

## *Lecture #6*

# Determinants of the Money Supply

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What Determines the Supply of  
Money?

### **Review of Money Creation**

The Federal Reserve affects the  
Monetary Base  
Base = Reserves + Currency  
Open Market Operations or Discount  
Loans  
Changes in the base affect the money  
supply  
Multiple Deposit Creation  
Changes in the money supply affect the  
economy

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### **Goal of today's class**

Formalize the link between changes in the  
base and changes in the money supply  
Develop a formula for the money multiplier  
$$M = (M \times Multiplier) * B$$

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### Three Important Ratios

C = Currency

D = Total Demand Deposits

RR = Required Reserves

ER = Excess Reserves

Currency to deposit ratio (C/D)

$r_d$  = required reserve ratio (RR/D)

Excess reserve ratio (ER/D)

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### Developing the Money Multiplier Formula

$$M = C+D$$

$$M = C/D * D + D$$

$$M = (1+C/D) * D$$

$$D = M * 1 / (1+C/D)$$

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### Developing the Money Multiplier

#### Formula (continued)

$$MB = C+R$$

$$MB = C+ER+RR$$

$$MB = (C/D) * D + (ER/D) * D + (RR/D) * D$$

$$MB = D * (C/D + ER/D + r_d)$$

$$MB = (M * 1 / (1+C/D)) * (C/D + ER/D + r_d)$$

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### Developing the Money Multiplier

#### Formula (continued)

Solving for M yields,

$$M = MB * ((1+C/D) / (C/D + ER/D + r_d))$$

$$M = MB * m$$

m is the money multiplier

One last step:  $MB = MB_n + DL$

$$M = (MB_n + DL) * ((1+C/D) / (C/D + ER/D + r_d))$$

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### Money Multiplier

$$M = m \square MB$$

### Deriving Money Multiplier

$$R = RR + ER$$

$$RR = r_D \square D$$

$$R = (r_D \square D) + ER$$

### Adding C to both sides

$$R + C = MB = (r_D \square D) + ER + C$$

1. Tells us amount of MB needed support D, ER and C
2. An additional \$1 of MB in C does not support additional D.
3. An additional \$1 of MB in ER does not support D or C

$$MB = r_D \square D + \{ER/D\} \square D + \{C/D\} \square D$$

$$= [r_D + \{ER/D\} + \{C/D\}] \square D$$

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### What the Money Multiplier Formula Means

#### Means

If C/D rises, m drops and M drops

If ER/D rises, m drops and M drops

If  $r_D$  rises, m drops and M drops

Fed sets  $r_D$

If DL rise, no change to m, but M rises

If  $MB_n$  rises, no change to m, but M rises

Open Market Operations

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$$D = \frac{1}{[r_D + \{ER/D\} + \{C/D\}]} \square MB$$

$$M = D + \{C/D\} \square D = [1 + \{C/D\}] \square D$$

$$M = \frac{[1 + \{C/D\}]}{[r_D + \{ER/D\} + \{C/D\}]} \square MB$$

$$m = \frac{[1 + \{C/D\}]}{[r_D + \{ER/D\} + \{C/D\}]}$$

$m < 1/r_D$  because no multiple expansion for currency and because as  $M \uparrow ER \uparrow$

### Full Model

$$M = m \square [MB_n + DL]$$

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### Who Affects the Money Supply?

Fed can directly control  $MB_n$  with Open Market Operations

Fed can directly control  $r_D$

Fed can indirectly control DL through setting a discount rate and determining who gets Fed loans

Households determine C/D

Banks determine ER/D

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## Example 1

Calculate the C/D ratio, the ER/D ratio  
and the money multiplier

$$r_d = 0.10$$

$$C = \$280 \text{ billion}$$

$$D = \$800 \text{ billion}$$

$$ER = \$40 \text{ billion}$$

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## Answer to Example 1

$$C/D = \$280 \text{ b} / \$800 \text{ b} = 0.35$$

$$ER/D = \$40 \text{ b} / \$800 \text{ b} = 0.05$$

$$m = (1 + 0.35) / (0.35 + 0.05 + 0.10) = 1.35 / 0.5 = 2.7$$

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## Example 1 (continued)

Calculate the required reserves, total  
reserves, the monetary base, and the  
money supply

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## Answers to Example 1 (continued)

$$RR = r_d * D = 0.10 * \$800 \text{ b} = \$80 \text{ b}$$

$$R = ER + RR = \$40 \text{ b} + \$80 \text{ b} = \$120 \text{ b}$$

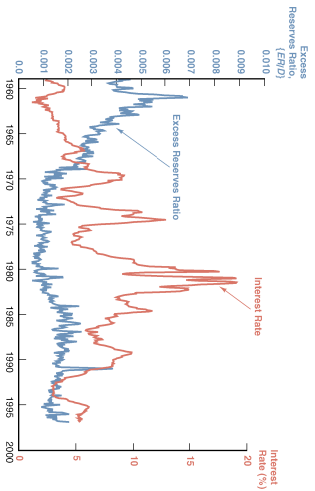
$$\text{Monetary base} = R + C = \$120 \text{ b} + \$280 \text{ b} = \$400 \text{ b}$$

$$M = C + D = \$280 \text{ b} + \$800 \text{ b} = \$1080 \text{ b}$$

$$\text{Also } M = m * MB = 2.7 * \$400 \text{ b} = \$1080 \text{ b}$$

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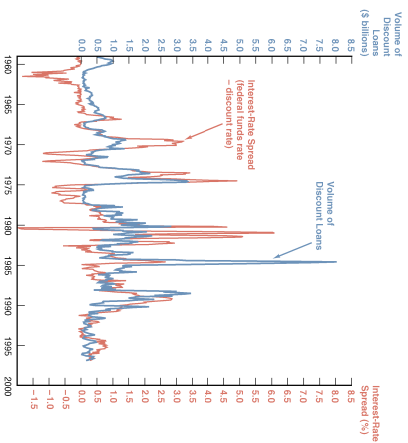
## Excess Reserves Ratio



- Determinants of  $\{ER/D\}$**
- $i \uparrow$ , Relative  $RET$  on  $ER$   $\square$  (opportunity cost  $\uparrow$ ),  $\{ER/D\}$   $\square$
  - Expected deposit outflows,  $ER$  insurance worth more,  $\{ER/D\}$   $\uparrow$

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## Discount Loans and Interest Spread



- Determinants of  $DL$**
- $i \uparrow$ ,  $i - i_d \uparrow$ ,  $DL \uparrow$
  - $i_d \uparrow$ ,  $i - i_d \square$ ,  $DL \square$

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## Factors Determining Money Supply

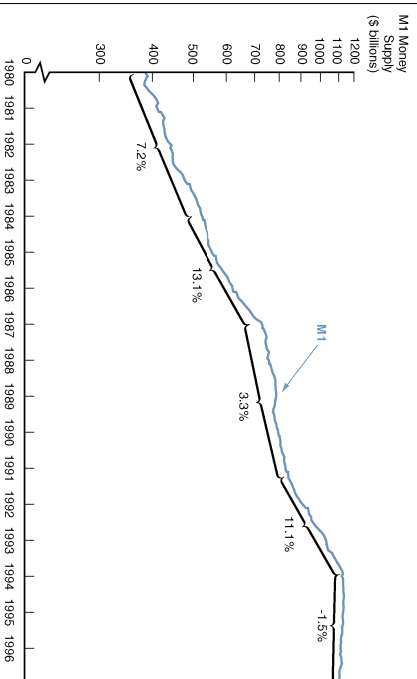
**TABLE 1** Money Supply (M1) Response

Player	Variable	Change in Variable	Money Supply Response	Reason
Federal Reserve System	$r_p$	$\uparrow$	$\downarrow$	Less multiple deposit expansion
	$MB_c$	$\uparrow$	$\uparrow$	More $MB$ to support currency and checkable deposits
	$i_d$	$\uparrow$	$\downarrow$	$DL \downarrow$ so less $MB$ to support $D$ and $C$
Depositors	$\{C/D\}$	$\uparrow$	$\downarrow$	Less multiple deposit expansion
Depositors and banks	Expected deposit outflows	$\uparrow$	$\downarrow$	$ER/D \uparrow$ so fewer reserves to support $D$
Borrowers from banks and the other three players	$i$	$\uparrow$	$\uparrow$	$ER/D \downarrow$ so more reserves to support $D$ ; $DL \uparrow$ so more $MB$ to support $D$ and $C$

Note: Only increases ( $\uparrow$ ) in the variables are shown. The effects of decreases on the money supply would be the opposite of those indicated in the "response" column.

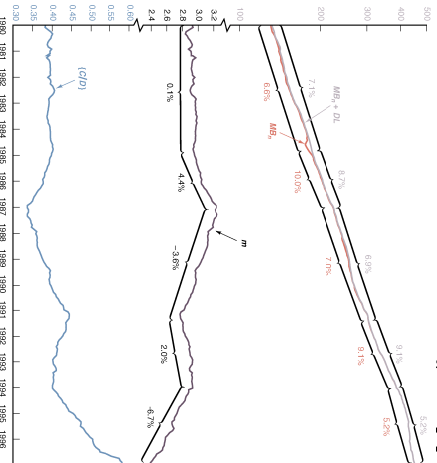
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## Money Supply



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## Determinants of the Money Supply



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## Lessons learned from the graphs

- 1980-1984  
base grows at 7%
- m doesn't change
- money supply grows at 7%
- 1984-1987  
base grows at 9%
- m grows at 4%
- money supply grows at 13%

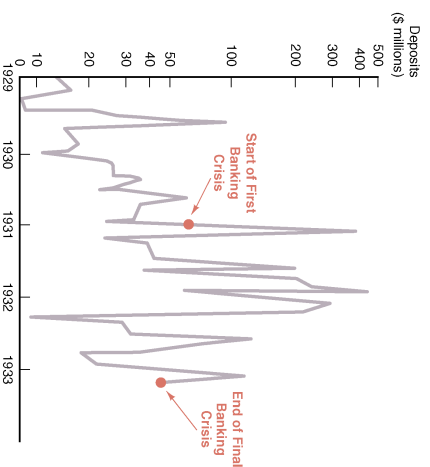
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## Lessons learned (cont.)

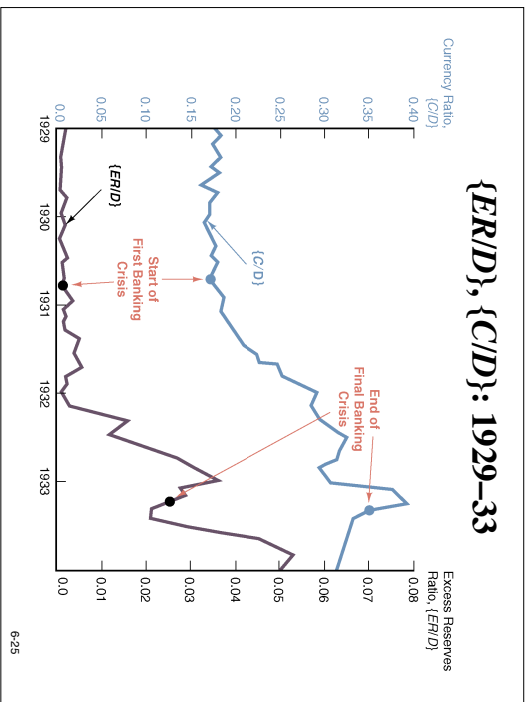
- In the long-run, changes in M1 determined by changes in Monetary Base
- 3/4 of money supply changes come from open market operations
- In the short-run, the changes in the multiplier can change M1 considerably
- Fed must be aware of consumer behavior
- Most multiplier changes come from C/D

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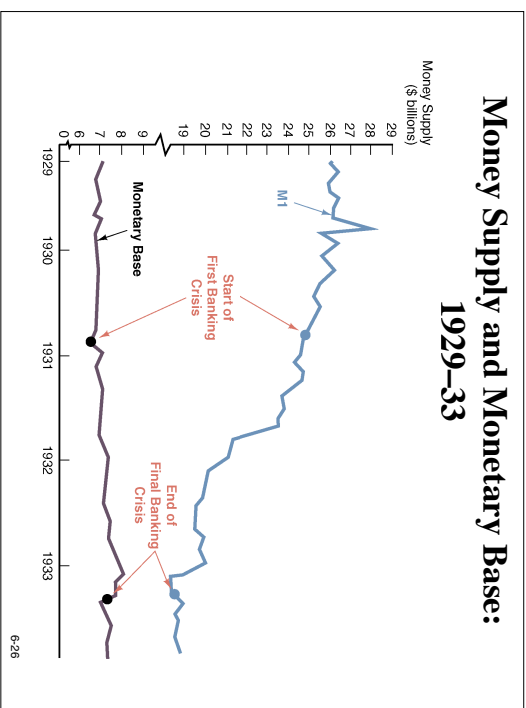
## Deposits at Failed Banks: 1929-33



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### {ER/D}, {C/D}: 1929-33

### Money Supply and Monetary Base: 1929-33

## M2 Money Multiplier

$$M2 = D + (\{C/D\}D) + (\{T/D\}D) + (\{MMF/D\}D) \\ = [1 + \{C/D\} + \{T/D\} + \{MMF/D\}] D$$

$$M2 = \frac{[1 + \{C/D\} + \{T/D\} + \{MMF/D\}]}{[r_D + \{ER/D\} + \{C/D\}]} MB$$

$$m2 = \frac{[1 + \{C/D\} + \{T/D\} + \{MMF/D\}]}{[r_D + \{ER/D\} + \{C/D\}]}$$

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## Factors Determining M2

TABLE A1 Response of the M2 Money Supply to Changes in  $MB_n$ ,  $DL$ ,  $r_D$ ,  $\{ER/D\}$ ,  $\{C/D\}$ ,  $\{T/D\}$ , and  $\{MMF/D\}$

Variable	Change in Variable	M2 Money Supply Response	Reason
$MB_n$	↑	↑	More $MB$ to support $C$ and $D$
$DL$	↑	↑	More $MB$ to support $C$ and $D$
$r_D$	↑	↓	Less multiple deposit expansion
$\{ER/D\}$	↑	↓	Fewer reserves to support $C$ and $D$
$\{C/D\}$	↑	↑	Less overall deposit expansion
$\{T/D\}$	↑	↑	More multiple deposit expansion
$\{MMF/D\}$	↑	↑	More multiple deposit expansion

Note: Only increases (↑) in the variables are shown; the effects of decreases in the variables on the money multiplier would be the opposite of those indicated in the "Response" column.

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