

W5

## 1. Central Bank:

- responsible for Money Supply  
conduct monetary policy to affect economics

## 2. Factors that affects central Bank:

### ① Public Interest View

Aims to max well being of Society

### ② Principal Agent View

Aims to max its own well-being (protect their position)

Ex: Before election: Increase Interest Rate  $CIDT$

to increase Economic activities

↓

Re-election of the incumbent gov to protect their own decision

通过降低利率  $\Rightarrow$  刺激经济  $\Rightarrow$  以此来增加现任政府的连任机会

↓

"Political business cycle"

Can Avoid "political business cycle"

If central Banks are independent

↓

decrease inflation  $\Rightarrow$  generate "Price Stability"

without generating employment / output

fluctuations

## Argument Supports central Bank Independence

- ① Monetary Policy is too important and technical to be determined by politicians

↓

Because of frequency of elections, politicians may be shortsighted and concerned with short-term benefits without regard to potential long-term costs

- ② Complete control of central Banks by elected officials Increases the influence of political business cycles on the Money Supply

## Argument Against central Bank Independence

- ① If the central Bank was controlled by elected officials, monetary policy could be coordinated with gov taxing and spending policy.

- # No universal agreement on the merits of Central Bank Independence

## Facts regarding Central Bank's Independence

1. Many believe that an independent central Bank improves Economy's performance by lowering inflation without raising output or employment fluctuations ↗(降低通胀)
2. Most independent central banks had the lowest average rate of inflation during 1970s and 1980s

## Part 2: Monetary Supply

### 2.1 Formula for money Supply

Money Supply

$$M = \underbrace{m}_{\text{Money multiplier}} \times \underbrace{B}_{\text{Monetary Base}}$$

Money multiplier

### 2.2 Money Supply is determined by

① The Central Bank :

Control Money Supply and regulating the Banking System

② The Banking system :

Create the checking account (活期存款账户) that are a major component of M1, and make loan

③ The Non-Bank public (all household and firms)  
decide the form they wish to hold money

### 2.3 The Money Supply Process :

① The Process Starts with Monetary Base

$$B = \underbrace{R}_{\text{Reserves}} + \underbrace{C}_{\text{Currency in Circulations}}$$

Reserves currency in Circulations

② From  $M = \underbrace{m}_{\text{Money multiplier}} \times \underbrace{B}_{\text{Monetary Base}}$

If money multiplier are stable, the central Bank can control the Money Supply by controlling the monetary Base.

↓

There's a close connection between the monetary base and central Bank's balance sheets.

2.4

## Central Bank Balance Sheet

	Asset	Liability
OMO = Buying / Selling Securities	Securities ① Treasury Bonds ② Others E.g. C. Bonds	Currency (C) } Reserves (R) } $B = C + R$
Discount loans	Loans to financial Institutions	

discount rate: Interest rate charged by Central Banks

用于应对客户日常  
个提款需求

银行的库存现金  
↑

Reserves (R) =

Bank's deposits held with central bank + vault cash

商业银行存放中央银行的存款 (cash held by Banks)

Reserves = Required reserves + Excess Reserves

$$(R) = (RR) + (ER)$$

↓

$$RR = r_D \cdot D \rightarrow deposit$$

Required  
reserves

required reserve ratio (determined by CB)

- Required reserves:

Reserves that CB requires Bank to hold

- Required Reserve Ratio:

the percentage of checkable deposits that CB specifies that Bank must hold as reserves

Q: Why reserves are assets for banks and liabilities for the central Bank

Banks deposit some money into central Bank

and Banks can request that the CB repay the deposit on demand

Outstanding currency (流通的货币) =

Currency held by non-bank public

(非银行公众持有的现金)

## 2.5 Monetary Base 分为

{ ① Borrowed Monetary Base  
② Non-Borrowed Monetary Base

1. Borrowed Monetary Base (借入的货币基础): 这是指商业银行通过向中央银行借款获得的货币基础。商业银行可以通过向中央银行申请贴现贷款 (Discount Loans) 来获得这些资金，贷款的利率就是中央银行设定的贴现率 (Discount Rate)。因为这些资金是银行向中央银行借入的，因此被称为 Borrowed Reserves (借入准备金)，并形成货币基础的一部分。

2. Non-borrowed Monetary Base (非借入的货币基础): 非借入的货币基础是指通过中央银行的公开市场操作 (Open Market Operations) 直接注入市场的货币。这部分货币基础并不是通过商业银行向中央银行借款产生的，而是通过中央银行在公开市场上购买证券 (如国债) 等方式直接创造的货币基础。这部分货币基础由中央银行完全控制。

## 2.6 How does CB influence Money Supply?

### ● Changing the Monetary Base (CB)

$$B = \underline{B_{\text{non}}} + \underline{BR} \rightarrow \begin{matrix} \text{Borrowed Monetary Base} \\ \downarrow \\ \text{non-borrowed Monetary Base} \end{matrix}$$

↓  
DMD

CB affects Monetary Base (B) by changing the assets

① By DMD  
  |  
  | DMP (Open market purchase)  
  | OMS (Open market Sale)

CBs have Direct Control over DMDs

② Discount Loans  
  |  
  | CBs need to change  
  | the discount Rate

CBs do not have direct control

"Non-Borrowed Monetary Base"

"Borrowed Monetary Base"

## Ex 1: Open market purchase

The Fed (C.B.) Buys \$1 million Treasury Bill from PNC Bank

→ C.B. uses Reserve to buy Securities from Bank

### ① Banking System

Asset	Liability
Securities	- \$1 million
Reserves	+ \$1 million

### ② Federal Reserve

Asset	Liability
Securities	+ \$1 million

Result: The monetary Base Increases ↑ by the amount of an open market purchase

$$B = \underbrace{\text{Reserve } (R)}_{\uparrow} + \text{Currencies } (C)$$

Open market purchase ⇒ Increase Reserves



Increase non-Borrowed Monetary Base

## Ex2: Open market Sale

The Fed (C.C.B.) sells \$1 million Treasury Bill to the Bank of America

### ① Banking System

Asset	Liability
Securities + \$1 million	
Reserves - \$1 million	

### ② Federal Reserve

Asset	Liability
Securities - \$1 million	Reserves - \$1 million

Result: The monetary Base decreases ↓ by the amount of an open market sales

$$B = \underbrace{\text{Reserve } (R)}_{\downarrow} + \text{Currencies } (C) \quad \downarrow$$

Open market sale  $\Rightarrow$  Reserves ↓



decrease non-Borrowed Monetary Base

Ex 3 : Household and firms decide to withdraw  
\$1 million from their checking account  
→ to get currency

### ① Non-Bank public

Asset	Liability
checkable deposits - \$1 million	
Currency + \$1 million	

### ② Banking System

Asset	Liability
Reserves - \$1 million	checkable deposits - \$1 million

### ③ Federal Reserve

Asset	Liability
	currency + \$1 million
	Reserves - \$1 million

The public's preference for currency relative to checkable deposits does not affect the Monetary Base

$$\tilde{B} = \tilde{C} + \tilde{R}$$

不变 ↑ ↓ → 无论公众倾向于持有现金还是存款，  
他们的选择本身不会改变货币基础

## Explanation:

### 银行提取储备金兑换现金：

- 当公众从他们的银行账户中提取现金时，银行需要向联邦储备系统（中央银行）请求相应的现金。为了获得这些现金，银行会使用它们在联邦储备系统中的储备金来兑换。
- 这时，联邦储备系统会从其储备中提取现金并交给银行。于是，这些现金就成为了流通中的货币，而联邦储备的储备金则相应减少。

### 流通中的货币成为中央银行的负债：

- 当这些现金（Currency）离开联邦储备系统进入流通时，它就不再属于联邦储备系统的资产，而成为其负债。这是因为，所有流通中的现金都是中央银行对公众的债务——换句话说，中央银行承诺随时用这些现金履行其法定价值。

Ex 4: \$1 million discount loan is made by Fred to commercial Bank

### ① Banking System

Asset	Liability
Reserves + \$1 million	Discount loan + \$1 million

### ② Federal Reserve

Asset	Liability
Discount loan + \$1 million	Reserves + \$1 million

### 贷款的形式：

贷款是以货币（通常是准备金的形式）发放的，也就是说，中央银行将一定数额的资金直接存入商业银行在中央银行的储备账户。这些资金立即可用于满足商业银行的流动性需求或储备要求。

Result: discount loan will increase Monetary Base

Ex 5: Banks repay \$1 million discount loans to the  
Fred

① Banking System

Asset		Liability	
Reserves	-\$1 million	Discount loan	-\$1 million

② Federal Reserve

Asset		Liability	
Discount loan	-\$1 million	Reserves	-\$1 million

## 2.7 How Bank responds to an Increase to Reserves

Ex1: The Fed purchases \$100,000 Treasury Bill from Bank of America

Bank of America	
Asset	Liability
Securities	- \$100,000
Reserves	+ \$100,000

美联储购买美国银行的国债

• 为什么美联储购买国债?

- 美联储通过公开市场操作来管理货币供应。当它购买国债时，它实际上是在向市场注入流动性，增加银行系统的储备金。

• 发生了什么?

- 美联储用10万美元购买了美国银行持有的国债。作为交换，美联储将这10万美元存入美国银行在联邦储备系统的储备账户中。

• 资产负债表的变化:

- **资产端：**美国银行的国债减少了10万美元，因为它卖掉了国债。但与此同时，储备金增加了10万美元，这是因为美联储将资金存入了美国银行的储备账户。

- **为什么储备金增加？** 储备金是银行在中央银行持有的资金，银行可以用这些储备金来满足日常清算和支付需求。当美联储购买国债时，支付给银行的资金直接增加了银行在中央银行的储备。

Ex2: Bank of America extends a loan to Rosie's Bakery

Bank of America

Asset

Liability

Securities	- \$100,000	checkable deposits	\$100,000
Reserves	+ \$100,000		
Loans	+ \$100,000		

- 美国银行决定利用新增的10万美元储备金，向Rosie's Bakery发放一笔10万美元的贷款。这笔贷款被存入Rosie's Bakery的支票账户中。

- 资产负债表的变化：

- 资产端：虽然储备金依然是10万美元，但现在银行的资产中新增了一项“贷款”10万美元。这是银行的应收账款，因为Rosie's Bakery未来需要偿还这笔钱。
- 负债端：美国银行的负债端增加了10万美元的“支票存款”，因为这笔贷款被存入Rosie's Bakery的账户，这些钱实际上属于Rosie's Bakery。

Ex3: Rosie's spend the loan by writing a check for \$100,000 to buy ovens from Bob's Bakery Equipment

Bank of America

Asset

Liability

Securities	- \$100,000	checkable deposits	<del>\$100,000</del>
Reserves	0	<del>+ \$100,000</del>	0
Loans	+ \$100,000		

贷款发放：当银行批准并发放一笔贷款时，它实际上是在为借款人创建一笔新资金。在这种情况下，美国银行向Rosie's Bakery发放了10万美元的贷款，这笔钱实际上是银行为Rosie's Bakery创造的新资金。

存入账户：这笔10万美元并不会以现金形式直接交给Rosie's Bakery，而是存入其在美国银行的支票账户。换句话说，这笔贷款成为了Rosie's Bakery在银行的存款。

存款的性质: 对于银行来说, 客户的存款是一种负债。这是因为银行欠客户这些钱, 客户可以随时提取或使用这些资金。因此, 当银行为Rosie's Bakery创建这10万美元的存款时, 这笔钱就成为了银行的负债。

负债的增加: 在银行的资产负债表上, 这10万美元被记录为负债的一部分。尽管这笔钱是银行发放的贷款, 但一旦它成为客户的存款, 就意味着银行欠客户10万美元, 这就是负债。

Ex 4: Suppose Bob's deposit the check in its account with PNC Bank

PNC Bank	
Asset	Liability
Reserves +\$100,000	Checkable deposits \$100,000

- PNC Bank在收到支票后, 向美国银行要求支付这10万美元。美国银行的储备金因此减少10万美元, PNC Bank的储备金增加10万美元。
- 资产负债表的变化:
  - 资产端: PNC Bank的储备金增加10万美元, 因为它从美国银行收到了这笔钱。
  - 负债端: PNC Bank的负债端增加了10万美元的“支票存款”, 这是因为这笔钱被存入Bob's Bakery Equipment的账户。

Ex5: Suppose PNC makes a \$90,000 loan to Jerome's Printing who writes a check in that amount for equipment from Computer Universe who has an account at SunTrust Bank



## PNC Bank

### Asset

Loans	+ \$90,000
Reserves	+ \$10,000
	= \$100,000 - 90,000

### Liability

checkable deposits + \$100,000

- PNC Bank 利用其新增的储备金，向 Jerome's Printing 发放了一笔 9 万美元的贷款。Jerome's Printing 用这笔钱购买了 Computer Universe 的设备，并向其开出支票。

- 资产负债表的变化：

- 资产端： 储备金减少 9 万美元（因为贷款的发放），但增加了 9 万美元的贷款（银行的新资产）。
- 负债端： Jerome's Printing 的支票存款为 9 万美元（用于支付 Computer Universe 的支票）。

## SunTrust Bank

### Asset

Reserves + \$90,000

### Liability

checkable deposits + \$90,000

- 当 Computer Universe 将支票存入 SunTrust Bank，SunTrust Bank 向 PNC Bank 要求支付这笔钱。PNC Bank 的储备金因此减少，SunTrust Bank 的储备金增加。

- 发生了什么？

- SunTrust Bank 收到了 Computer Universe 的支票存款 9 万美元，并向 PNC Bank 要求支付这笔钱。

- 资产负债表的变化：

- 资产端： SunTrust Bank 的储备金增加 9 万美元（因为它从 PNC Bank 收到了这笔钱）。
- 负债端： 支票存款增加 9 万美元（Computer Universe 的账户余额增加）。

Ex 6: Suppose SunTrust Bank lends its new excess Reserves to Howard's Barber Shop to use for remodeling

SunTrust Bank	
Asset	Liability
Reserves +\$ 90,000	checkable deposits +\$ 90,000
Loans +\$ 21,000	

If the proceeds of loan to Howard's Barber Shop are deposited in other bank

Other Bank	
Asset	Liability
Reserves +\$ 21,000	checkable deposits +\$ 21,000

(MO (gov buys Treasury bills from Bank)  
↓

create initial \$ 100,000 increase in Reserve



Increase checkable deposit by  $\$100,000 + \$90,000 + \$21,000$   
 $= \$271,000$



This is called "Multiple deposit creation" =

is part of money supply process

- An increase in Bank Reserves results in rounds of Bank loans and creation of checkable deposits.

↓

An Increase in the Money Supply is a multiple of the initial increase in reserves.

## 2.7 Simple multiplier 公式推導

Multiple Deposit Creation: Assuming a Fed Open Market Purchase of \$100,000 and a Required Reserve Ratio of 10%

Bank	Increase in deposits	Increase in loans	Increase in reserves
PNC Bank	\$100,000	\$90,000	\$10,000
Sun Trust Bank	90,000	81,000	9,000
Third Bank	81,000	72,900	8,100
Fourth Bank	72,900	65,610	7,290
Fifth Bank	65,610	59,049	6,561
Total Increase	1,000,000	900,000	100,000

Simple deposit multiplier is the ratio of the amount of deposits created by banks to the amount of new reserves.

$$\Delta D = 100,000 + [0.9 \times 100,000] + [0.9 \times 0.9 \times 100,000] + \dots$$

$$\Delta D = 100,000 \times [1 + 0.9 + 0.9^2 + \dots]$$

An infinite series such as  $[1 + 0.9 + 0.9^2 + \dots]$ , reduces to:  $\frac{1}{1-0.9} = \frac{1}{0.10} = 10$ .

So,  $\Delta D = 100,000 \times 10 = 1,000,000$ .

Simple deposit multiplier =  $\frac{1}{rr_D}$   $\Rightarrow$  required reserves Ratio  
 ↓

the ratio of the amount of deposits created by banks to the amount of new reserves

Changes in deposit :  $\Delta D = \frac{1}{rr_D} \times \Delta R$  changes in Reserve Ratio  
 required reserves Ratio

意义：当中央银行增加准备金（例如通过公开市场操作购买证券，或向商业银行发放贴现贷款），这些额外的准备金将通过银行系统的多次存款创造（Multiple Deposit Creation）过程转化为更多的存款。在这个过程中，每增加一单位的准备金，银行可以发放贷款，进而产生更多的存款。最终，存款总量的增加是初始准备金增加的倍数。

## 2-8 Increase In Currency Holdings and Increase in Excess Reserves

1. key assumption of deriving deposit multiplier

① Bank holds no excess reserves

② The non-Bank public does not increase its holding of currencies

2. Derive deposit multiplier = we need to change the simple deposit multiplier by

① a link between monetary Base and Money Supply

$$M = m \times B \Rightarrow m = M / B$$

② Include the effect of changes in the non-Bank public's desire to hold currencies relative to checkable deposits

$$m = \frac{\frac{C}{D} + I}{\frac{C}{D} + RR + ER} \Rightarrow \text{Currency to debt Ratio}$$

③ Include the effect of changes in Bank's desire to hold excess reserves

$$m = \frac{\frac{C}{D} + I}{\frac{C}{D} + RR + ER} \Rightarrow \text{Excess Reserve to debt Ratio}$$

$$M = m \times B \Rightarrow m = \frac{M}{B}$$

$M = C + D$   
Currency deposit

$$m = \frac{C+D}{C+R}$$

$B = C + R$   
Currency reserves

$$= \frac{C+D}{C+RR+ER}$$

$$= \frac{\frac{C}{D} + 1}{\frac{C}{D} + \frac{RR}{D} + \frac{ER}{D}}$$

$RR = rr_D \cdot D$   
 $m_D = \frac{RR}{D}$

$\frac{C}{D} + 1$   
 $\frac{C}{D} + rr_D + \frac{ER}{D}$

Excess Reserve to deposit  
Ratio

Currency-deposit ratio

Required reserves ratio

$$M = \frac{\frac{C}{D} + 1}{\frac{C}{D} + rr_D + \frac{ER}{D}} \times B$$

$$= \frac{\frac{C}{D} + 1}{\frac{C}{D} + rr_D + \frac{ER}{D}} \times (B_{non} + BR)$$

$\downarrow$   
OMO

$\downarrow$   
Discount loans

Money Supply (M) will change in the same direction as Monetary Base (B) or the Money Multiplier (m)

$$B \uparrow / m \uparrow \Rightarrow M \uparrow$$

{ Non-Borrowed Base ( $B_{non}$ )  $\uparrow$  :  $\underline{B \uparrow} \Rightarrow M \uparrow$

$$B = R + C$$

$$\uparrow \quad \widehat{\{T\}} \xrightarrow{\text{through OMO purchase}} M^S \uparrow$$

{ Currency to deposit Ratio ( $\frac{C}{D}$ )  $\uparrow$  =  $m \downarrow / M \downarrow$

required reserve ratio ( $rr_D$ )  $\uparrow$  :  $m \downarrow / M \downarrow$

Excess reserves to deposit ratio ( $\frac{ER}{D}$ )  $\uparrow$  =  $m \downarrow / M \downarrow$

An increase in the ...	based on the actions of ...	Causes the money supply to...	because...
non-borrowed base	the CB through open market operations	increase	the monetary base increases, and more reserves are available for deposit expansion
required reserve ratio	the CB through changes in reserve requirements	decrease	fewer reserves can be lent out, and the value of money multiplier falls
currency-to-deposit ratio	the non-bank public	decrease	the value of the money multiplier falls, reducing deposit expansion
excess reserves to deposit ratio	banks	decrease	the value of the money multiplier falls, reducing deposit expansion

Note:

Public's preference for Holding currency / deposit ( $\frac{C}{D}$ ) does not affect Monetary Base (CB)



But will affect deposit multiplier ( $m$ )

By  $M = m \times B$

## 2.9 The Money Supply Process for M2

$$M2 = \underbrace{C}_{\text{Currency}} + \underbrace{D}_{\text{Checkable deposit}} + \underbrace{N}_{\text{Saving and small time deposit}} + \underbrace{MM}_{\text{Money market deposit accounts and similar accounts}}$$

M2 multiplier: 
$$\frac{1 + (\frac{C}{D}) + (\frac{N}{D}) + (\frac{MM}{D})}{(\frac{C}{D}) + rr_D + (\frac{ER}{D})}$$

$M2 = M2 \text{ multiplier} \times \text{Monetary Base}$

Q<sub>1</sub>: Who determines the excess reserve - deposit Ratio  
Banking System

Q<sub>2</sub>: What happens to excess reserves - deposit Ratio during Recession?

Excess reserves - deposit Ratio will increase  
↓

Banks want to protect itself from bankrupt So that they will hold more reserves to protect themselves