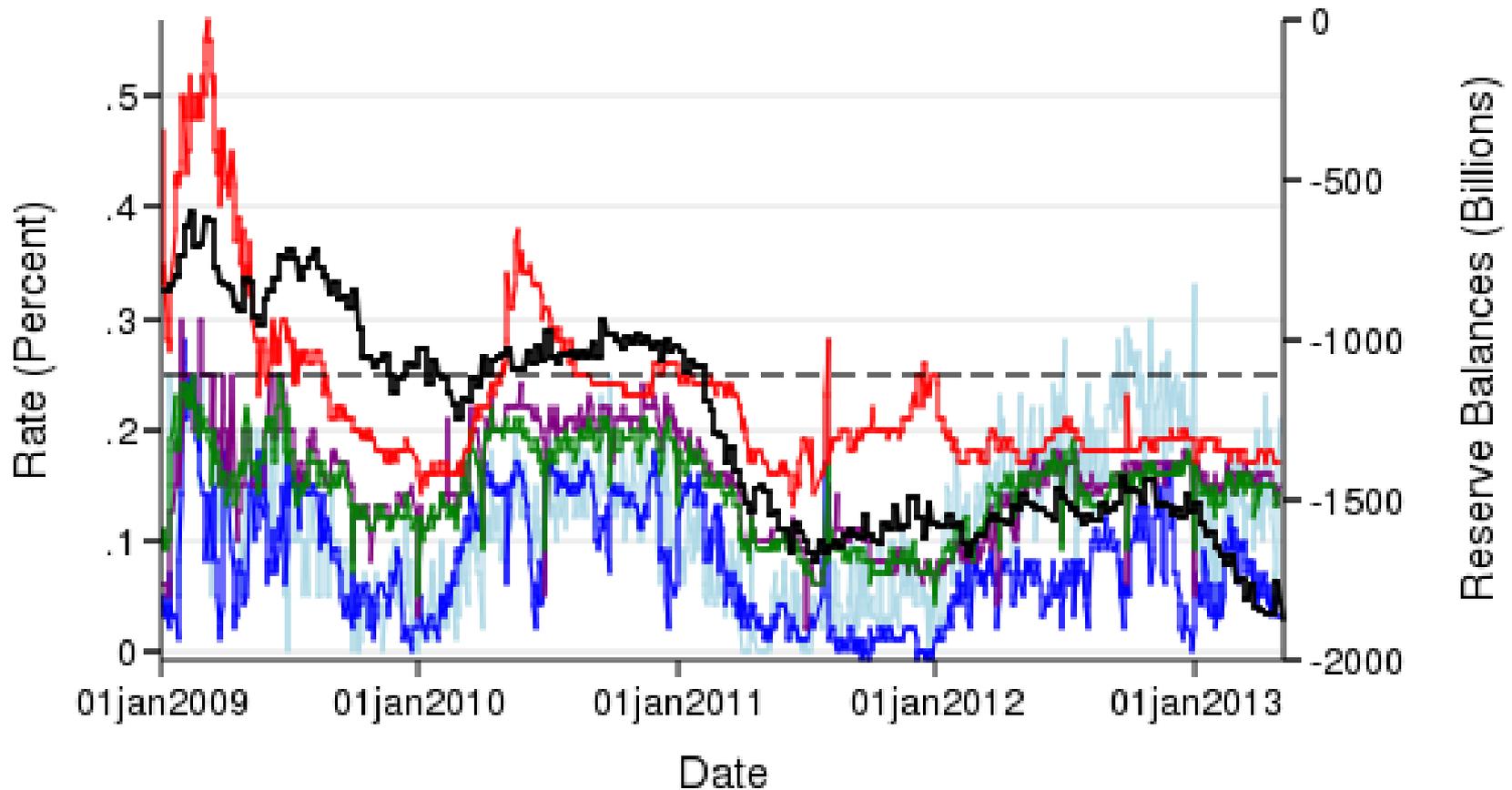
- However, little formal analysis of effect of reserves levels on bank lending under IOER

What impact do reserves have on bank lending?

Modern banking

- Interest on excess reserves (IOER)
- Reserve requirements not binding in the U.S.
 - Bennet and Peristiani (2002): reserve requirements have been largely avoided since the 1980s by sweep accounts and are largely met by vault cash that banks hold at branches and ATMs
 - Recently, required reserves were \$71 billion, just 0.6% of total bank assets. Vault cash satisfied the majority of these requirements, to the amount of \$43 billion.
 - Many countries have no reserve requirements
 - Quantity of reserves no longer determines bank lending
- **Needed:** new understanding of the role and effects of reserves in the banking system

Rates move together and are negatively correlated with reserves



- O/N Treasury Repo
- Eurodollar (ED)
- 1 Month CD
- 4 Week T-bill
- Fed Funds (FF)
- IOER
- (Total Reserves)

Our framework and results

- Framework of banking lending with interest on reserves and with no binding reserves requirements
- Invariance result for the quantity of reserves with no frictions
 - Bank lending quantities and interest rates are invariant to the level of reserves chosen by the central bank
 - Banks lend up to the point where the marginal return on loans equals its opportunity cost of holding reserves (IOER)
 - IOER is equivalent to banks' previous opportunity cost
 - Lending fed funds
 - Under few reserves and no IOER
- Large reserves may be contractionary and deflationary when there are balance sheet costs near the zero lower bound on rates

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Participants in the economy

- Banks (**B**)
- Firms (**F**)
- Money Market Funds (**MMF**)
- Households (**H**)
 - The rest of the economy
- Central Bank (**CB**)
- Government (**G**)

Assets

- Bank deposits (**D**)
 - Held by households
- Loans (**L**)
 - From banks to firms
- Government bonds (**B**)
 - T-bills
 - Held by the central bank (**B^{CB}**)
 - Held by households (**B^H**) through shares in MMFs
 - Banks do not hold bonds for simplicity
- Money (**M**)
 - Reserves
- Market returns on assets: **R^D**, **R^L**, **R^B**
 - Simplify: no credit risk
- **R^M ≡ IOER**

Real economy

- Households

- Sell endowment E at P_0 (normalized to 1) or hold as storage at $t=0$
- Hold residual claims (equity) of firms and banks, not traded for simplicity
- Buy production goods for consumption at price $P_1 \equiv P$ at $t=1$
- Goods prices (inflation) $\Pi \equiv P = \frac{P_1}{P_0}$ is determined

- Firms

- Buy household endowment at $t=0$ and sell production goods at $t=1$

Preferences and optimizations

- Households maximize expected utility:

$$\max \left(\frac{R^D D + R^B B^H}{P} + S \right)$$

$$\text{s. t. } D + B^H + S = E$$

- Firms maximize profits:

$$\max [P \int r(L) - R^L L]$$

- $r(L)$ is a firm's marginal real return on production

- Banks maximize expected profits:

$$\max [(R^L L + R^M) - \int C(D)]$$

- $C(D^0)$ is a bank's marginal nominal balance sheet cost

Equilibrium

An equilibrium is:

- Quantities (D, L, M, B^H, B^{CB}) and rates (R^D, R^M, R^L, R^B, P)
- All agents are optimizing at the quantities given the rates
- Markets clear

First order conditions:

- Households:

$$R^B = R^D$$

- Firms:

$$R^L = r(L)P$$

- Banks:

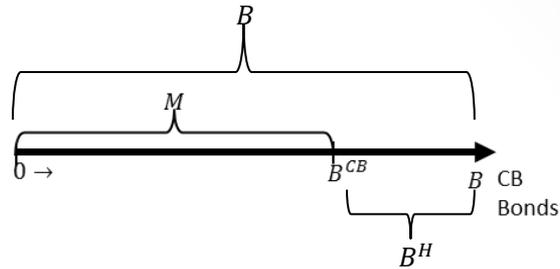
$$R^L = R^M = R^D + c(D)$$

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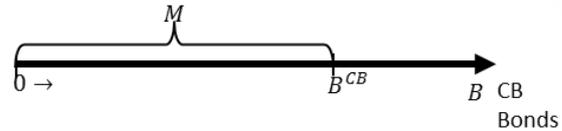
Bonds

Bonds

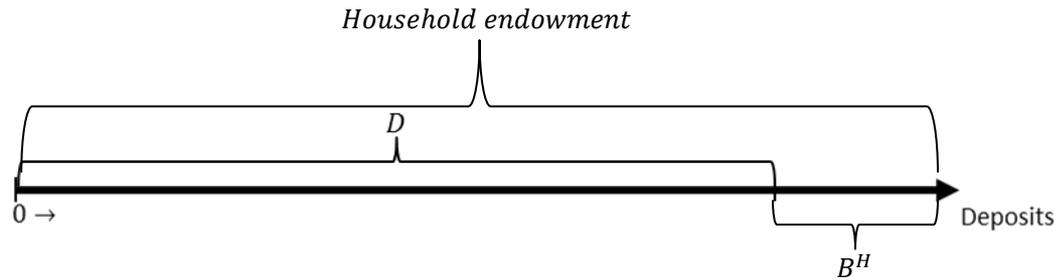


- Government issues a quantity B of bonds
- Central bank issues a quantity M of reserves to buy B^{CB} bonds
- B and M are exogenous
- Households buy the remainder B^H of bonds

Deposits

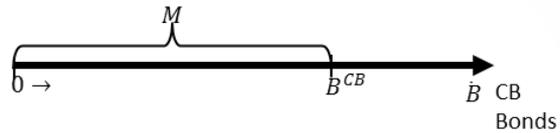


Deposits



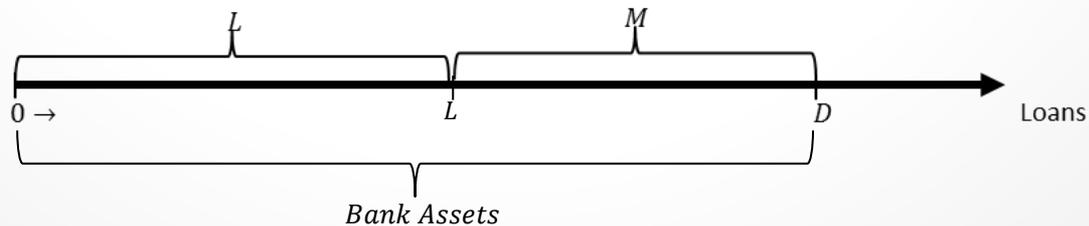
- Household endowment not spent on bonds is invested in bank deposits D

Loans



- The amount of deposits determines bank balance sheet size
- Bank assets not held as reserves are loans L to firms

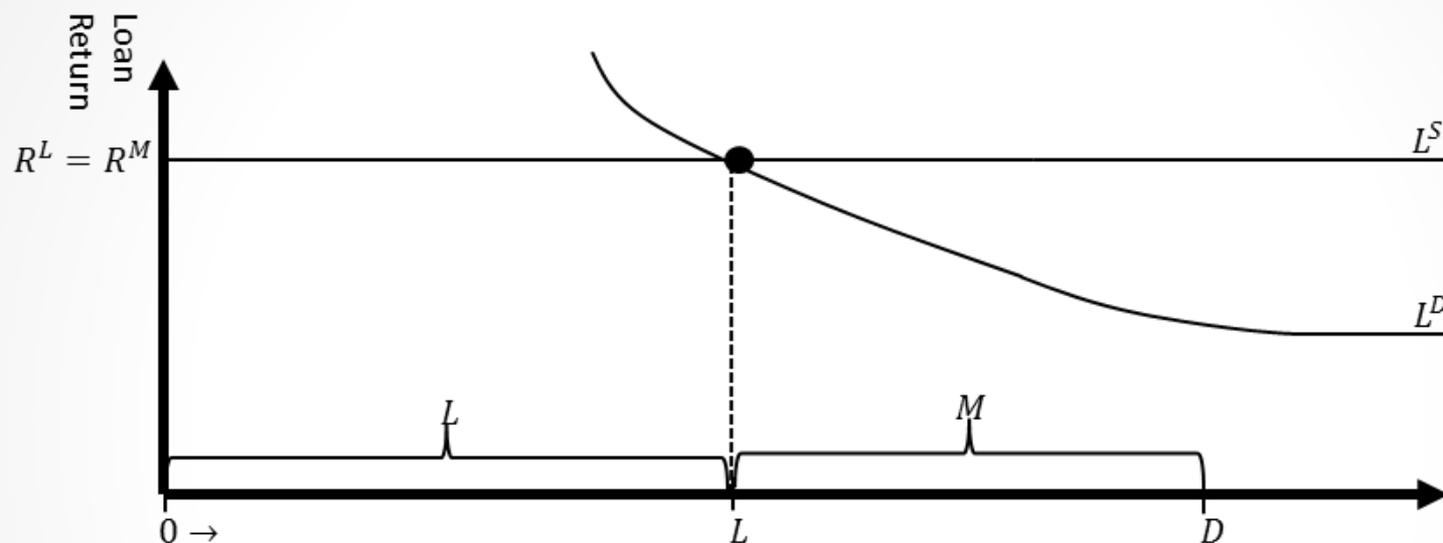
Loans



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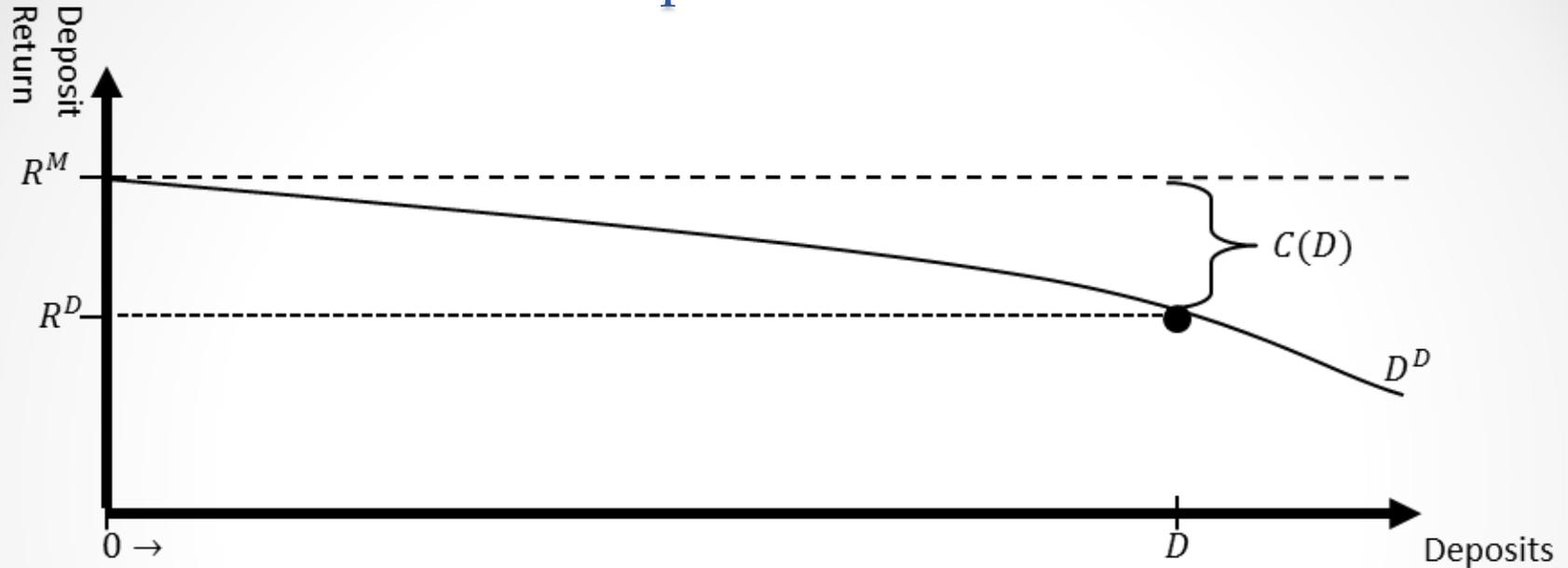
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Loan market



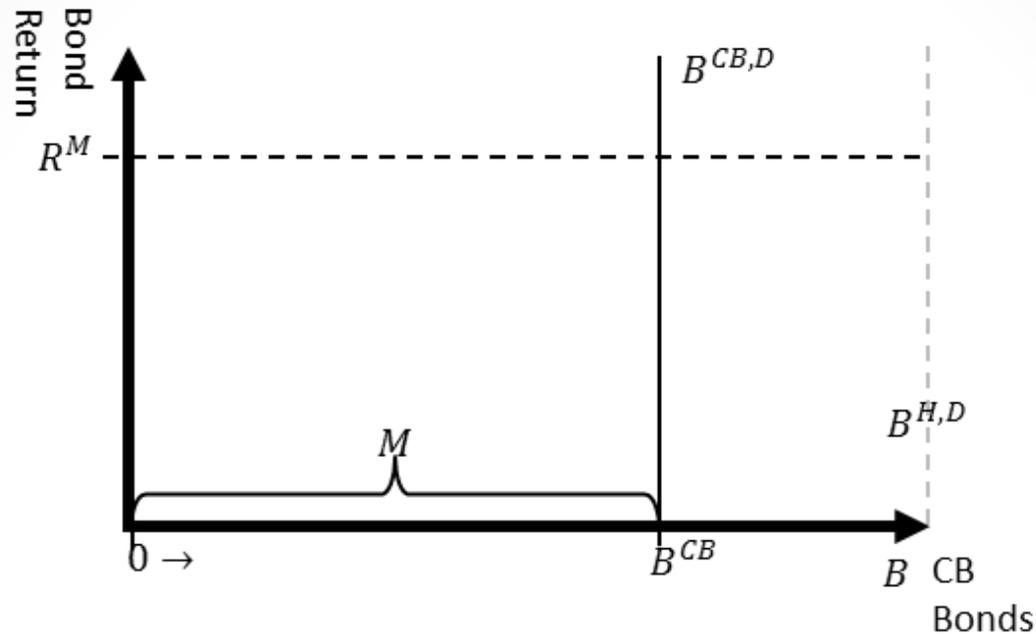
- Firms have a downward sloping demand curve for loans L^D
 - Reflects diminishing marginal return on production
- Banks' loan supply L^S is perfectly elastic at $R^M \equiv \text{IOER}$
 - Bank must be indifferent between loans and reserves at the margin
- Equilibrium loan rate R^L equals R^M
- Equilibrium loan quantity L equals $(D - M)$

Deposit market



- $C(D)$ is a bank's marginal balance sheet cost
 - $C(D)$ increases with the size D of a bank's balance sheet
- Balance sheet cost includes:
 - shadow price of leverage requirements
 - deposit insurance
- $C(D)$ pushes banks' demand curve for deposits D^D below R^M
 - The balance sheet cost is pushed onto depositors
- R^D is determined by the quantity of deposits

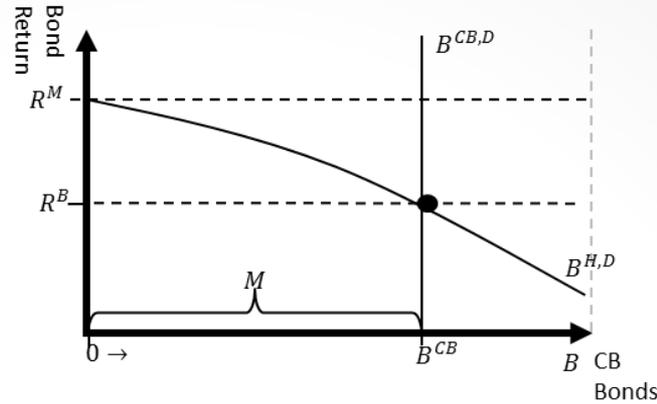
Bond market



- Central bank has a perfectly inelastic demand for bonds $B^{CB,D}$ at the reserve level M
- Excess bond supply available to households $(B - B^{CB})$ is perfectly inelastic

Bond and deposit market

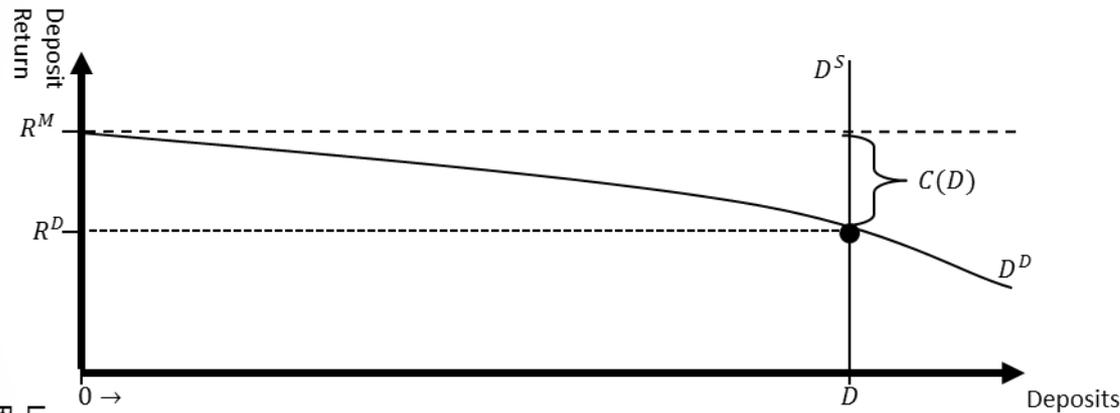
Bond market



Households' supply of deposits D^S is inelastic at $(E - B^H)$

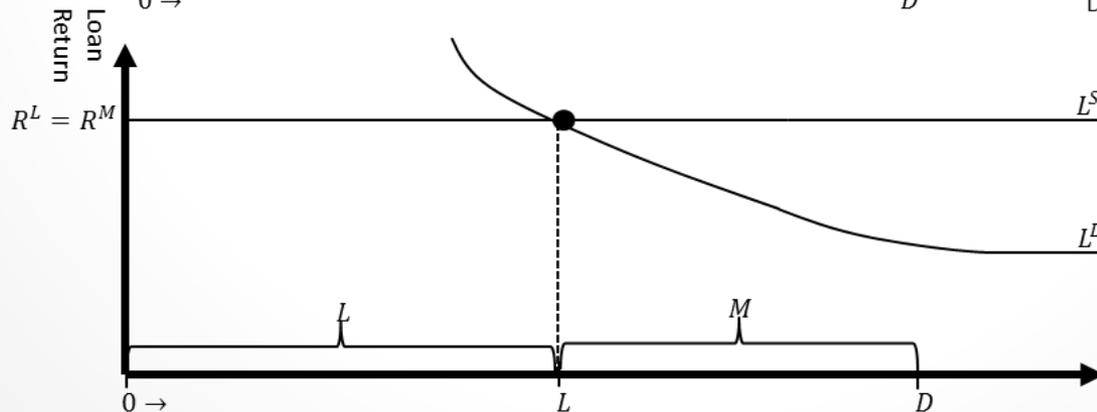
Households must be indifferent between deposits and bonds

Deposit market



$B^{H,D}$ is a downward sloping equilibrium rate correspondence determined by equilibrium in the deposit market

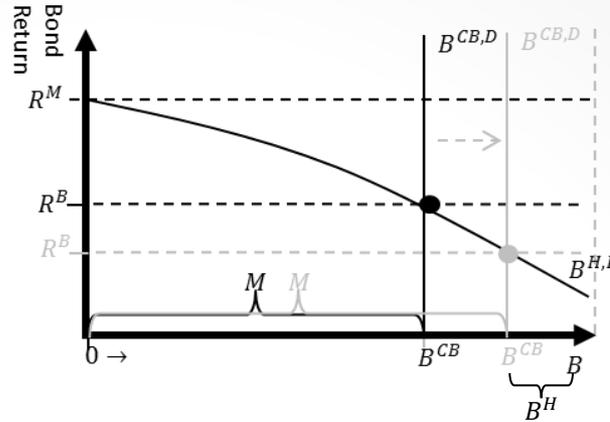
Loan market



Equilibrium bond rate R^B equals R^D , below R^M

Increase in reserves

Bond market

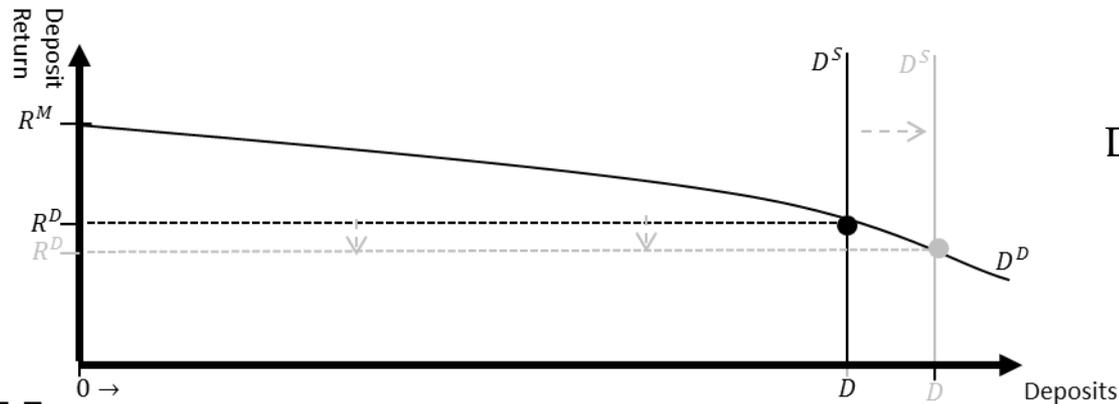


An increase in M :
 Increases B^{CB}
 Decreases B^H

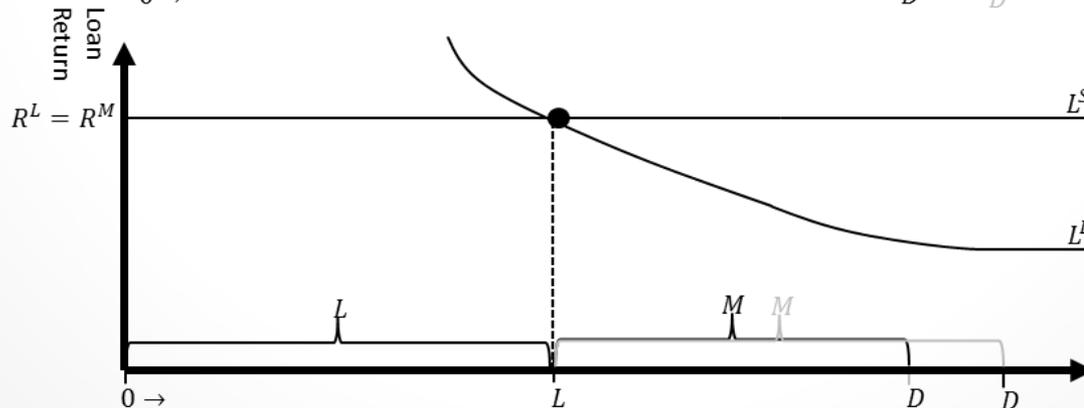
Increases:
 Deposits D
 Balance sheet size
 and costs $C(D)$

Decreases:
 Bond rate R^B
 Deposit rate R^D

Deposit market



Loan market

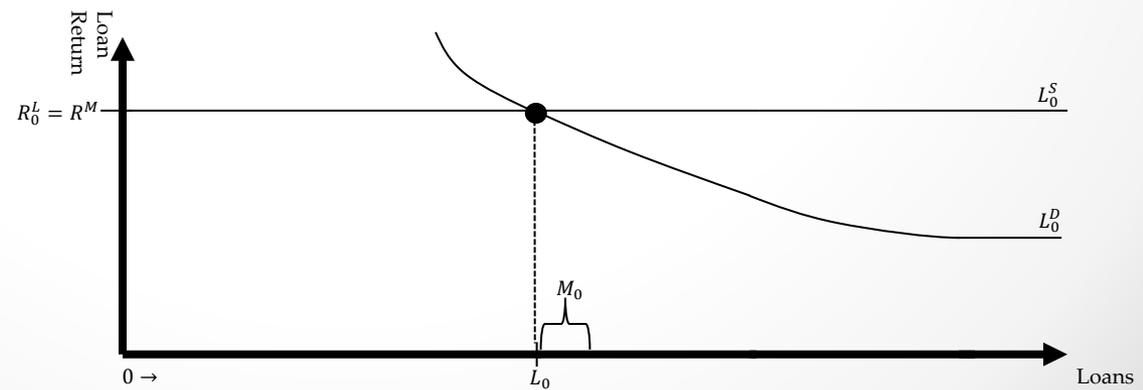
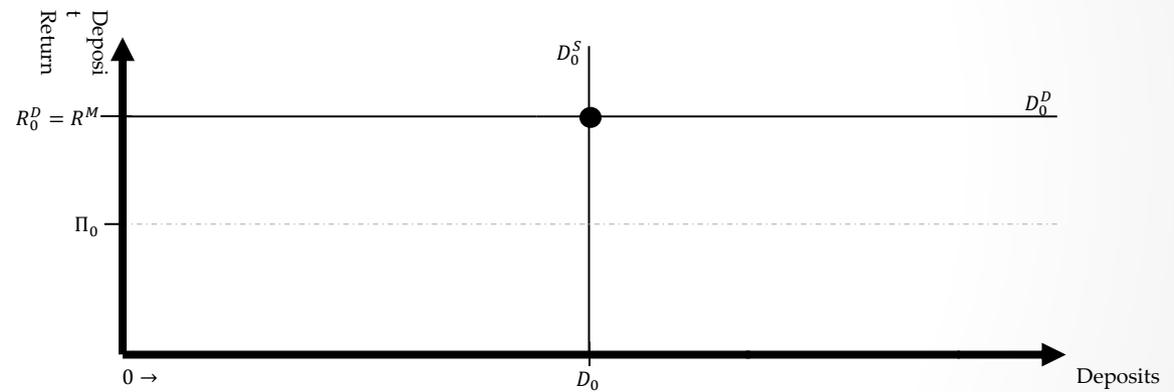
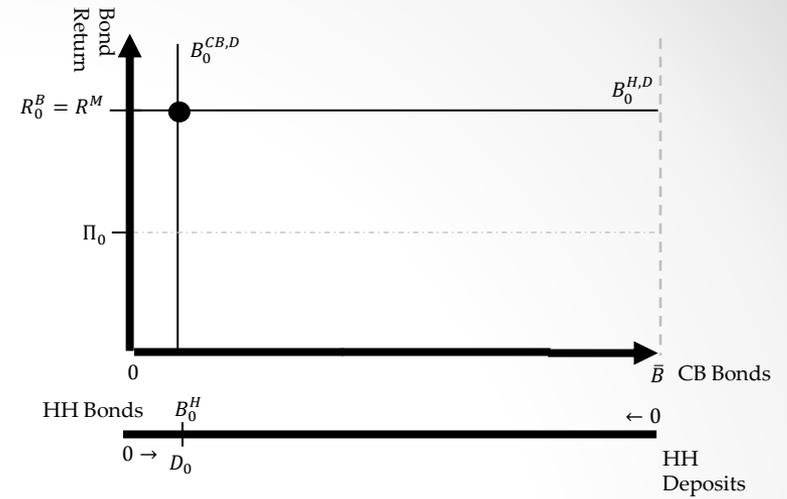


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Frame 0

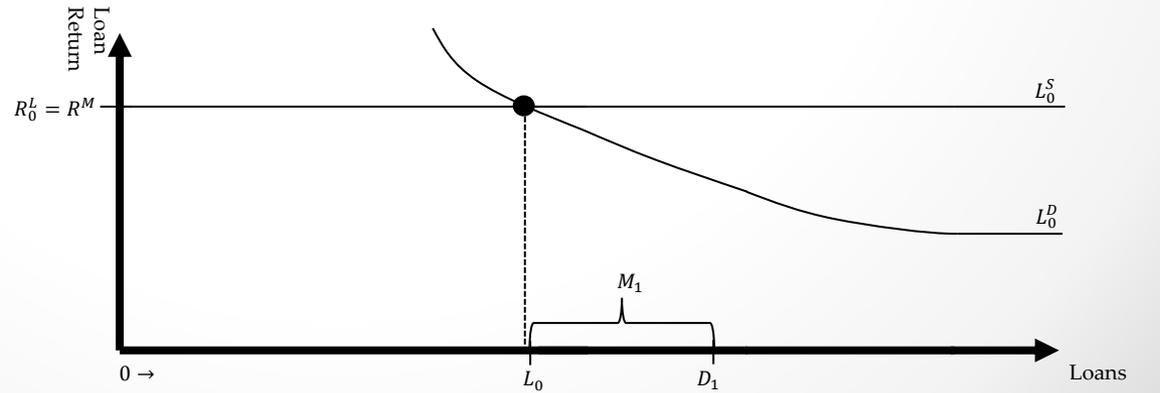
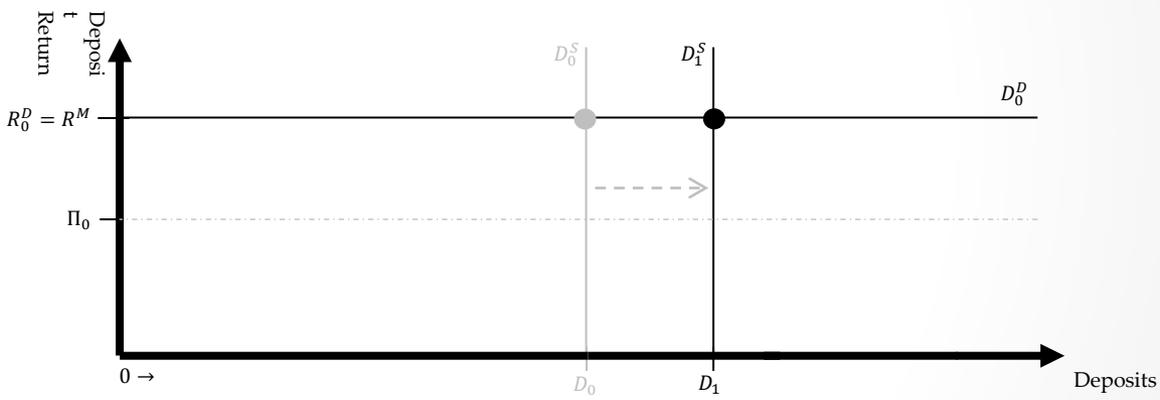
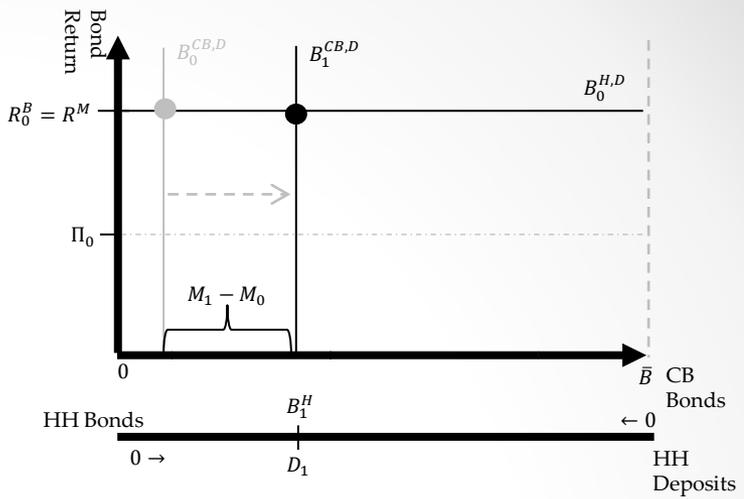
Starting with no balance sheet costs and few reserves...



Frame 1

With no balance sheet costs

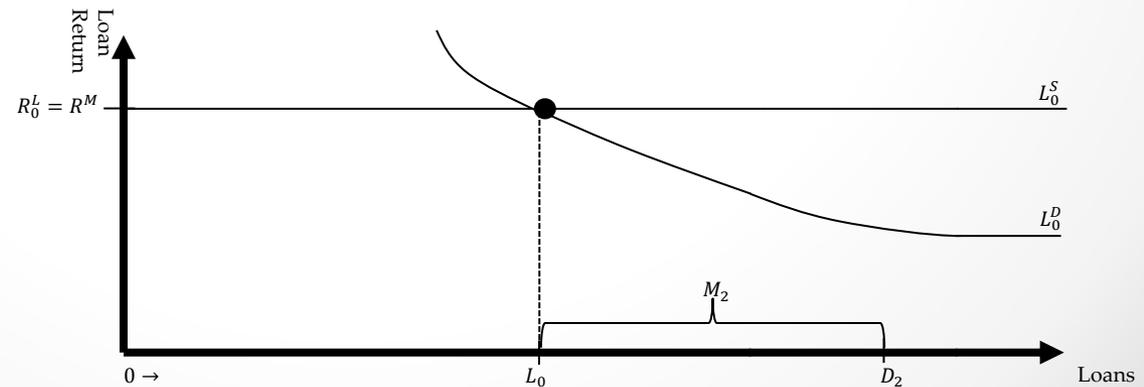
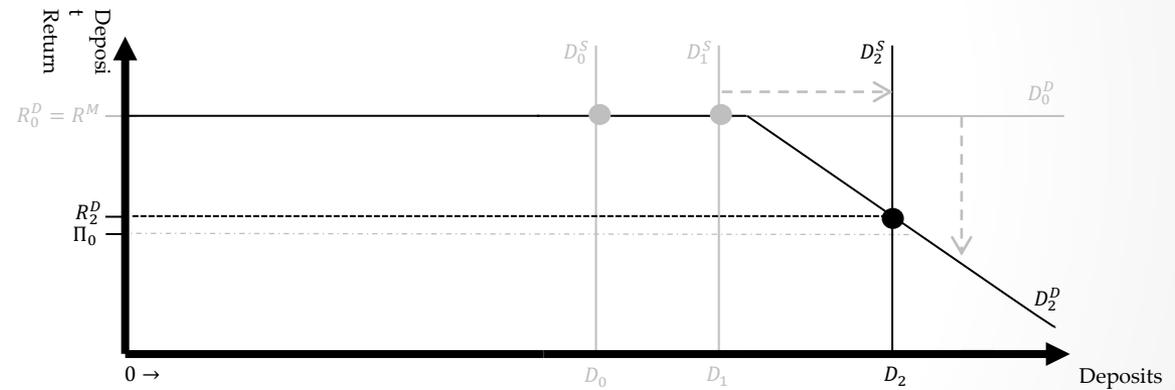
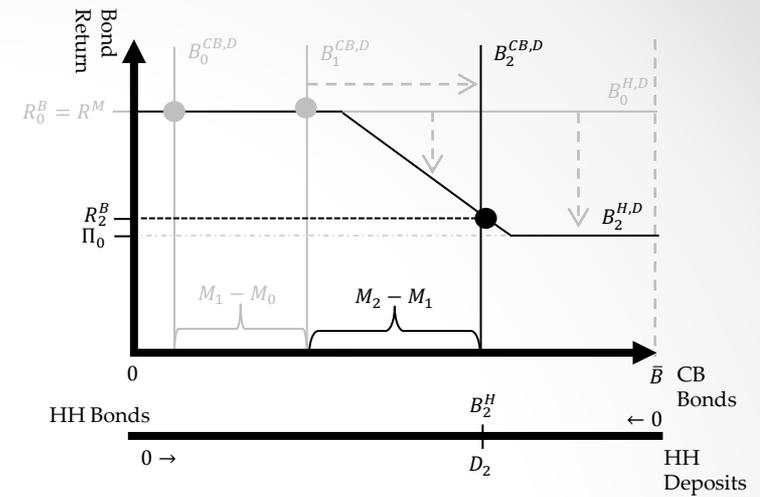
- The quantity and marginal return of lending by the banking sector are independent of the quantity of reserves



Frame 2

For moderate balance sheet costs and reserve levels

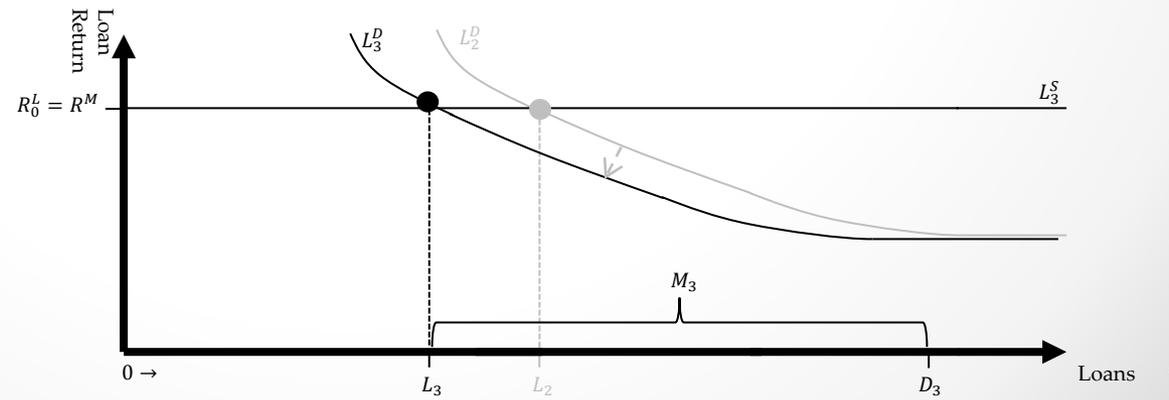
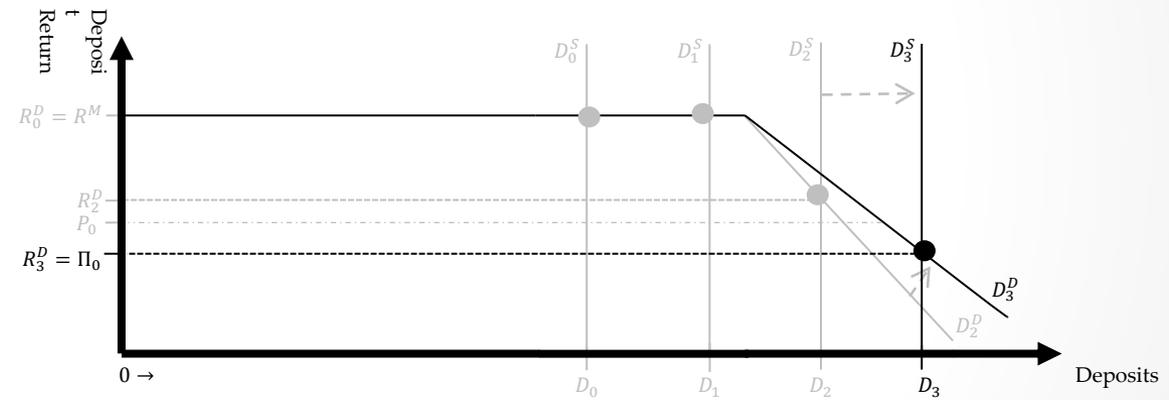
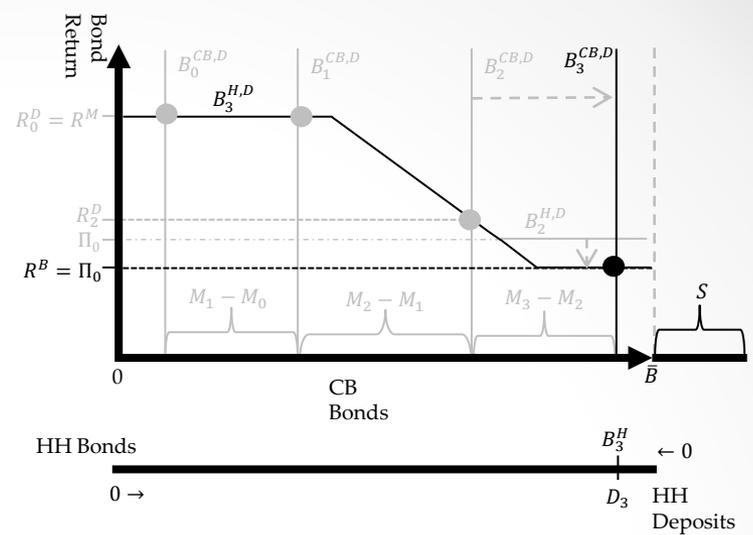
- The marginal return on lending equals IOER
- This determines the quantity of bank lending
- Lending is independent of balance sheet costs and reserves



Frame 3

For large enough balance sheet costs and/or reserves

- The rate on deposits and bonds decreases to the inflation rate
- The inflation rate decreases with the quantity of reserves
- The real deposit and bond rates hit the zero lower bound
- Storage is positive
- Bond demand curve shifts downward to reflect decreasing price level
- Deposit demand curve shifts upward with decreasing inflation until the deposit rate and inflation are equated



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Conclusion

- Simple and elementary model
 - The key determinant of bank lending is unaffected by the quantity of reserves
- The money multiplier model obscures this point
 - The money multiplier is a simple but not elementary model
 - Hidden assumption the money multiplier constraint is always binding
- A large quantity of reserves may actually crowd out bank lending because of balance sheet costs
- Companion paper: “Central Bank Policy Tools for Liabilities Management”
- Apply framework to analyze the Federal Reserve’s “exit tools”
 - Term Deposit Facility with banks, Reverse Repos with non-banks