# A Simple Model on Money and Banking

Pengfei Jia

Business School, Nanjing University

# The model – basic setup

- The economy produces one single consumption good
- Labor is the only input
- Three types of agents: firms, banks, and households (workers), each of equal number
- All agents are risk-neutral
- Partial equilibrium (can be extended to a GE setting easily)
- The model is static; there is no uncertainty

# The model – basic setup

- To produce, firms need to obtain bank credit to pay wages to households before production takes place
- Banks make loans to firms and *create deposit money*
- Households work and consume
- They have the option of either keeping wages as deposits at the bank or investing in a risk-free government bond with return $R$, $R$ is controlled by the central bank
- In this model, both the price of good $P$ and the wage rate $W$ are exogenously given
- The focus of the analysis is the impact of monetary policy on new loans (i.e. new credit)

# Firms

- All firms use the same production technology:

$$Y = F(N) = AN^{\alpha}, 0 < \alpha < 1$$

where $A$ is the production technology, $N$ is the units of labor

- Total nominal labor cost is $WN$, and has to be paid up-front through bank loans
- Firms need to obtain loans in order to contract labor and initiate production, (a lack of trust is why)
- Note that bank financing or deposit money is essential here, because without it, no production can take place
- It is equivalent to say firms are subject to a financing constraint, like a deposit-in-advance constraint
- In this regard, money is "productive"

# Firms

- Given the real lending rate $R_L$, firms maximize:

$$\Pi = PF(N) - R_L WN$$

Note again that $P$ and $W$ are exogenously given, $R_L$ is set by banks

- Labor is assumed to be supplied elastically at the given wage level and firms choose how much to employ in order to maximize profits
- First order condition gives optimal employment as:

$$N = \left(\frac{PA\alpha}{R_L W}\right)^{\frac{1}{1-\alpha}} \tag{1}$$

- This implies firms' profit: $\Pi = \left(\frac{1-\alpha}{\alpha}\right) R_L WN$

# Loan demand

- Previous deviations also imply the amount of nominal borrowing desired by firms is:

$$L = WN = W\left(\frac{PA\alpha}{R_L W}\right)^{\frac{1}{1-\alpha}}$$

- This yields firms' loan demand schedule as a function of the bank lending rate: if the loan rate increases, firms' loan demand reduces since borrowing costs go up

# Banks

- Banks are risk neutral and operate in a perfectly competitive market; banks earn zero profits in equilibrium
- New loans are financed completely by issuing deposits to households
- Loan supply is elastic and new credit created within the period is $L$
- The funding cost for banks is $R_D$, i.e. the deposit rate
- Assume financial intermediation is costly; banking activity incurs monitoring and operational costs $\bar{R}L$, which are proportional to loans extended

# Loan rate

- On the lending side, banks bid down the lending rate $R_L$ to the effective financing cost
- The zero-profit condition pins down the equilibrium lending rate $R_L$, the net interest income $NII$ is:

$$\begin{aligned} NII &= R_L WN - \bar{R} WN - R_D WN \\ &= (R_L - \bar{R} - R_D) WN \end{aligned}$$

- Perfect price competition in the loan market then implies the lending rate is set at the marginal financing cost:

$$R_L = \bar{R} + R_D \tag{2}$$

# Households

- Households are risk neutral, provide labor to firms, receive wage payments in the form of bank deposits
- As mentioned earlier, they also have the option of investing their income in a risk free government bond, with return $R$
- $R$ is set by the central bank, as monetary policy instrument
- $R$ also represents households' opportunity cost of deposits
- The key is that monetary policy works by influencing the funding cost of banks

# Households

- Given the existence of a competitive deposit market, the rate of return that banks must pay depositors, $R_D$, is determined by monetary policy, i.e.

$$R_D = R \tag{3}$$

- If a bank sets the deposit rate lower than $R_D$, it will lose all the deposits to other banks, so in equilibrium, banks must set the rate at $R_D$

# Households

- Note that, technically speaking, the amount of funds investing in bank deposits or government bonds is indeterminate when the return is the same
- We assume here that government bonds are in zero supply (or households are subject to a small fee when investing in bonds) so that when this is the case, households keep their money in bank deposits

# Equilibrium

- Equilibrium is obtained by combining (1), (2), and (3), employment in equilibrium is:

$$N = [\frac{PA\alpha}{(\bar{R} + R)W}]^{\frac{1}{1-\alpha}}$$

- Total loans or total credit is:

$$L = W[\frac{PA\alpha}{(\bar{R} + R)W}]^{\frac{1}{1-\alpha}}$$

- Output is:

$$Y = A[\frac{PA\alpha}{(\bar{R} + R)W}]^{\frac{\alpha}{1-\alpha}}$$

# Equilibrium

- Firms' profit is:

$$\Pi = (\frac{1-\alpha}{\alpha})(\bar{R}+R)W[\frac{PA\alpha}{(\bar{R}+R)W}]^{\frac{1}{1-\alpha}}$$

- Households' consumption is:

$$C = RW[\frac{PA\alpha}{(\bar{R}+R)W}]^{\frac{1}{1-\alpha}}$$

# Implications

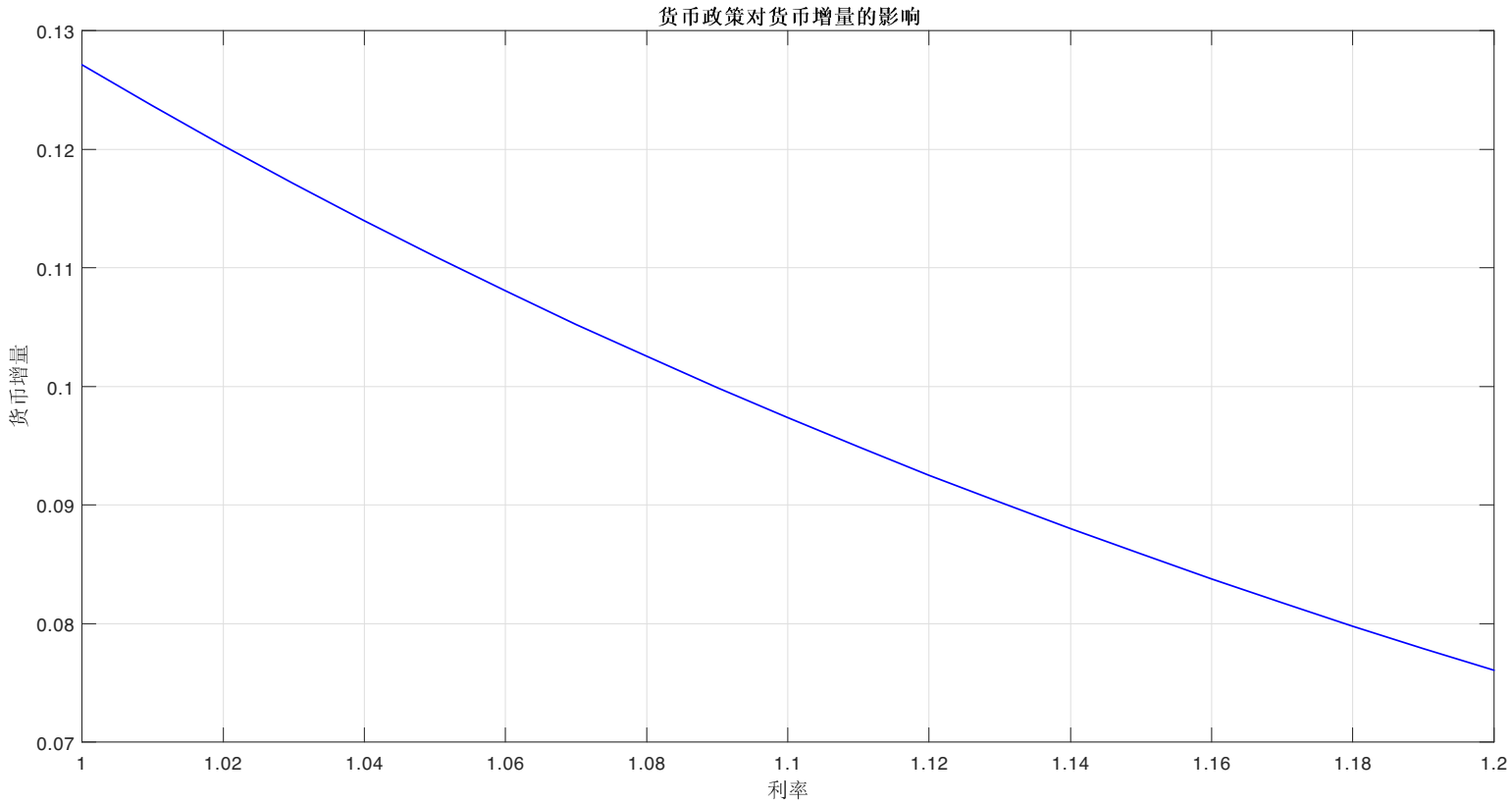
- In this simple environment, monetary policy is the ultimate anchor for credit creation
- Monetary policy affects both financial variables (new credit) and real variables (output, consumption, and employment)

# Monetary policy tightening

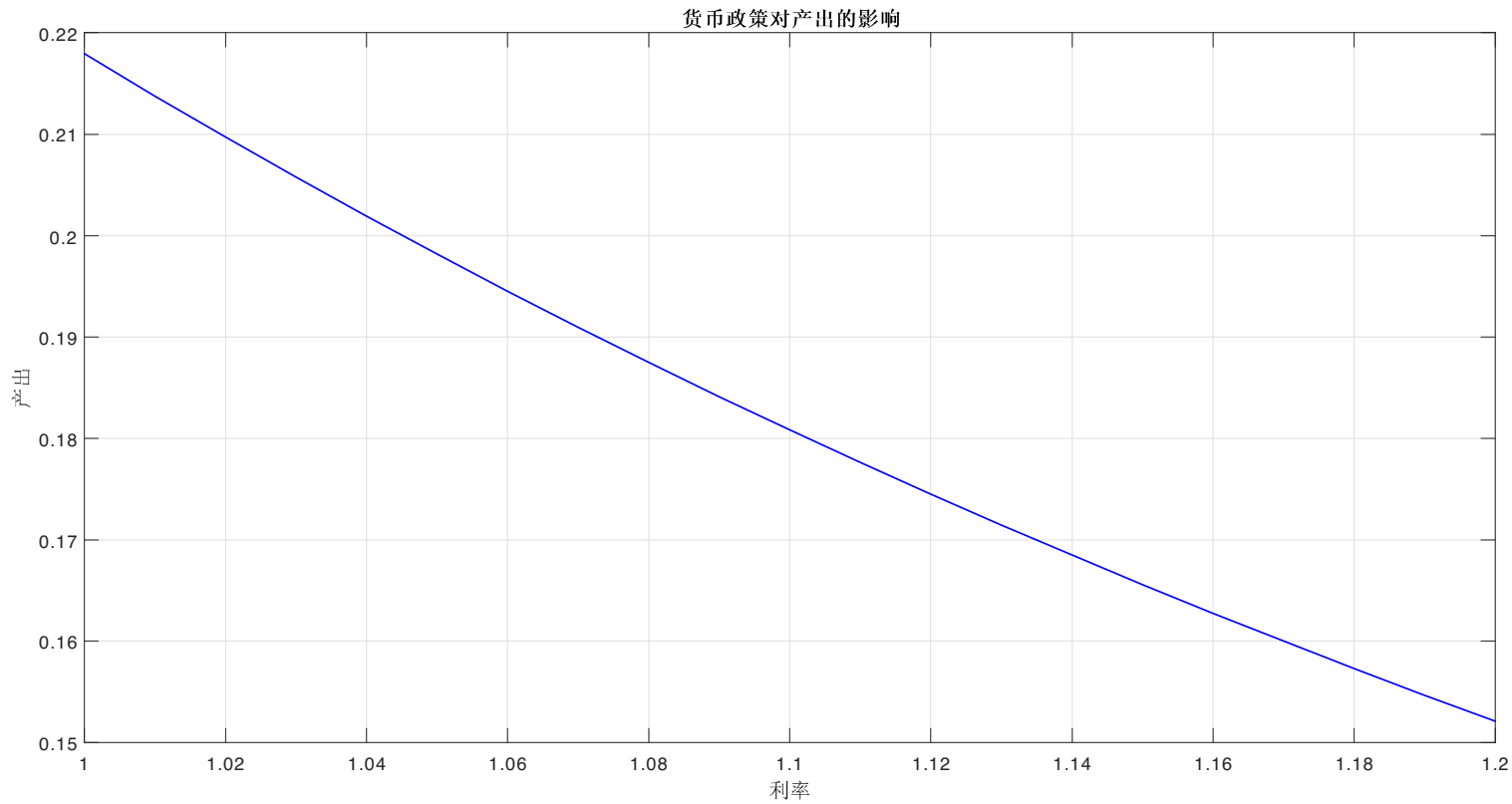
- Consider a monetary policy tightening, an increase in $R \uparrow \longrightarrow$ opportunity cost of deposits$\uparrow \longrightarrow R_D \uparrow$ funding cost of banks $\longrightarrow$ lending rate $R_L \uparrow \longrightarrow$ increases in real factor costs $\longrightarrow$ less employment $\longrightarrow$ less borrowing $\longrightarrow$ *less credit* $\longrightarrow$ *less output* $\longrightarrow$ less profit and consumption
- A bank lending channel and a credit channel of monetary policy
- Total credit matters
- Money is not neutral; monetary policy is not neutral

# Numerical illustration

- We set $P = 1, W = 2, A = 1.5, \alpha = 0.7, \bar{R} = 0.2$



# Numerical illustration



# Money in the economy

- Stage 1: firms decide how much to borrow, given the loan rate, output price and wages
- Stage 2: firms get a loan from banks, *deposit money is created* in the name of the firm
- Stage 3: before production, firms pay wages to households, deposits are transferred to households
- Stage 4: production finishes, firms sell goods to households, deposits are transferred back to firms
- Stage 5: firms use deposits to pay back their bank loans, once this is settled, *money is destroyed*

# Money creation approach (MC) vs. loanable funds approach (LF)

- MC approach is consistent with the reality and facts
- In MC, banks are not simply financial intermediaries, they create money by making loans
- New loans are financed by new deposits, there is no quantitative constraint on bank lending by banks
- Banks do not need households to make deposits first
- Firms face a financing constraint

# Money creation approach (MC) vs. loanable funds approach (LF)

- Money is not neutral, and is determined *endogenously* in the economy
- In LF, banks simply channel funds, new money is not created
- In LF, money aggregates do not play a role, it is like a barter economy

# Money creation approach (MC) vs. loanable funds approach (LF)

- In LF, it is unclear where does money come from
- In LF, household's saving is important, as without it, banks cannot channel funds, no investment can take place, it's saving creates investment
- In MC, banks are important as they create money and firms are subject to financial constraint, it's investment creates saving
- More money (or credit) in MC, which has important implications for inflation, asset pricing, financial instability, etc.

# Something more

- Why do we need banks in this model?
- Essentially, it is because firms cannot credibly promise to pay for labor in advance
- It is *trust* that matters (see Kiyotaki and Moore (2002))
- Money is a solution to distrust