Mishkin ch.14: The Money Supply Process

- **Objective:** Show how the Fed controls stocks of money; focus on M1.
  - Macro theory simply assumes that the Fed can set “M” via open market operations.
  - Point here: control is indirect – relies on assumptions about banks and depositors.

- **Focus on M1:** *Money = Currency + Deposits*  \[ M1 = C + D \]

  1. Show that the Fed can control the monetary base
     *Monetary Base = Currency + Reserves*  \[ MB = C + R \]
  2. Derive a money multiplier so that
     \[ M1 = \text{Multiplier} \cdot \text{Monetary Base} \]
     \[ M1 = m \cdot MB \]
  - Message: Fed can control M1 by controlling MB, but not perfectly.
  - Assumes “normal” conditions: interest rates > 0. Later examine crises.

- **Add extensions and prepare for Fed Funds market analysis:**
  - Show how the Fed can control balance sheet items other than MB.
  - Introduce distinction between dynamic and defensive open market operations.
  - Derive a money multiplier for M2.
  - Case studies: the Great Depression and the 2007-09 crisis.
**Balance Sheet Analysis: Monetary Aggregates at Banks and at the Fed**

- **Balance Sheet of the Banking System:**

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loans</td>
<td>D Checkable Deposits</td>
</tr>
<tr>
<td>Securities</td>
<td>Time Deposits etc.</td>
</tr>
<tr>
<td>R Reserves</td>
<td>BR Borrowed Reserves</td>
</tr>
</tbody>
</table>

- **Balance Sheet of the Federal Reserve:** includes all of MB but only part of M1.

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Securities</td>
<td>C Currency</td>
</tr>
<tr>
<td>BR Discount loans</td>
<td>R Bank reserves</td>
</tr>
<tr>
<td>Gold</td>
<td>Treasury Dep.</td>
</tr>
<tr>
<td>Check Float</td>
<td>Foreign CB Dep.</td>
</tr>
</tbody>
</table>

- **Money stock M1** = Sum of monetary aggregates C+D from both balance sheets.  
  [Similar for M2. Note that currency includes Treasury coins – small amount ignored to simplify.]

- **Monetary base MB = C+R:** exclusively on the Fed balance sheet.

- **Linkages:**

  - R = Bank Reserves = Banks’ deposits at Fed + Vault cash
  - BR = Borrowed Reserves = Discount loans from Fed

[Notes on Mishkin Ch.14 - P.2]
Open Market Operations (OMO) and the Monetary Base

Examine with numerical examples

Initial Fed Balance Sheet (normal: assets mostly securities; liabilities mostly currency)

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Securities 99</td>
<td>Currency 90</td>
</tr>
<tr>
<td>Discount Loans 1</td>
<td>Reserves 5</td>
</tr>
<tr>
<td></td>
<td>Treasury/CB Dep. 5</td>
</tr>
</tbody>
</table>

⇒ MB = 95

Example 1: Purchase of securities with payment to a bank’s reserve account:

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Securities +1</td>
<td>Reserves +1</td>
</tr>
</tbody>
</table>

New Fed Balance Sheet:

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Securities 100</td>
<td>Currency 90</td>
</tr>
<tr>
<td>Discount Loans 1</td>
<td>Reserves 6</td>
</tr>
<tr>
<td></td>
<td>Treasury/CB Dep. 5</td>
</tr>
</tbody>
</table>

⇒ MB = 96

Find: Open market purchases increase the monetary base one-for-one.
Example 2: Sale of securities with payment from a bank’s reserve account:

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Securities -1</td>
<td>Reserves -1</td>
</tr>
</tbody>
</table>

New Fed Balance Sheet:

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Securities</td>
<td>98</td>
</tr>
<tr>
<td>Currency</td>
<td>90</td>
</tr>
<tr>
<td>Discount Loans</td>
<td>1</td>
</tr>
<tr>
<td>Reserves</td>
<td>4</td>
</tr>
<tr>
<td>Treasury/CB Dep.</td>
<td>5</td>
</tr>
</tbody>
</table>

⇒ MB = 94

Find: Open market sales reduce the monetary base one-for-one.

Example 3: Purchase of securities with currency issued to the public

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Securities +1</td>
<td>Currency +1</td>
</tr>
</tbody>
</table>

New Fed Balance Sheet:

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Securities</td>
<td>100</td>
</tr>
<tr>
<td>Currency</td>
<td>91</td>
</tr>
<tr>
<td>Discount Loans</td>
<td>1</td>
</tr>
<tr>
<td>Reserves</td>
<td>5</td>
</tr>
<tr>
<td>Treasury/CB Dep.</td>
<td>5</td>
</tr>
</tbody>
</table>

⇒ MB = 96

• Conclude: Open market operations change MB one-for-one, regardless how the Fed pays for them. (Settlement is almost always with reserves.)

⇒ Tool for the Fed to change the monetary base – at will and at short notice.
Open Market Operations and Bank Reserves

Why focus on MB and not bank reserves?

- Open market operations with banks also change R one-for-one.
- Argument for using MB: R changes when the public demands currency.

**Example 4**: Bank customers withdraw currency from checking accounts.

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currency</td>
<td>+1</td>
</tr>
<tr>
<td>Reserves (vault cash)</td>
<td>- 1</td>
</tr>
</tbody>
</table>

New Fed Balance Sheet:

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Securities</td>
<td>99</td>
</tr>
<tr>
<td>Discount Loans</td>
<td>1</td>
</tr>
<tr>
<td>Currency</td>
<td>91</td>
</tr>
<tr>
<td>Reserves</td>
<td>4</td>
</tr>
<tr>
<td>Treasury/CB Dep.</td>
<td>5</td>
</tr>
</tbody>
</table>

⇒ MB = 95

Find: Changes in the composition of money demand (C vs. D within M1) have no effect on the monetary base.

- Counterargument: R is also controllable because the Fed can monitor currency withdrawals and execute offsetting open market operations immediately.
  - Analysis of the Fed funds market commonly assumes the Fed can control R
**Discount Loans: An instructive complication**

**Example 5:** Bank takes out a discount loan. (Note: Loans require Fed approval, but approval is routine, so bank effectively determine BR.)

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount Loans</td>
<td>+1</td>
</tr>
<tr>
<td>Reserves</td>
<td>+1</td>
</tr>
</tbody>
</table>

New Fed Balance Sheet:

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Securities</td>
<td>99</td>
</tr>
<tr>
<td>Currency</td>
<td>90</td>
</tr>
<tr>
<td>Discount Loans</td>
<td>2</td>
</tr>
<tr>
<td>Reserves</td>
<td>6</td>
</tr>
<tr>
<td>Treasury/CB Dep.</td>
<td>5</td>
</tr>
</tbody>
</table>

⇒ MB = 96

Find: Discount loans increase the monetary base one-for-one.

• How can the Fed avoid losing control over MB?
  - Answer: quickly do offsetting OMO; works because Fed knows BR.
  - Here: if MB target is 95 and BR increases, do open market sale => MB=95.

• Distinction: **Defensive versus Dynamic open market operations**
  - Dynamic = intended to change a variable targeted by monetary policy
  - Defensive = intended to prevent or offset a change in a targeted variable
Non-Borrowed MB and Non-Borrowed Reserves

• Standard way of handling discount loans:
  - Define: \[ MB_n = MB - BR = \textit{non-borrowed monetary base}. \]
  - Note in the Example: \( MB_n = 94 \) remains unchanged. Suggests that \( MB_n \) is easier to control than MB.

=> Approach in Mishkin:
  - Write \( MB = MB_n + BR \) and treat \( MB_n \) as completely under Fed control
  - Assume BR is controlled by banks, so changes in BR require defensive open market operation to control MB.

• Analogous approach for the Fed funds market:
  - Define: \( NBR = R - BR = \textit{non-borrowed reserves}. \)
  - In Example 5: \( NBR = 4 \), remains unchanged as BR changes
  - In Example 4: Currency outflow reduces R and NBR. But again, Fed can control NBR using defensive open market operations.

• General insight: Defensive open market operations can be used to control any single variable that (a) responds to OMOs and (b) the Fed can observe.
  - Caveat: controlling one variable means giving up control of others.
The Multiplier Idea

- Motivation: Fed cannot directly control M1. Bank deposit volume depends on
  bank customers’ decisions how to allocate their wealth.

- Fed has authority to impose reserve requirements on checkable deposits:
  - Reserve ratio = $rr$. (Fed policy since 1990s: $rr = 10\%$.)
    \[
    \text{Reserves} \geq rr \cdot \text{Deposits} \quad \Rightarrow \quad \text{Deposits} \leq (1/rr) \cdot \text{Reserves}
    \]
    \[
    R \geq rr \cdot D \quad \Rightarrow \quad D \leq (1/rr) \cdot R
    \]
  - Find: Reserve requirements impose an upper bound on deposit volume.

- Complications:
  - What if $R > rr \cdot D$? Define $RR = rr \cdot D$, $ER = R – RR$. Argue that excess
    reserves are costly under normal conditions ($i>i_{er}$), hence small.
  - Currency: if $C/M1$ is small, then $M1 \approx D$ and $MB \approx R$, so $M1/MB \approx D/R \approx 1/rr$;
    if $D/M1$ is small, then $M1 \approx C$ and $MB \approx C$, so $M1/MB \approx 1$.
  - Find: For given $MB$, $M1$ depends on how money demand divides into $C$ and
    $D$. Upper bound on $D/R$ implies an upper bound on $M1/MB$.

- Systematic approach: find conditions for constant multiple $M1/MB = m$.
  Start with simple case, then generalize.
The Deposit Multiplier

- Simple math combining definitions and assumptions:
  - Definition of required reserves: \( RR = rr \cdot D \)
  - Assumption of no excess reserves: \( ER = 0 \) (assuming \( i>0 \))
  - Definition of total reserves: \( R = RR + ER \)
    \[ \Rightarrow R = rr \cdot D \] (with equality, not \( \geq \))
    \[ \Rightarrow \text{Invert:} \quad D = \left(\frac{1}{rr}\right) \cdot R \]
- Define: Deposit multiplier \( = 1/rr \)
  - If \( rr = 10\% \): Deposit multiplier \( = 10 \)

- Key assumption: No excess reserves \( \Rightarrow \) When Fed increases MB, banks will create deposits whenever they can: \( \Delta D = \left(\frac{1}{rr}\right) \cdot \Delta R \)

- Don’t confuse the deposit multiplier with the general money multiplier (next):
  Money includes currency: Different answers if customers withdraw currency.
- Textbook distinction between banking system and a single bank: Single bank is limited to own excess reserves, not a multiple. Outdated: Banks can borrow Fed Funds.
The M1 Money Multiplier

- Include currency and non-zero excess reserves in a simple way. Define:
  \[ c = \frac{C}{D} \text{ = Currency-deposit ratio} \]
  \[ e = \frac{ER}{D} = \text{Excess reserves-deposit ratio} \]
  - Assume both ratios are constant.
  - Modify the derivation of the deposit multiplier.

- Step 1: Reserves are a fixed fraction of deposits:
  - Definition of total reserves: \[ R = RR + ER \]
  - Definition of required reserves: \[ RR = rr \cdot D \]
  - Assumption about excess reserves: \[ ER = e \cdot D \]
  \[ \Rightarrow \quad R = rr \cdot D + e \cdot D = (rr+e) \cdot D \]

- Step 2: Monetary base is a fixed fraction of deposits:
  - Definition of monetary base: \[ MB = R + C \]
  - Assumption about currency: \[ C = c \cdot D \]
  - Know reserve-deposit relation: \[ MB = (rr+e+c) \cdot D \]
  \[ \Rightarrow \text{Invert:} \quad D = \frac{MB}{(rr+e+c)} \]
• Step 3: M1 is currency plus checkable deposits:

\[ M1 = C + D = (1+c) \cdot D = (1+c)/(rr+e+c) \cdot MB \]

• Result: The M1 money multiplier

\[ m = (1+c)/(rr+e+c) \]

• Economic reasoning:

1. Money multiplier = Ratio of \( M = D + C \) to \( MB = R + C \).
   - Ratio of \( D \) to \( R \) is \( 1/(rr+e) \sim 10 \). Ratio of \( C \) to \( C \) is 1.
   => Ratio of \( M \) to \( MB \) normally between 1 and 10.

2. If the Fed increases reserves, banks seek to expand deposits until
   - Bank customers withdraw currency (c)
   - Reserves are tied down as required reserves (rr)
   - Reserves are held as targeted excess reserves (e)

3. Derivation: All quantities are proportional to deposits.
The M2 Money Multiplier

• Same idea with more components – practically relevant.
• Use same approach as for M1. See Mishkin’s online appendix14#2
  
  Simplified definition:

  \[ M2 = D + C + T + MMF \]

  where \( T \) = time and savings deposits = \( t \cdot D \)

  \[ MMF = \text{money market funds etc.} = mm \cdot D \]

  \[ \Rightarrow m_2 = \frac{(1+c+t+mm)}{(rr+e+c)} \]

• Find: If \( m_2 \) is constant, \( \Delta M2 = m_2 \cdot \Delta MB \), is controllable by the Fed.

• Conclude: Multiplier idea works for any concept of money, if bank and customer behavior is stable – if “everything is proportional to \( D \)” applies.

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• Applications will focus on M1 to avoid duplication

• Summary: TABLE 1 of Ch.14 …
## Summary: Determinants of the M1 Money Supply

<table>
<thead>
<tr>
<th>Player</th>
<th>Variable</th>
<th>Change in Variable</th>
<th>Money Supply Response</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal Reserve System</td>
<td>Nonborrowed monetary base, $MB_n$</td>
<td>↑</td>
<td>↑</td>
<td>More $MB$ for deposit creation</td>
</tr>
<tr>
<td></td>
<td>Required reserve ratio, $rr$</td>
<td>↑</td>
<td>↓</td>
<td>Less multiple deposit expansion</td>
</tr>
<tr>
<td>Banks</td>
<td>Borrowed reserves, $BR$</td>
<td>↑</td>
<td>↑</td>
<td>More $MB$ for deposit creation</td>
</tr>
<tr>
<td></td>
<td>Excess reserves</td>
<td>↑</td>
<td>↓</td>
<td>Less loans and deposit creation</td>
</tr>
<tr>
<td>Depositors</td>
<td>Currency holdings</td>
<td>↑</td>
<td>↓</td>
<td>Less multiple deposit expansion</td>
</tr>
</tbody>
</table>

*Note: Only increases (↑) in the variables are shown. The effects of decreases on the money supply would be the opposite of those indicated in the “Money Supply Response” column.*
Applications of Multiplier Analysis

- Clarify the objective: Control M1. If m is constant, open market operations should translate into predictable, proportional changes in M1:

\[ \Delta M_1 = m \cdot \Delta M_B \]

where \( m = \frac{1+c}{(rr+e+c)} \) and \( \Delta M_B = \Delta M_{Bn} + \Delta BR \)

- Fact: M1 also changes when m or BR change. These are complications.

Money Multiplier Example #1

- Normal Conditions (2007 data, $bill.)

  - Data: C=760, D = 620, R = 64.5, BR=0.1
  - Implies: M1 = 1380, MB = 824.5, MBn = 824.4, NBR = 64.4, RR = 62, ER = 2.5
  - Ratios: \( c = \frac{760}{620} = 1.2258 \), \( e = 0.0040 \), \( rr = 0.10 \).

  \[ m = \frac{1+c}{rr+e+c} = \frac{1+1.2258}{0.1+0.004+1.2258} = \frac{2.2258}{1.3298} = 1.6738 \]

  - Verify: M1 = 1.6738 \cdot 824.5 = 1380

  - Lesson: $1 open market purchase/sale should raise/reduce M1 by $1.67.
Case Study #1: The Great Depression

Series of Bank Runs

[Chart showing deposits ($ millions) from 1929 to 1933 with major peaks in 1931 and 1932, indicating periods of bank runs, and labeled 'Start of First Banking Crisis' and 'End of Final Banking Crisis.']

[Notes on Mishkin Ch.14 - P.15]
Currency and Excess Reserve Ratios

[Note on 2008: Rise in $e$ but stable $c$. FDIC has prevented bank runs!]

[Notes on Mishkin Ch.14 - P.16]
Conclusion by Milton Friedman and Anna Schwartz: The Fed should have stabilized M1. Policy mistake made the Great Depression worse.

General lesson: The money stock must be monitored in problem situations, e.g., during financial crises; also, in financially unstable countries.
Case Study #2: The Financial Crisis of 2007-2009

- No shift to currency (Difference to Great Depression: FDIC insurance.)
- Huge increase in excess reserves.
Policy Responses to the Financial Crisis

• Federal Reserve liquidity programs (2007-early 2009)
  Term Auction Facility (TAF) – December 2007. 28-day discount loans.
  Emergency lending to non-banks – to Primary Dealers – March 2008, to Commercial

• Support for specific institutions (Treasury, Federal Reserve, & FDIC)
  Bear Stearns (Mar.08); AIG (Sept.08); Citigroup (Nov. 08); Bank of America (Jan.09)

• Federal Reserve “quantitative easing” (QE)
  - Buying agency MBS and Treasury securities (2009-11)
  - Extending maturities from short to long – “Operation Twist” (2011-12)
Emergency Loans and Quantitative Easing
Phases: Exceptional Lending (using BR); then Quantitative Easing (NBR)
The Federal Reserve Balance Sheet: Credit

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(bili.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treasury Bills</td>
<td>277.0</td>
<td>227.8</td>
<td>21.7</td>
<td>18.4</td>
<td>18.4</td>
</tr>
<tr>
<td>Treasury Bonds&amp;Notes</td>
<td>513.5</td>
<td>512.8</td>
<td>457.1</td>
<td>457.5</td>
<td>* 758.2</td>
</tr>
<tr>
<td>MBS &amp; Agency Debt *</td>
<td></td>
<td></td>
<td></td>
<td>20.3</td>
<td>* 1069.5</td>
</tr>
<tr>
<td>Repurchase Agreements</td>
<td>27.2</td>
<td>39.8</td>
<td>110.3</td>
<td>80.0</td>
<td>0.0</td>
</tr>
<tr>
<td>TAF credit</td>
<td>40.0</td>
<td>150.0</td>
<td>450.2</td>
<td>75.9</td>
<td></td>
</tr>
<tr>
<td>Discount loans</td>
<td>0.2</td>
<td>5.8</td>
<td>15.0</td>
<td>86.6</td>
<td>19.7</td>
</tr>
<tr>
<td>Other loans (PD, AIG, TSLF)</td>
<td></td>
<td></td>
<td>1.7</td>
<td>101.2</td>
<td>68.4</td>
</tr>
<tr>
<td>Commercial Paper Funding</td>
<td></td>
<td></td>
<td>332.4</td>
<td>14.1</td>
<td></td>
</tr>
<tr>
<td>Maiden Lane I-III</td>
<td></td>
<td></td>
<td>29.8</td>
<td>75.0</td>
<td>90.1</td>
</tr>
<tr>
<td>Central Bank Swaps</td>
<td>24.0</td>
<td>62.0</td>
<td>553.2</td>
<td>10.3</td>
<td></td>
</tr>
<tr>
<td>Other assets (incl. Float)</td>
<td>39.4</td>
<td>41.6</td>
<td>42.3</td>
<td>71.7</td>
<td>95.4</td>
</tr>
<tr>
<td>Total Reserve Bank Credit</td>
<td>857.3</td>
<td>891.7</td>
<td>890.0</td>
<td>2246.5</td>
<td>2219.9</td>
</tr>
</tbody>
</table>

Summary:

- Securities: Treasury 817.7 780.4 589.1 556.0 776.6
  - New: MBS etc. 20.3 1069.5
- Discount Lending: regular… 0.2 5.8 15.0 86.6 19.7
  - New: TAF & CB swaps 64.0 212.0 1003.4 86.2
  - New: Loans to Non-banks 31.5 508.6 172.6
- Memo: Fed Funds Rate 5.25% 4.25% 2.00% 0.16% 0-0.25%

* Exceptional Lending Pre-crisis Discount Loans up, Loans UP, Start of QE
  - loans up T-bills down Total UP

* Quantitative Easing (QE)

[Notes on Mishkin Ch.14 - P.21]
Money Multiplier Example #2

- Discount lending during the financial crisis (Spring 2009 data, $bill.)
  - Data: C=860, D = 740, R = 765, BR = 404
  - Implies: M1 = 1600, MB = 1625, MBn = 1221, NBR = 361, RR = 74, ER = 691
  - Ratios: c = 860/740 = 1.1622, e = 0.9338, rr = 0.10.
    \[ m = \frac{1+c}{rr+e+c} = \frac{1+1.1622}{0.1+0.9338+1.1622} = \frac{2.1622}{2.196} = 0.9846 \]
  - Verify: M1 = 0.9846 \cdot 1625 = 1600.

- Compare to M1=1380 in 2007: In contrast to the Great Depression, Fed did not allow M1 to decline, and instead increased R to offset the decline in m.

- Question 1: What if the Fed had refused to ease? Example: keep MB = 880 as in 2007
  => M1 = 0.9846 \cdot 880 = 866. Suggests reduction in M1, deflation

- Question 2: What if banks had used their excess reserves to expand lending?
  - Example: for e=0, \[ m = \frac{1+c}{rr+e+c} = \frac{1+1.1622}{0.1+0+1.1622} = 1.713, \text{ so } M1 = 1.713 \cdot 1625 = 2874. \]
  => Potential for inflation? Easy response: Fed could have stopped lending.

  - Example: For BR=0, MB = MBn = 1221, so M1 = 1.713 \cdot 1221 = 2165.
Money Multiplier Example #3

- **Era of Quantitative Easing** (Fall 2010 data, $bill.)
  - Data: \( C=910, D = 850, R = 1060, BR = 70 \)
  - Implies: \( M_1 = 1760, MB = 1970, MB_n= 1900, NBR= 990, RR=85, ER=975 \)
  - Ratios: \( c = 910/850 =1. 0706, e = 1. 1471, rr = 0.10. \)
    \[
m = \frac{1+c}{rr+e+c} = \frac{1+1.0706}{0.1+1.1471+1.0706} = \frac{2.0706}{2.3177} = 0.8934.\]
  - Verify: \( M_1 = 0.8934 \cdot 1970 = 1760 \)

- Questions:
  - What if bank had used excess reserves to expand lending?
    For \( e=0, \ m = \frac{1+c}{r+e+c} = \frac{1+1.1471}{0.1+1.1471} = 1.66, \) so \( M_1 = 1.66 \cdot 1970 = 3270.\)
  - Could loan policy reverse the increase? No. \( BR \) is now small. Example:
    For \( BR=0, MB = MB_n= 1900, \) so \( M_1 = 1.66 \cdot 1900 = 3154.\)
    => Keeping \( M_1 \) stable would have required huge open market operations.
  - Re. open market operations: Would an open market sale for $1 reduce \( M_1 \) by $0.89? Depends on banks – will they keep ER unchanged?
    => QE raises questions about Fed control of \( M_1 \) and about future inflation.
    Consistent with goal of QE to increase expected inflation.
2009-2014 – Five Years of Quantitative Easing