Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

Banks and the macroeconomy I
Econ 4335 Lecture 7

Asbjørn Rødseth

University of Oslo

8th March 2010

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

Fractional reserve banking

Central banking and the supply of M_0

The interbank market and reserve demand

A model with an interest rate policy

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

Fractional reserve banking

Deposits (D) are either lent (L) or kept in reserve (M_B)

$$D = L + M_B \qquad (1)$$

A constant fraction ($0 < \kappa < 1$) of deposits is kept in reserve:

$$M_B = \kappa D \qquad (2)$$

Central bank money (M_0) equals bank reserves plus currency outside banks (M_{CY}):

$$M_0 = M_{CY} + M_B \qquad (3)$$

M_0 set by CB, C constant

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

The multipliers

Insertion from (2) and (3) in (1) yields

$$D = \frac{1}{\kappa}[M_0 - M_{CY}], \qquad L = \frac{1-\kappa}{\kappa}[M_0 - M_{CY}] \qquad (4)$$

- ▶ Money supply is increased by ΔM_0
- ▶ Banks lend ΔM_0
- ▶ Deposits increase by ΔM_0
- ▶ Bank keep $\kappa \Delta M_0$ in reserve and lends $(1-\kappa)\Delta M_0$
- ▶ Deposits increase by $(1-\kappa)\Delta M_0$
- ▶ Process continues until $\Delta D = \Delta M_0/\kappa$, $\Delta L = (1-\kappa)\Delta M_0/\kappa$

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

Money supply

Money supply:

$$M_1 = D + M_{CY} = \frac{1}{\kappa}[M_0 - (1 - \kappa)M_{CY}] \qquad (5)$$

$1/\kappa > 1 =$ money multiplier

Determined by

- ► Central Bank through M_0
- ► Banks through κ
- ► Public through M_{CY}

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

The link to the real economy

Money demand

$$M_1 = PL(Y, i) \qquad L_Y^{'} > 0, \quad L_i^{'} < 0 \tag{6}$$

Money market equilibrium

$$M_1 = \frac{1}{\kappa}[M_0 - (1 - \kappa)M_{CY}] = PL(Y, i) \tag{7}$$

$i =$ nominal interest rate on bonds (no interest on deposits)

▶ Keynes: Interest rate main link to the real economy

▶ Bond market behind the scene (Walras's law)
▶ Loans lumped together with bonds

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

The quantity theory of money

Before Keynes:

$$M_1 V = PY \tag{8}$$

$V =$ velocity of circulation, constant

- M_1 determines nominal GDP
- Quantity theory revived by Milton Friedman
- Money supply affects aggregate demand directly

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
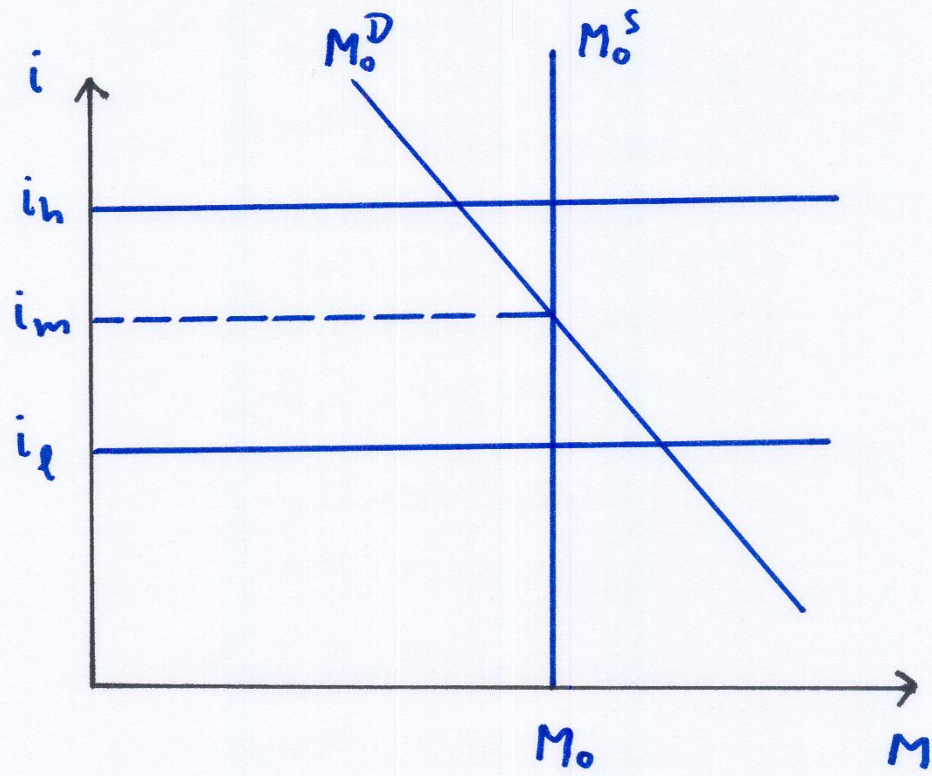A model with an interest rate policy

Effects of shocks

$$M_1 = D + C = \frac{1}{\kappa}[M_0 - (1 - \kappa)C] \qquad (9)$$

- ▶ Increased demand for currency lowers money supply
- ▶ Increased demand for bank reserves lowers money supply

- ▶ Friedman and Schwartz and the US Great Depression 1930s
- ▶ Errors in monetary policy started depression, banking crisis deepened and prolonged it
- ▶ Nominal interest rates low, real rates high

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

The corridor system

Central banks:

- ▶ Take demand deposits from banks, interest rate i_ℓ
- ▶ Give overnight loans to banks, $i_h > i_\ell$
- ▶ Adjusts money-supply, M_0, through open market operations (repos, fixed term loans with collateral, T-bills)
- ▶ Overnight interest rate on CB money i_m ("federal funds rate")

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

Two ways of conduting policy

M_0 main policy decison

- ▶ Implemented through open market operations
- ▶ i_h and i_ℓ adjusted to make $i_\ell < i_m < i_h$
- ▶ Often $i_\ell = 0$

Interest rate main policy decison

- ▶ ECB, Fed: i_m implemented through dayly open market operations $i_\ell < i_m < i_h$
- ▶ Norges Bank: i_ℓ
    - ▶ Keep money supply high enough that $i_m \approx i_\ell$
    - ▶ Daily fine-tuning not needed

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

Bank reserve demand, normal times

▶ Banks trust each other

▶ Unsecured deposits with other banks are reserves almost as good as CB deposits

▶ Interbank interest rate almost equal to i_m. (In Norway slightly above i_ℓ).

▶ Credit lines with other banks reduce need for deposits at CB.

▶ Remember: Deposits withdrawn from one bank ends up in another who needs to lend the money (unless money is put under matress)

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

Bank reserve demand, normal times

- ▶ Banks will want to keep their deposits in CB close to zero
- ▶ Or close to the legal limit, if one exists (not in Norway)
- ▶ Banks will want to avoid using overnight loans (expensive)
- ▶ Loss from having a postive balance with CB is smaller than loss from borrowing from CB
- ▶ Hitting zero is difficult, aim for small positive balance to reduce risks
- ▶ Demand for M_0 not closely related to volume of deposits?
- ▶ Anyhow, when the policy variable is an interest rate, CB will supply the amount of M_0 that is demanded

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

Assumptions

- ▶ The interest rate set by the central bank, i_m, also becomes the interbank rate
- ▶ The central bank supplies the level of M_0 that is demanded at the given interest rate
- ▶ Banks compete for deposits and loans untill alle excess profits are exhausted.
- ▶ Deposit and lending rates proportional to i_m: $i_D = \mu_D i_m$ and $i_L = \mu_L i_m$ where $\mu_D < 1$ and $\mu_L > 1$.
- ▶ The volume of deposits and loans is determined by the demands of the non-banking sectors ("the public")
- ▶ Short period (meaning we can neglect the effects of flows on stocks)
- ▶ Closed economy

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

The public

Balance sheet:

$$QK + D - L = QK^0 + D^0 - L^0 = W_p \tag{10}$$

K = capital stock, Q = price of capital, superscript 0 = initial holdings

Asset demands

$$\begin{aligned}
QK/P &= f_K(i_K, i_D, i_L, W_p/P) \tag{11} \\
D/P &= f_D(Y, i_K, i_D, i_L, W_p/P) \tag{12} \\
L/P &= f_L(Y, i_K, i_D, i_L, W_p/P) \tag{13}
\end{aligned}$$

The nominal retrun on real capital is

$$i_K = Pr_K + (\dot{Q}/Q)^e = Pr_K + \dot{q}^e \tag{14}$$

r_K = marginal productivty of capital
Expected inflation $\dot{P}^e$ neglected

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

Properties of the demand functions 1

$$f_K(\cdot) + f_D(\cdot) - f_L(\cdot) \equiv W_p/P \tag{15}$$

Generates restriction on sum of derivatives for each variable, e.g.

$$\partial f_K/\partial i_D + \partial f_D/\partial i_D - \partial f_L/\partial i_D = 0 \tag{16}$$

Assumption, direct effects:

$$\partial f_K/\partial i_K > 0, \quad \partial f_D/\partial i_D > 0, \quad \partial f_L/\partial i_L < 0 \tag{17}$$

Cross derivates have opposite sign of direct derivatives in same equation
Output effects

$$\partial f_D/\partial Y > 0, \quad \partial f_L/\partial Y > 0 \tag{18}$$

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

Properties of the demand functions 2

Wealth effects

$$
\begin{aligned}
0 &< \partial f_K/\partial W < 1, \\
0 &< \partial f_D/\partial W < 1, \quad\quad (19) \\
0 &< \partial f_L/\partial W < 1
\end{aligned}
$$

▶ Does increased wealth raise or lower demand for loans?

▶ Aggregation problems

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy
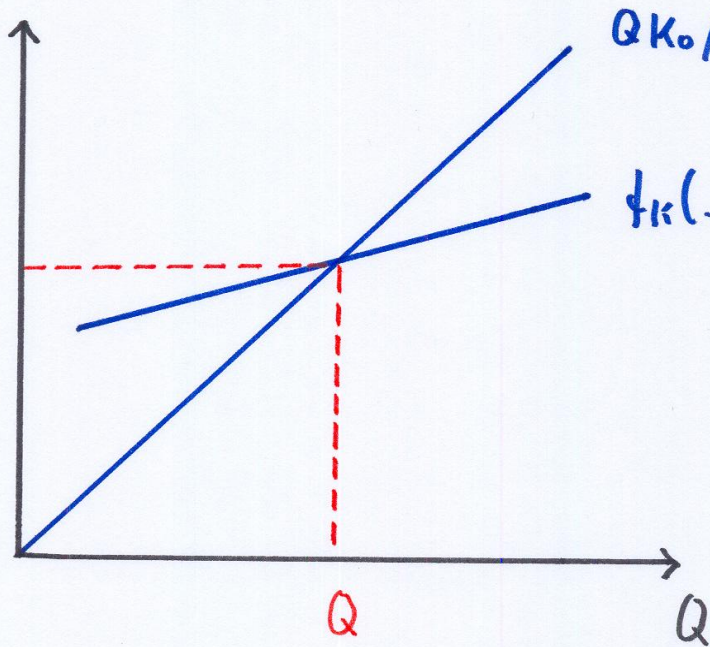
Equilibrium in the capital market, $K = K^0$

Equilibrium condition

$$QK^0/P = f_K(Pr_K + \dot{q}^e, \mu_D i_m, \mu_L i_m, (QK^0 + D^0 - L^0)/P) \quad (20)$$

Determines Q

For a given expected price increase on capital, effect of Q on *lhs* is greater than on *rhs*.

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

Effects of interest rate on goods market

Two channels

- ▶ Direct from interest rates to consumption
- ▶ Indirect via price on capital goods Q
  - ▶ Effect on real investment
  - ▶ Wealth effect on consumption

Increased interest rate shifts down demand for capital, lowers Q

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

Effects of changes in bank behavior

Increased interest rate margins

- ▶ Loan margin lowers Q
- ▶ Deposit margin raises Q

Inceased reserve ratios

- ▶ Matter only through interest rate margins
- ▶ Main effect to raise deposit margin
- ▶ Lowers Q, moderate effect likely

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

Loans, deposits and reserves 1

With Q determined from capital market, D and L are determined by the demands of the public. The public's balance sheet:

$$QK + D - L = QK^0 + D^0 - L^0 = W_p \qquad (21)$$

Equilibrium in capital markets, $K = K^0$, imply

$$D - L = D^0 - L^0 \Leftrightarrow D - D^0 = L - L^0 \qquad (22)$$

Loans and deposits always change by the same amount!

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

Loans, deposits and reserves 2

Balance sheet of bank sector L_{CB} are loans from CB):

$$L + M_0 - D - L_{CB} = L^0 + M_0^0 - D^0 - L_{CB}^0 \qquad (23)$$

Taking account of that $D - D^0 = L - L^0$:

$$L_{CB} - L_{CB}^0 = M_0 - M_0^0 = \kappa(D - D^0) \qquad (24)$$

Central bank has to satisfy an eventual extra demand for bank reserves

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

Effect of increased i_M on banks' balance sheet

Demand for loans

$$L/P = f_L(Y, i_K, i_D, i_L, (QK^0 + D^0 - L^0)/P)$$

- $i_M \uparrow \Rightarrow Q \downarrow \Rightarrow L \downarrow$ if $f_L > 0$
- $i_M \uparrow \Rightarrow i_L \uparrow \Rightarrow L \downarrow$
- $i_M \uparrow \Rightarrow i_D \uparrow \Rightarrow L \uparrow$
- direct effect (i_L) is likely to dominate cross effect (i_D), since margin between i_L and i_D increases

Conclusion: L and D decreases if $f_L > 0$, ambiguous if $f_L < 0$

Short run effects on D and L may be modest.

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

Expectation of higher price increases on capital goods

- ▶ Raises Q now
- ▶ Increases demand for loans now
- ▶ Deposits go up

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

Comments

- ▶ A more disaggregate analysis needed. Differences between borrowers and lenders.
- ▶ Partial model, need to consider repercussions from the real economy and the price level.
- ▶ Short period, more effects over time.
- ▶ Closed economy, need to consider international relations and exchange rates

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

Dynamic effects, a Keynesian sketch

▶ higher interest rate reduces demand for investment, increases
  supply of savings
▶ in the Keynesian view output shrinks until
▶ lower incomes has reduced savings to the level of investment
▶ lower savings means slower growth in demand for real capital
  and for deposits and loans
▶ lower output also has an immediate negative effect on
  deposits and loans

In closed economy the growth in intermediation is likely to be
positively related to the rate of saving / investment.

Fractional reserve banking
Central banking and the supply of M_0
The interbank market and reserve demand
A model with an interest rate policy

Open economies

► Major difference: Saving and real investment does not have to be equal

► Interest rate hike may simulatneously raise savings, reduce investment and improve the current account

► Loans may turn up as deposits in foreign banks

► The interbank market is international

► Domestic banks may be dependent on borrowing abroad

► International loans less reliable than customer deposits

► Asian crisis of 1997-98