ECON 354
Money and Banking

Professor Yamin Ahmad

Lecture 10: Money Supply

- Understanding the Fed's Balance Sheet
- Open Market Operations
- Deposit Creation

Big Concepts

- Understanding items on the Balance Sheet for Commercial banks and the Fed
- The Bank Lending Channel of Monetary Policy
- How changes in the instruments affects the supply of money
  - Emphasis on Open Market Operations
- Deposit Creation
- Money Multiplier Process
- Non Borrowed Monetary Base and Discount Loans

Note: These lecture notes are incomplete without having attended lectures

Banks' role in the money supply

- The money supply equals currency plus demand (checking account) deposits:

$$M = C + D$$

- Since the money supply includes demand deposits, the banking system plays an important role.

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The Four Players in the Money Supply Process

1. Central bank: the Fed
2. Banks
3. Depositors
4. Borrowers from banks

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The Fed's Policy Tools

- Recall the Fed uses following monetary policy tools:

1. Required reserve ratios
2. The discount rate
3. Open market operations
4. Term Auction Facility
5. Primary Dealer Credit Facility
6. Term Securities Lending Facility

The Federal Reserve System

- The Fed sets required reserve ratios, which are the minimum percentages of deposits that depository institutions must hold as reserves.
- The Fed does not change these ratios very often.
- The **discount rate** is the interest rate at which the Fed stands ready to lend reserves to depository institutions.
- An **open market operation** is the purchase or sale of government securities—U.S. Treasury bills and bonds—by the Federal Reserve System in the open market.

The Fed's Balance Sheet

- On the Fed's balance sheet, the largest and most important asset is U.S. government securities.
- The most important liabilities are Federal Reserve notes in circulation and banks' deposits.
- The sum of Federal Reserve notes, coins, and banks' deposits at the Fed is the **monetary base**.

Understanding the Fed's Balance Sheet

July 2007

Assets		*Liabilities*	
Securities		Federal Reserve Notes	$781.4
Held Outright	$790.6	Commercial Bank Reserve Balance	$16.8
Repos	$30.3	Liabilities related to foreign official and US Treaury Deposits	$42.4
Loans			
Primary Lending (Discount Window)	$0.19	Other Liabilities	$5.7
Foreign Exchange Reserves	$20.8		
Gold	$11.0		
Other Assets	$27.5		
Total Assets	**$880.4**	**Total Liabilities**	**$846.3**

Capital (= Total Assets - Total Liabilities) **$34.1**

Note: Numbers are in Billions of dollars

Composition of Assets

Securities:

- Fed holds securities both outright and as part of repurchase agreements (repos).
- Securities that Fed owns are comprised of US Treasury bills, notes and bonds
- Prior to the crisis, securities amounted to about 90% of the Fed's assets

Composition of Assets

- Definition: Repos – short term collateralized loan in which a security is exchanged for cash with the agreement that both parties will reverse the transaction on a specific future date at an agreed upon price
  - Kind of like an overnight mortgage, e.g. in the same way you would pledge your house to the bank in exchange for a loan (i.e. use the house as collateral), a financial institution pledges a bond to the Fed in exchange for funds, and also promises to reverse the transaction and provide cash for the bond in the near future
  - Fed does this by FRBNY's Open Market Desk through "primary dealers".
- Use of Repurchase Agreements allow for two things:
  - Keeps a fraction of the Fed's asset very short term, allowing flexibility for the Fed to expand and contract the quantity quickly. This allows policy makers to add or take away reserves from the system immediately if needs be.
  - By operating every day, the Fed is in contact with market participants daily.

Composition of Assets

Loans

- The Discount Window serves as an avenue for banks in need of reserves to be able to borrow from the Fed.
  - Fed performs one of it's roles as the Lender of Last Resort.
- Historically, banks have been hesitant to borrow from the Fed because of the stigma attached with borrowing from the Fed.
  - Banks fear that if they borrow from the Fed, other banks and financial institutions will draw negative conclusions about their financial strength.
  - Prior to the 2007-09 crisis, borrowing averaged less than $200 million per day.

Composition of Liabilities

- Currency in Circulation
  - Approximately one-half to two-thirds is typically held outside the U.S.
- Commercial Bank Reserves: Banks hold reserves at the Fed because:
  - The are required to do so
  - They need them to do business so they can meet customer demands for withdrawals and make payments to other banks
  - It is prudent to do so because reserves act as the bank's emergency funds in case of a disaster.

The Fed's Balance Sheet In June 2009

June 2009

Assets		*Liabilities*	
Securities Held Outright	$1,115.8	Federal Reserve Notes	$868.8
US Treasury	$606.2	Commercial Bank Reserve Balance	$844.7
Federal Agency Debt	$82.0	Liabilities related to foreign official	$313.8
Mortgage Backed	$427.6	and US Treaury Deposits	
Repurchase Agreements	$0	Other Liabilities	$6.3
Term Auction Credit	$372.54		
Other Loans	$124.2		
Primary Lending	$42.1		
Asset Backed Commerical Paper	$23.64		
Credit to AIG	$43.1		
Term Security Loan Facility	$15.4		
Commercial Paper Funding Facility	$142.6		
Maiden Lane Assets	$62.5		
Central Bank Liquidity Swaps	$175.7		
Foreign Exchange Reserves	$23.3		
Gold	$11.0		
Other Assets	$51.4		
Total Assets	**$2,079.0**	**Total Liabilities**	**$2,033.5**

Capital (= Total Assets - Total Liabilities) **$45.7**

Note: Numbers are in Billions of dollars

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Key Elements of The Fed's Balance Sheet

Federal Reserve System

Assets	Liabilities
Government securities Discount loans	Currency in circulation (C) Reserves (R)

Monetary Base, ***MB = C + R***

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A few preliminaries

- **Reserves** (***R***): the portion of deposits that banks have not lent out.
- A bank's liabilities include deposits, assets include reserves and outstanding loans.
- **100-percent-reserve banking**: a system in which banks hold all deposits as reserves.
- **Fractional-reserve banking**: a system in which banks hold a fraction of their deposits as reserves.

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Commercial Bank's Balance Sheet

June 2009

Assets	Percent	*Liabilities*	Percent
Reserves and Cash Items	7.75	Checkable Deposits	69.51
Securities	22.26	Nontransaction Deposits	62.49
U.S. Government and Agency state	10.58	Small -denomination Time deposits	44.74
and local governments and		(<$100,000) + savings deposits	
other securities	11.68	Large Denomination time deposits	17.76
		Transactions Deposits	7.01
Loans	59.1	Borrowings	22.49
Commerical and Industrial	12.35		
Real Estate	32.36	Bank Capital	8.0
Consumer	7.33		
Interbank	3.52		
Other	3.5		
Other Assets (for example, physical capital)	10.9		
Total Assets	**100.0**	**Total Liabilities**	**100.0**

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Key Elements of a Commercial Bank's Balance Sheet

Commercial Bank

Assets	Liabilities
Reserves (R) Outstanding loans …	Deposits (D) …

Controlling the Quantity of Money

- How Required Reserve Ratios Work
  - An increase in the required reserve ratio boosts the reserves that banks must hold, decreases their lending, and decreases the quantity of money.
- How the Discount Rate Works
  - An increase in the discount rate raises the cost of borrowing reserves from the Fed and decreases banks' reserves, which decreases their lending and decreases the quantity of money.

Controlling the Quantity of Money

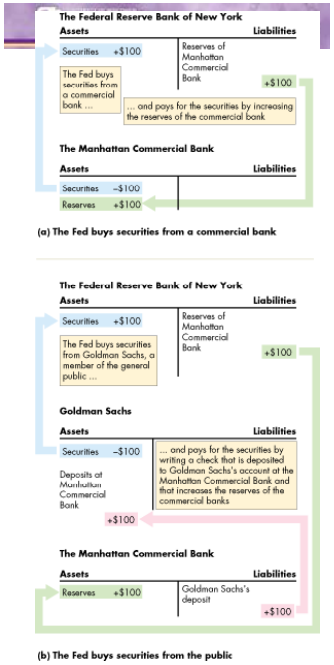
- How an Open Market Operation Works
  - When the Fed conducts an open market operation by buying a government security, it increases banks' reserves.
  - Banks loan the excess reserves.
  - By making loans, they create money.
- The reverse occurs when the Fed sells a government security.

Controlling the Quantity of Money

- Although the details differ, the ultimate process of how an open market operation changes the money supply is the same regardless of whether the Fed conducts its transactions with a commercial bank or a member of the public.
- An open market operation that increases banks' reserves also increases the monetary base.

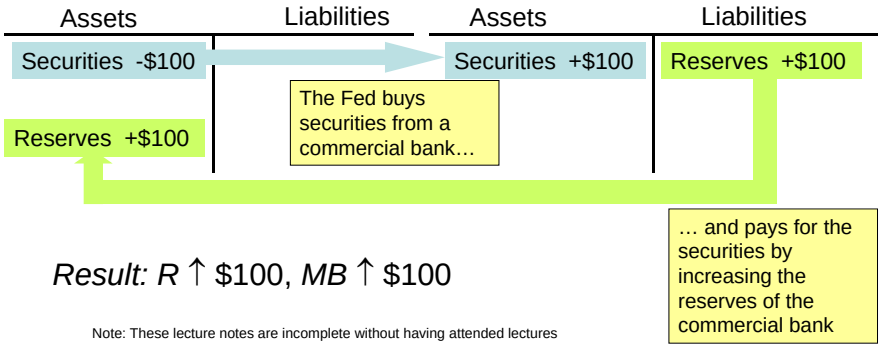
Controlling the Quantity of Money

Figure 1 summarizes both types of open market operation. These are shown in more details on the following slides



Control of Monetary Base

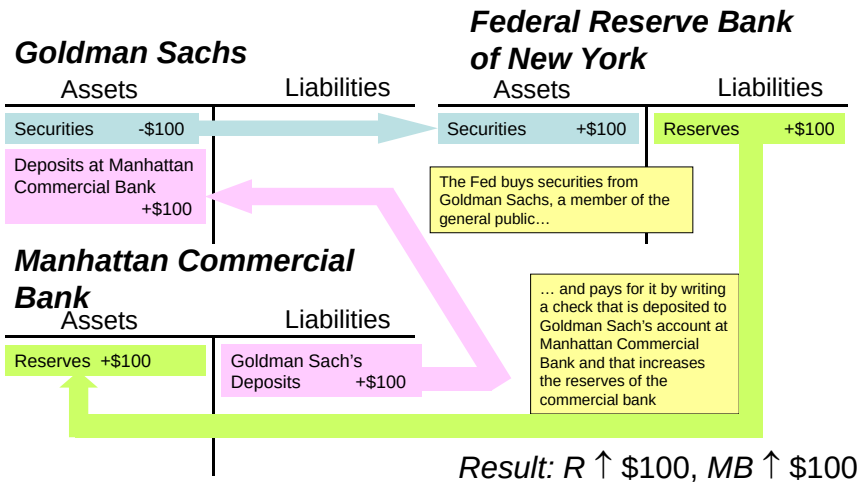
Open Market Purchase From a Bank:



Result: R ↑ $100, *MB* ↑ $100

Control of Monetary Base

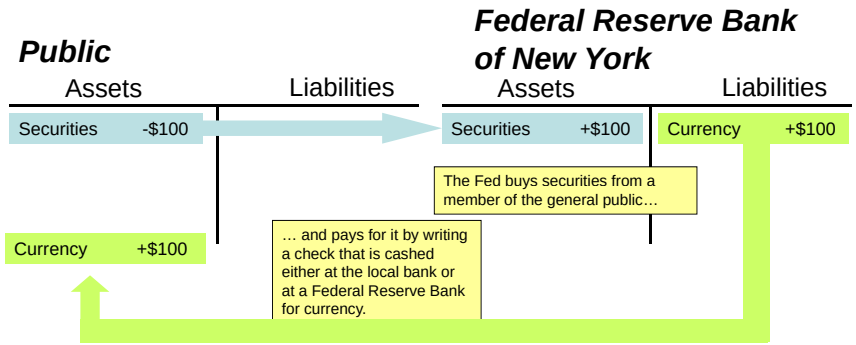
Open Market Purchase from Public



Result: R ↑ $100, *MB* ↑ $100

Control of Monetary Base

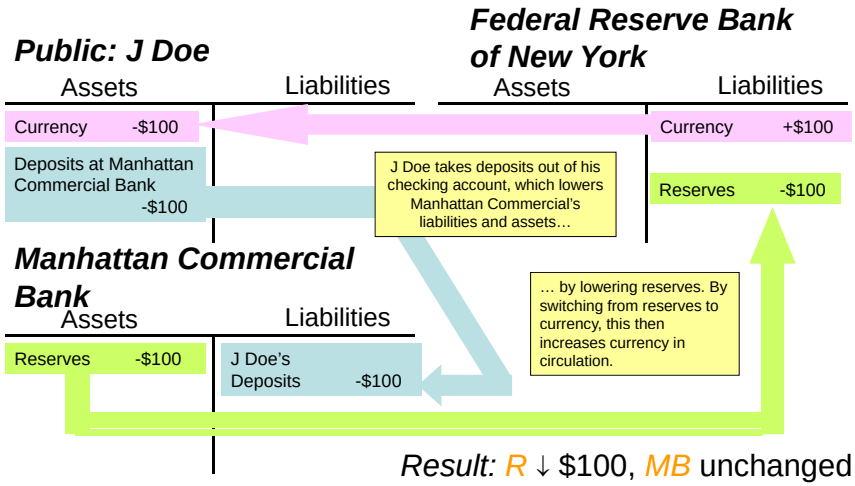
Open Market Purchase from Public: Cashing a Check



Result: R unchanged, *MB* ↑ $100;
Effect on MB certain, on R uncertain

Control of Monetary Base

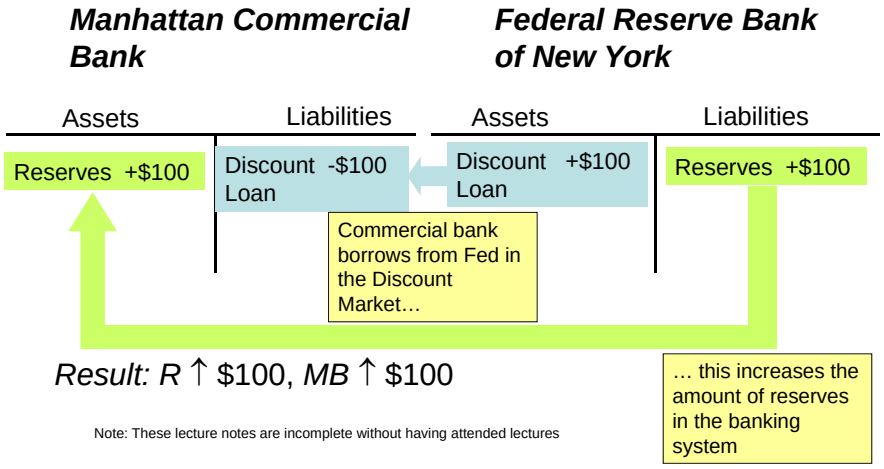
Shifts From Deposits into Currency



Result: R ↓ $100, *MB* unchanged

Control of Monetary Base

Discount Loans:



Result: R ↑ $100, *MB* ↑ $100

… this increases the amount of reserves in the banking system

Conclusion…

Fed has a better ability to control monetary base (MB) than reserves (R)!

Bank Reserves, the Monetary Base, and the Money Multiplier

- The **money multiplier** is the amount by which a change in the monetary base is multiplied to calculate the final change in the money supply.
- An increase in currency held outside the banks is called a **currency drain**.
- Such a drain reduces the amount of banks' reserves, thereby decreasing the amount that banks can loan and reducing the money multiplier.

Controlling the Quantity of Money

- The money multiplier differs from the deposit multiplier.
- The deposit multiplier shows how much a change in reserves affects deposits.
- The money multiplier shows how much a change in the monetary base affects the money supply.

Note: These lecture notes are incomplete without having attended lectures

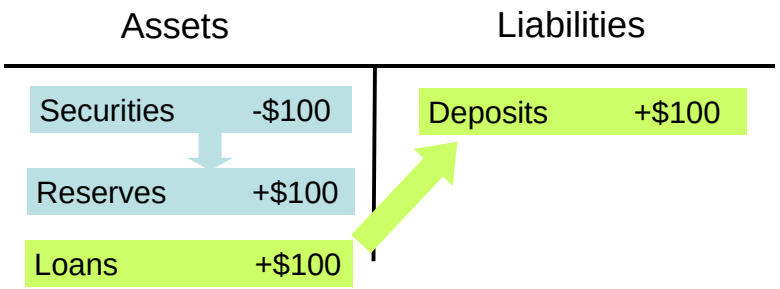
A Simpler Example…

- An Example of Deposit Creation!

Deposit Creation: Single Bank

Suppose the Fed bought $100 securities from Manhattan Commercial Bank via an open market purchase.

- What does Manhattan Commercial do with excess reserves?



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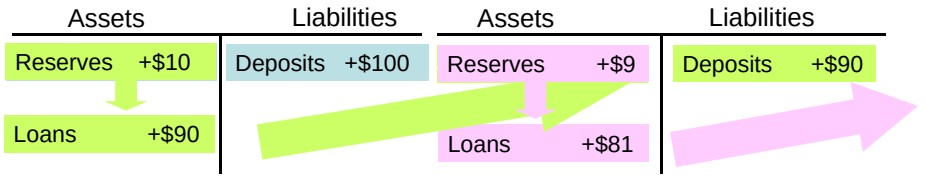
Deposit Creation: Banking System

What happens next at other banks…

Fleet Bank ***Bank One***



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Deposit Creation

Creation of Deposits (assuming 10% Reserve Requirement and $100 increase in reserves)

Bank	Increase in Deposits	Increase in Loans	Increase in Reserves
Manhattan Commercial	0.00	100.00	0.00
Fleet Bank	100.00	90.00	10.00
Bank One	90.00	81.00	9.00
Bank A	81.00	72.90	8.10
Bank B	72.90	65.61	7.29
Bank C	65.61	59.05	6.56
Bank D	59.05	53.14	5.91
.	.	.	.
.	.	.	.
.	.	.	.
Total For All Banks	1000.00	1000.00	100.00

Deposit Creation

If Fleet Bank buys securities with $90 check

Fleet Bank

Assets		Liabilities	
Reserves	+ $10	Deposits	+ $100
Securities	+ $90		

Seller deposits $90 at Bank One and process is same

Whether bank makes loans or buys securities, get same deposit expansion

Deposit Multiplier

Simple Deposit Multiplier

$$\Delta D = \frac{1}{r} \times \Delta R$$

i.e. the change in reserves that arises is a multiple of the change in deposits.

Derivation of the Simple Deposit Multiplier

- Total Reserves = Required Reserves + Excess Reserves, i.e. R = RR+ER
- Assume that banks hold no excess reserves, i.e. ER=0
- Then: $R = RR = r \times D$

$$\Rightarrow D = \frac{1}{r} \times R$$

$$\Rightarrow \Delta D = \left(\frac{1}{r}\right) \times \Delta R$$

Deposit Creation: Banking System as a Whole

Banking System

Assets	Liabilities
Securities – $100	Deposits + $1000
Reserves + $100	
Loans + $1000	

Critique of Simple Model

From our simple model, deposit creation stops if:

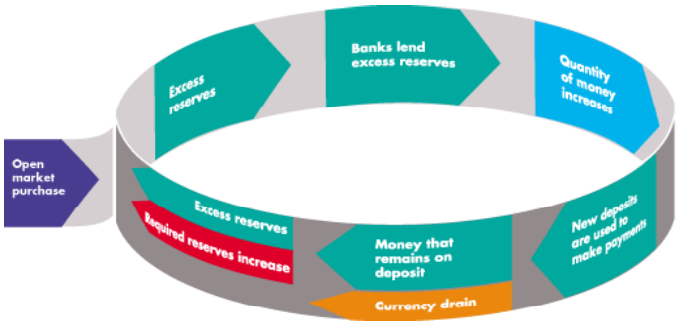
1. Proceeds from loan kept in cash
2. Bank holds excess reserves, ER

The Multiplier Effect of an Open Market Operation

- When the Fed conducts an open market operation, the ultimate change in the money supply is larger than the initiating open market operation.
- Banks use excess reserves from the open market operation to make loans so that the banks where the loans are deposited acquire excess reserves which they, in turn, then loan.

Controlling the Quantity of Money

Figure 2 illustrates a round in the multiplier process following an open market operation.



Controlling the Quantity of Money

Figure 3 illustrates the multiplier effect of an open market operation.

Extending the model

What happens if:

- People convert loans to currency and hold cash? (Currency drain)
- Banks hold additional reserves beyond what they need to hold in the form of required reserves, i.e. they hold ***excess reserves***.

Deriving The Money Multiplier

Money Multiplier:

$M = m \times MB$; MB = Monetary Base

- Assume: ratio of currency to checkable deposits and ratio of excess reserves to checkable deposits are constant in equilibrium

  i.e. c=C/D and e = ER/D

- Implication: Desired level of currency and excess reserves grow proportionately with checkable deposits

Deriving the Money Multiplier (cont.)

Examining the equation for reserves:

$R = RR + ER$; R = Reserves, RR = Required Reserves

$RR = r \times D$; D = Deposits

$R = (r \times D) + ER$; ER = Excess Reserves

- Note: r<1

Adding C to both sides

$R + C = MB = (r \times D) + ER + C$

$$R + C = MB = (r \times D) + ER + C$$

Equation above tells us three things:

1. Tells us amount of *MB* needed support *D*, *ER* and *C*
2. An increase of $1 of MB in C, does not get multiplied, whilst those that go into supporting deposits (e.g. Reserves) does get multiplied.
3. An increase of $1 of *MB* in *ER*, does not support *D* or *C*

$$MB = (r \times D) + (e \times D) + (c \times D)$$
$$= (r + e + c) \times D$$

Deriving the Money Multiplier (cont.)

$$D = \frac{1}{r + e + c} \times MB$$

$$M = D + (c \times D) = (1 + c) \times D$$

$$\Rightarrow M = \frac{1 + c}{r + e + c} \times MB$$

$$\text{where} \quad m = \frac{1 + c}{r + e + c}$$

Exercise 1…

- *Suppose: r=0.2, M=$1500 billion, C=$500 billion, D=$1000 billion, ER=$1.2 billion*
- What is the money multiplier?
  - Answer:
- What is the value of the monetary base?
  - Answer:

Exercise 2…

$$\boldsymbol{M = m \times B} \text{ where } \boldsymbol{m = \frac{1 + c}{r + e + c}}$$

Question: Suppose households decide to hold more of their money as currency and less in the form of demand deposits.

1. Determine impact on money supply.
2. Explain the intuition for your result.

$$M = m \times MB = \frac{1+c}{r+e+c} \times MB$$

Note:

- $m < 1/r$ because no multiple expansion for currency and because as $D \uparrow$ $ER \uparrow$

- The money supply, M (and the money multiplier, m) is negatively related to
  - The required reserve ratio, r
  - The currency ratio, c
  - The excess reserve ratio, e

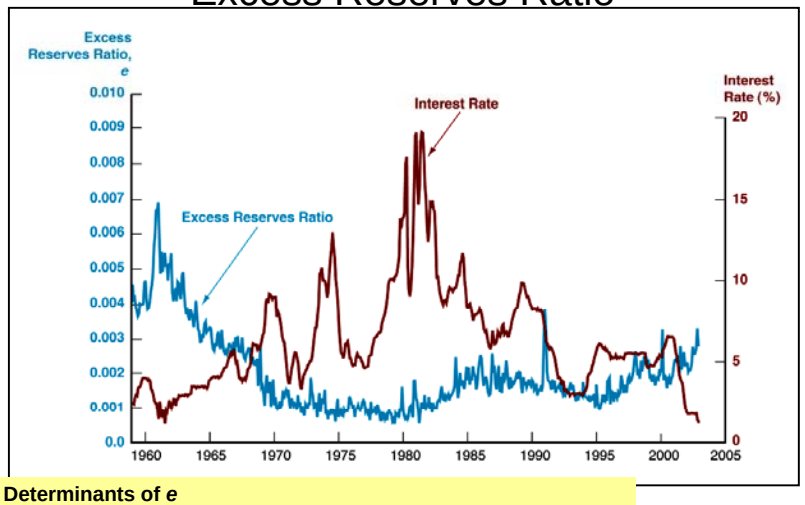
What factors influence bank's holdings of Excess Reserves?

The banking system's excess reserve ratio e is:

- ***negatively*** related to the market interest rate, i

- ***positively*** related to expected deposit outflows

Excess Reserves Ratio



Determinants of *e*

1. ***i*** **↑, relative** R^e **on *ER*** **↓ (opportunity cost ↑),** ***e*** **↓**
2. **Expected deposit outflows, *ER* insurance worth more, *e* ↑**