Bank Expansion \( M_{t-8} \) 9

Money Multiplier \( M_{t+8} \) 10
Bank Expansion \((M+B)\)

- \(C\) = Currency in circ.
- \(D\) = Checkable Deposits
- \(R\) = Bank Reserves

Money Stock \((M1)\)

\[ M = C + D \]

Monetary Base aka High-Powered Money

\[ B = C + R \]
Simple Example

- Public starts with $100 in C.

\[ D = 0 \]

<table>
<thead>
<tr>
<th>Banks</th>
<th>Public</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>L, nw</td>
</tr>
<tr>
<td>0</td>
<td>C 100</td>
</tr>
<tr>
<td>0</td>
<td>NW 100</td>
</tr>
</tbody>
</table>

Money Stock

\[ M = C = 100 \]

Monetary Base

\[ B = C = 100 \]
- Initially, public has $100 in C, banks have 0 assets, liabilities, 
  \[ M = C = B = $100 \]

- Suppose public wants to hold all M as D.

Public deposits $100:

<table>
<thead>
<tr>
<th></th>
<th>Bank (A)</th>
<th>Public (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D 100</td>
<td>NW 100</td>
</tr>
<tr>
<td></td>
<td>NW 0</td>
<td>0</td>
</tr>
</tbody>
</table>

Now \[ M = D = $100 \] (unchanged)

And \[ B = R = $100 \] (unchanged)
Depositing C in Bank

- changes composition of \( M = C + D \)
- does not change \( M = C + D \)
  (same for withdrawals of C from D)
- doesn't change \( B \)

Spending Deposited Funds

- only changes ownership of \( D \)
- does not change \( M \) or \( B \)
Suppose Banks only want to keep 10% reserves.

Banks lend $90 to public, who keep this on deposit.

<table>
<thead>
<tr>
<th>Banks</th>
<th>Public</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>L, NW</td>
</tr>
<tr>
<td>R 100</td>
<td>D 190</td>
</tr>
<tr>
<td>Loan 90</td>
<td>NW = 0</td>
</tr>
<tr>
<td>190</td>
<td>190</td>
</tr>
<tr>
<td></td>
<td>Loan 90</td>
</tr>
<tr>
<td></td>
<td>NW 100</td>
</tr>
<tr>
<td></td>
<td>190</td>
</tr>
</tbody>
</table>

Now, \( M = D = 190 \)

- \( M \) as banks lend surplus reserves!

But \( B = R = 100 \)

* Been unaffected by Bank actions.
Now,
\[ D = 190 \\
R = 100 \]

Banks only want to hold 10\% of
\$190 or \$19 in \( R \).

Lend out \( 100 - 19 = 81 \)

But Public keeps this on deposit:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>100</td>
<td>D 271</td>
</tr>
<tr>
<td>Loans</td>
<td>171</td>
<td>NW = 0</td>
</tr>
<tr>
<td></td>
<td>271</td>
<td>271</td>
</tr>
</tbody>
</table>

\[ A \]
\[ L, NW \]
\[ D 271 \]
\[ Loans 171 \]
\[ NW 100 \]
\[ 271 \]

Now
\[ M = D = \$271 \] (↑1!)

But
\[ B = R = \$100 \] (No change)
Table 1

The Bank Expansion Process

\[ \beta = \frac{1}{100} \]

Money Supply ($)

<table>
<thead>
<tr>
<th>Round #</th>
<th>Example 1 ((f=0.1,c=0))</th>
<th>Example 2 ((f=0.1,c=1.0))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>1</td>
<td>190.00</td>
<td>145.00</td>
</tr>
<tr>
<td>2</td>
<td>271.00</td>
<td>165.25</td>
</tr>
<tr>
<td>3</td>
<td>343.90</td>
<td>174.36</td>
</tr>
<tr>
<td>4</td>
<td>409.51</td>
<td>178.46</td>
</tr>
<tr>
<td>5</td>
<td>468.56</td>
<td>180.31</td>
</tr>
<tr>
<td>6</td>
<td>521.70</td>
<td>181.14</td>
</tr>
<tr>
<td>7</td>
<td>563.53</td>
<td>181.53</td>
</tr>
<tr>
<td>8</td>
<td>512.58</td>
<td>181.68</td>
</tr>
<tr>
<td>9</td>
<td>651.32</td>
<td>181.76</td>
</tr>
<tr>
<td>10</td>
<td>686.19</td>
<td>181.79</td>
</tr>
<tr>
<td>Equilibrium</td>
<td>1000.00</td>
<td>181.82</td>
</tr>
</tbody>
</table>
Currency Holdings

- Attenuate, but do not eliminate bank expansion

- Suppose $M_0 = C_0 = $100

  but public wants to hold equal C.D.

Round #1

Public Deposits $50

Banker Lend $45 in currency

$M = C + D = 95 + 50 = $145$

Round #2

Public redeposits $22.50

Banker Lend $.9(22.50) = $20.25

$M = C + D = (95 - 22.50 + 20.25)
  + (50 + 22.25)
  = $165.25

Etc.
Bank Expansion Multiplier $K \ (M+\delta_0)$

$C =$ currency in circulation
$D =$ checkable deposits
$R =$ bank reserves

$M = C + D \ (M1)$

Monetary Base

$B = C + R$

With fractional reserve banking,
$R < D,$ so
$B < M.$

Multiplier

$K = \frac{M}{B}$

or $M = KB$

$k > 1 \text{ if } R < D$
Determination of $k$

Let

$c =$ Public's desired ratio of $\frac{C}{D}$

$f =$ Banks' desired ratio of $\frac{R}{D}$

(fractional reserve ratio) $0 \leq c \leq \infty$

$0 \leq f \leq 1$

If public is happy,

$c = cD$

If banks are happy,

$R = fD$

So in equilibrium,

$k = \frac{M}{B}$

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

$= \frac{cD + D}{cD + fD}$

$\Rightarrow k = \frac{c + 1}{c + f}$
\[ k = \frac{c+1}{c+f}, \quad M = kB \]

**Examples** \((B = \$100)\)

1. **10% reserves, no \(C\)**
   
   \[ f = 0.1, \quad c = 0 \]
   
   \[ k = \frac{(0)+1}{(0)+1.1} = \frac{1}{1.1} = 10 \]
   
   \[ M \to (10)(\$100) = \$1000 \]

2. **10% reserves, \(C = D\)**
   
   \[ f = 0.1, \quad c = \frac{C}{D} = 1.0 \]
   
   \[ k = \frac{(1)+1}{(1)+(0)} = \frac{2}{1.1} = 1.8182... \]
   
   \[ M \to (1.8182)(\$100) = \$181.82 \]
Properties of $k = \frac{c+f}{c+f}$

- $f \uparrow \Rightarrow k \downarrow$
  $f \downarrow \Rightarrow k \uparrow$

- $f = 1 \Rightarrow k = 1$ (100\% reserve banking)
  $\Rightarrow M = B$, regardless of $c$

- If public uses only $C$, no $D$,
  $c = \infty$, $k = 1$, $M = B = C$

- $c \uparrow \Rightarrow k \downarrow$
- $c \downarrow \Rightarrow k \uparrow$ if $f < 1$

- $c = 0 \Rightarrow k = \frac{1}{f}$

- $c = 0$, $f > 0 \Rightarrow k = \infty$

($1$ of $B$ supports an indefinitely large $M$.)
Table 2
Illustrative Values of the Bank Expansion Multiplier

\[ k = \frac{c + 1}{c + f} \]

<table>
<thead>
<tr>
<th>Fractional Reserve Ratio (f)</th>
<th>Currency/Deposit ratio (c)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.25</td>
</tr>
<tr>
<td>0.00</td>
<td>5.00</td>
</tr>
<tr>
<td>.10</td>
<td>10.00</td>
</tr>
<tr>
<td>.20</td>
<td>5.00</td>
</tr>
<tr>
<td>.50</td>
<td>2.00</td>
</tr>
<tr>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

* If the public uses no checking deposits at all, \( c = C/D \) becomes infinitely large, hence \( k \approx 1 \).

** The multiplier becomes infinitely large as \( f \) and \( c \) both approach 0.
Excess vs Required Resources

Let \( R_R = \text{Legally required reserve ratio on } D \)

\[ R_R = \text{Legally required reserves} \]

so \( R_R = f_R \cdot D \).

Let \( R_x = R - R_R \)

\[ = \text{Excess Reserves} \]

and \( f_x = \text{Banks' desired ratio of } \frac{R_x}{D} \)

so \( R_x = f_x \cdot D \) if banks happy.

Then \( f = \frac{R}{D} = \frac{R_R + R_x}{D} = \frac{f_R D + f_x D}{D} \)

\[ f = f_R + f_x \]

So \( k = \frac{c+1}{c+f} \)

\[ k = \frac{c+1}{c+f_R + f_x} \]

\( f_R \uparrow \Rightarrow k \downarrow \)

\( f_x \uparrow \Rightarrow k \downarrow \)
Reserve Requirements, 2010

<table>
<thead>
<tr>
<th>Type of Deposit</th>
<th>Current setting Setting</th>
<th>Discretionary Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transactions (checking) deposits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$0-10.7 million***</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>$10.7-55.2 million***</td>
<td>3%</td>
<td></td>
</tr>
<tr>
<td>$55.2 million up***</td>
<td>10%*</td>
<td>8-14%</td>
</tr>
<tr>
<td>Savings and time deposits</td>
<td>0%**</td>
<td>0-9%</td>
</tr>
<tr>
<td>Eurocurrency liabilities</td>
<td>0%</td>
<td></td>
</tr>
</tbody>
</table>

* Top rate on Transactions deposits reduced from 12% 4/92.
** Reserve requirements on savings and time deposits eliminated 12/90.
*** Reserve requirements for each bank increase progressively with size of bank. Brackets indexed annually by 80% of change in total reservable liabilities (0% bracket) or in total transactions deposits (3% bracket).

Graduated reserve requirement act as a progressive tax on banks, favors small banks.

Means average reserve requirement less than top (10%) reserve requirement.
Bank Expansion Multiplier, $k = \frac{M1}{B}$
M1, C, D = Total Checkable Deposits (excl. Sweeps)
Sweep Accts

Important since 1995

Pairs
• Demand Deposit or NOW Act.
  up to 10% Reserve Requirement

  unlimited checking

  w/b
• MMDA
  0 reserve requirement (since 1991),
  only 6 checks or transfers/mo.

1. Deposits go in MMDA
2. Checks come out of checking acct.
3. 6 times/mo, bank transfers $
   from MMDA to checking, so checks
   clear, yet avg checking balance
   is minimized.
4. Customer may be unaware of arrangement.
5. Bank veg'd R minimized.
6. Balance shows up in M2, not official M1

Included in "M1-S." (unofficial)
Sweeps grew rapidly after 1995:

![Cumulative New Sweep Accounts](image)

Data Source: [http://research.stlouisfed.org/aggreg/swdata.html](http://research.stlouisfed.org/aggreg/swdata.html)

But Fed does not require banks to report Sweep Accounts separately from MMDAs.

Best data are only for cumulative new conversions of conventional accounts to Sweep accounts, do not include growth since accounts were converted.

⇒ Slowdown after 2000 must understate actual growth in Sweeps,

Even M1-S may understate narrow Money Stock since 2000.
The Monetary Aggregates
(5/09, $ billions, s.a.)

Official M1:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currency in circulation</td>
<td>849.8</td>
<td>(53.2%)</td>
</tr>
<tr>
<td>Checkable Deposits (excl Sweep Accts)</td>
<td>741.0</td>
<td>(46.4%)</td>
</tr>
<tr>
<td>Demand Deposits</td>
<td>406.6</td>
<td></td>
</tr>
<tr>
<td>Other (NOW etc)</td>
<td>334.4</td>
<td></td>
</tr>
<tr>
<td>Non-Bank traveler's checks</td>
<td>5.2</td>
<td>(0.3%)</td>
</tr>
<tr>
<td>Total M1</td>
<td>1,596.0</td>
<td></td>
</tr>
</tbody>
</table>

M1-S (Unofficially computed for this course):

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currency in circulation</td>
<td>849.8</td>
<td>(35.5%)</td>
</tr>
<tr>
<td>Checkable Deposits (incl Sweep Accts)</td>
<td>1,536.2</td>
<td>(64.2%)</td>
</tr>
<tr>
<td>Official</td>
<td>741.0</td>
<td></td>
</tr>
<tr>
<td>Sweep Accts (est.)</td>
<td>795.2</td>
<td></td>
</tr>
<tr>
<td>Non-Bank traveler's checks</td>
<td>5.2</td>
<td>(0.2%)</td>
</tr>
<tr>
<td>Total M1-S</td>
<td>2,391.2</td>
<td></td>
</tr>
</tbody>
</table>

M2:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>1,596.0</td>
</tr>
<tr>
<td>Savings Deposits (incl. MMDA)</td>
<td>4,445.0</td>
</tr>
<tr>
<td>Small time deposits</td>
<td>1,307.3</td>
</tr>
<tr>
<td>Retail Money Market Mutual Funds</td>
<td>979.2</td>
</tr>
<tr>
<td>Total M2</td>
<td>8,326.6</td>
</tr>
</tbody>
</table>

MZM (Zero-Maturity M, computed by St. Louis Fed per Wm. Poole):

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>1,596.0</td>
</tr>
<tr>
<td>Savings Deposits (incl MMDA)</td>
<td>4,445.0</td>
</tr>
<tr>
<td>All Money Market Mutual Funds</td>
<td>3,517.6</td>
</tr>
<tr>
<td>Retail</td>
<td>979.2</td>
</tr>
<tr>
<td>Institution-only</td>
<td>2,538.4</td>
</tr>
<tr>
<td>Total MZM</td>
<td>9,558.6</td>
</tr>
</tbody>
</table>

MMDA = Money Market Deposit Account, a Bank/Thrift liability
MMMФ = Money Market Mutual Fund, not a Bank/Thrift liability.

Data sources: *Federal Reserve Statistical Release H.4.1*; St. Louis Fed
(http://research.stlouisfed.org/aggreg/swdata.html) for estimated Sweep Accounts.
M1, M1S, Monetary Base B

"M1S" = M1 + Sweeps

$ Billions

$k = \frac{M1}{B}, \ k_S = \frac{M1S}{B}$
Currency/(Deposit+Sweeps) Ratio

Optimal 1955-2000:

- "Underground Economy"
  - Tax Evasion
  - Illegal Activities
- "Currency Substitution"
  - Foreign use of US currency in high M countries

\( \frac{C}{D+S} \)

\[ R = \frac{c+1}{c+f_2+f_x} \]

\[ f = f_R + f_X \]

R/D, Rr/D, Rx/D Ratios

\[ f \approx 0.17 \] (1970)

1980-85 Dismal
Reduced \( f_R \)

1/91 From Saving \( \Rightarrow 0 \%

4/92 - Top Fr. 6 to 10 \%
from 12 \%

\( f_x < \frac{1}{2} \% \), negligible*(due to FF market)

* Prior to 2008!
R/DS, Rr/DS, Rx/DS Ratios

"05" = D + Sweeps

M1S Bank Expansion Multiplier, $k_S = \frac{M1S}{B}$

Trends in $k_S$ fr offset, $k_S$ mostly in range 2.6-3.0.
Interest on Bank Reserves

Pre-2008:

Fed pays no interest on Reserve Deposits

$\Rightarrow$ Banks keep $R_X$ to minimum via Fed Funds Mkt,

$\Rightarrow$ $f_R$ acts as a small tax on D, increases seigniorage

$\Rightarrow k = \frac{c+1}{c+f_R+f_X}$ fairly stable, M predictable

Since 10/08 (authorized by TARP Bill)

Fed pays $i$ on Reserve deposits at rate slightly above Fed Funds rate.

$\Rightarrow R_X$ has exploded, base has tripled!

Implications ???
Most of Base Explosion since 2008 has been Excess Reserves, which now pay interest at slightly more than the Fed Funds Rate.

“Net Base” = Base B – Required Reserves \( R_R \)

\[
= \text{Currency } C + \text{Excess Reserves } R_X
\]

Net Base has grown rapidly since 2008 (+25% 2008 to 2011), which should be of great concern for inflation.

Optimistically, however, these Excess Reserves represent Financial Intermediation on the part of the Fed rather than direct Inflationary Finance, and hence may not have the direct inflationary implications that Currency does.