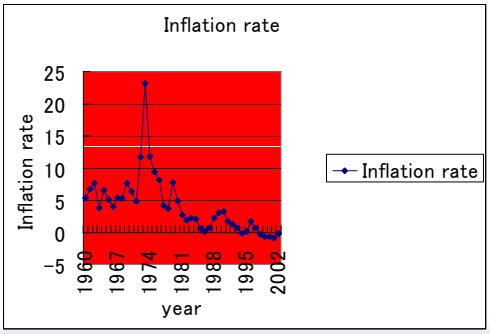
Macroeconomics
Money and Inflation

Professor Hisahiro Naito

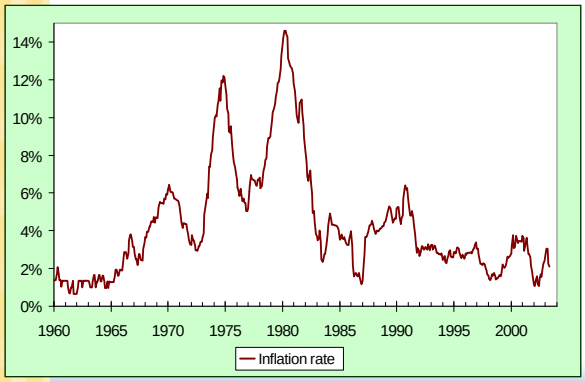
In this chapter you will learn

- The classical theory of inflation
  - causes
  - effects
  - social costs
- "Classical" -- assumes prices are flexible & markets clear.
- Applies to the long run.

Inflation rate in Japan



U.S. inflation & its trend, 1960-2003



The connection between money and prices

- Inflation rate = the percentage increase in the average level of prices.
- price = amount of money required to buy a good.
- Because prices are defined in terms of money, we need to consider the nature of money, the supply of money, and how it is controlled.

Money: definition

Money is the stock of assets that can be readily used to make transactions.

Money: functions

1. **medium of exchange**
   we use it to buy stuff
2. **store of value**
   transfers purchasing power from the present to the future
3. **unit of account**
   the common unit by which everyone measures prices and values

Money: types

1. **fiat money**
   - *has no intrinsic value*
   - *example: the paper currency we use*
2. **commodity money**
   - *has intrinsic value*
   - *examples: gold coins, silver coin, koban cigarettes in P.O.W. camps*

The money supply & monetary policy(CH 18)

- The **money supply** is the quantity of money available in the economy.
- **Monetary policy** is the control over the money supply.

Money supply measures, May 2004

Symbol	Assets included	Amount (billions)
C	Currency	$671.7
M1	C + demand deposits, travelers' checks, other checkable deposits	1319.2
M2	M1 + small time deposits, savings deposits, money market mutual funds, money market deposit accounts	6268.9
M3	M2 + large time deposits, repurchase agreements, institutional money market mutual fund balances	9193.8

Banks' role in the money supply

- The money supply equals currency plus demand (checking account) deposits(in the case of M1)

$$M = C + D$$

- Since the money supply includes demand deposits, the banking system plays an important role.

A few preliminaries

- **Reserves** (***R***): the portion of deposits that banks have not lent.
- To a bank, liabilities include deposits, assets include reserves and outstanding loans
- **100-percent-reserve banking**: a system in which banks hold all deposits as reserves.
- **Fractional-reserve banking**: a system in which banks hold a fraction of their deposits as reserves.

SCENARIO 1: No Banks

With no banks,
D = 0 and ***M*** = ***C*** = $1000.

SCENARIO 2: 100 Percent Reserve Banking

- Initially **C** = $1000, **D** = $0, **M** = $1000.
- Now suppose households deposit the $1000 at "Firstbank."

FIRSTBANK'S balance sheet

Assets	Liabilities
reserves $1000	deposits $1000

- After the deposit, **C** = $0, **D** = $1000, **M** = $1000.
- 100% Reserve Banking has no impact on size of money supply.

SCENARIO 3: Fractional-Reserve Banking

- Suppose banks hold 20% of deposits in reserve, making loans with the rest.
- Firstbank will make $800 in loans.

FIRSTBANK'S balance sheet

Assets	Liabilities
reserves $200	deposits $1000
loans $800	

The money supply now equals $1800:

The depositor still has $1000 in demand deposits,

but now the borrower holds $800 in currency.

SCENARIO 3: Fractional-Reserve Banking

Thus, in a fractional-reserve banking system, banks create money.

FIRSTBANK'S balance sheet

Assets	Liabilities
reserves $200	deposits $1000
loans $800	

The money supply now equals $1800:

The depositor still has $1000 in demand deposits,

but now the borrower holds $800 in currency.

SCENARIO 3: Fractional-Reserve Banking

- Suppose the borrower deposits the $800 in Secondbank.
- Initially, Secondbank's balance sheet is:

SECONDBANK'S balance sheet

Assets	Liabilities
reserves $160	deposits $800
loans $640	

- But then Secondbank will loan 80% of this deposit
- and its balance sheet will look like this:

SCENARIO 3: Fractional-Reserve Banking

- If this $640 is eventually deposited in Thirdbank,
- then Thirdbank will keep 20% of it in reserve, and loan the rest out:

THIRDBANK'S balance sheet

Assets	Liabilities
reserves $128	deposits $640
loans $512	

Finding the total amount of money:

	Original deposit	= $1000
+	Firstbank lending	= $ 800
+	Secondbank lending	= $ 640
+	Thirdbank lending	= $ 512
+	other lending...	

Total money supply = $(1/rr) \times \$1000$
where rr = ratio of reserves to deposits

In our example, $rr = 0.2$, so $M = \$5000$

Money creation in the banking system

- This process is called “Creation of money”.
- In Japanese,it is called 通貨創造

A model of the money supply

exogenous variables

- the **monetary base**, $B = C + R$
  controlled by the central bank
- the **reserve-deposit ratio**, $rr = R/D$
  depends on regulations & bank policies
- the **currency-deposit ratio**, $cr = C/D$
  depends on households' preferences

Solving for the money supply:

$$M = C + D = \frac{C + D}{B} \times B = m \times B$$

where

$$m = \frac{C + D}{B}$$

$$= \frac{C + D}{C + R} = \frac{(C/D) + (D/D)}{(C/D) + (R/D)} = \frac{cr + 1}{cr + rr}$$

The money multiplier

$M = m \times B$, where $m = \frac{cr + 1}{cr + rr}$

- If $rr < 1$, then $m > 1$
- If monetary base changes by ΔB, then $\Delta M = m \times \Delta B$
- m is the **money multiplier**, the increase in the money supply resulting from a one-dollar increase in the monetary base.

Exercise

$M = m \times B$, where $m = \frac{cr + 1}{cr + rr}$

Suppose households decide to hold more of their money as currency and less in the form of demand deposits.

1. Determine impact on money supply.
2. Explain the intuition for your result.

Solution to exercise

Impact of an increase in the currency-deposit ratio
$\Delta cr > 0$.

1. An increase in ***cr*** increases the denominator of ***m*** proportionally more than the numerator. So ***m*** falls, causing ***M*** to fall too.
2. If households deposit less of their money, then banks can't make as many loans, so the banking system won't be able to "create" as much money.

Three instruments of monetary policy

1. Open market operations
2. Reserve requirements
3. The discount rate

Open market operations

- *definition:*
  The purchase or sale of government bonds by the Federal Reserve.
- *how it works:*
  If Fed buys bonds from the public, it pays with new dollars, increasing ***B*** and therefore ***M***.

Reserve requirements

- *definition:*
  Fed regulations that require banks to hold a minimum reserve-deposit ratio.
- *how it works:*
  Reserve requirements affect ***rr*** and ***m***:
  If Fed reduces reserve requirements, then banks can make more loans and "create" more money from each deposit.

The discount rate

- *definition:*
  The interest rate that the Fed charges on loans it makes to banks.
- *how it works:*
  When banks borrow from the Fed, their reserves increase, allowing them to make more loans and "create" more money.
  The Fed can increase ***B*** by lowering the discount rate to induce banks to borrow more reserves from the Fed.

Which instrument is used most often?

- Open market operations:
  Most frequently used.
- Changes in reserve requirements:
  Least frequently used.
- Changes in the discount rate:
  Largely symbolic;
  the Fed is a "lender of last resort,"
  does not usually make loans to banks on demand.

Why the Fed can't precisely control *M*

$$M = m \times B, \quad \text{where} \quad m = \frac{cr + 1}{cr + rr}$$

- Households can change ***cr***, causing ***m*** and ***M*** to change.
- Banks often hold **excess reserves** (reserves above the reserve requirement). If banks change their excess reserves, then ***rr***, ***m*** and ***M*** change.

CASE STUDY: Bank failures in the 1930s

From 1929 to 1933,

- Over 9000 banks closed.
- Money supply fell 28%.

This drop in the money supply may have caused the Great Depression.

It certainly contributed to the Depression's severity.

Table 18-1: The Money Supply and its Determinants: 1929 and 1933

	August 1929	March 1933
Money Supply	**26.5**	**19.0**
Currency	3.9	5.5
Demand deposits	22.6	13.5
Monetary Base	**7.1**	**8.4**
Currency	3.9	5.5
Reserves	3.2	2.9
Money Multiplier	**3.7**	**2.3**
Reserve–deposit ratio	0.14	0.21
Currency–deposit ratio	0.17	0.41

cr rose due to loss of confidence in banks

Table 18-1: The Money Supply and its Determinants: 1929 and 1933

	August 1929	March 1933
Money Supply	**26.5**	**19.0**
Currency	3.9	5.5
Demand deposits	22.6	13.5
Monetary Base	**7.1**	**8.4**
Currency	3.9	5.5
Reserves	3.2	2.9
Money Multiplier	**3.7**	**2.3**
Reserve–deposit ratio	0.14	0.21
Currency–deposit ratio	0.17	0.41

rr rose because banks became more cautious, increased excess reserves

Table 18-1: The Money Supply and its Determinants: 1929 and 1933

	August 1929	March 1933
Money Supply	**26.5**	**19.0**
Currency	3.9	5.5
Demand deposits	22.6	13.5
Monetary Base	**7.1**	**8.4**
Currency	3.9	5.5
Reserves	3.2	2.9
Money Multiplier	**3.7**	**2.3**
Reserve–deposit ratio	0.14	0.21
Currency–deposit ratio	0.17	0.41

The rise in ***cr*** and ***rr*** reduced the money multiplier.

Could this happen again?

- Many policies have been implemented since the 1930s to prevent such widespread bank failures.
- Example: Federal Deposit Insurance, to prevent bank runs and large swings in the currency-deposit ratio.

The Quantity Theory of Money(Ch4 again)

- A simple theory linking the inflation rate to the growth rate of the money supply.
- Begins with a concept called "**velocity**"...

Money demand and Velocity

- *basic concept:* the rate at which money circulates
- *definition:* the number of times the average dollar bill changes hands in a given time period
- example: In 2003,
  - $500 billion in transactions
  - money supply = $100 billion
  - The average dollar is used in five transactions in 2003
  - So, velocity = 5

Velocity, *cont.*

- This suggests the following definition:

$$V = \frac{T}{M}$$

where

V = velocity

T = value of all transactions

M = money supply

Velocity, *cont.*

- Use nominal GDP as a proxy for total transactions.

Then, $$V = \frac{P \times Y}{M}$$

where

P = price of output (GDP deflator)

Y = quantity of output (real GDP)

$P \times Y$ = value of output (nominal GDP)

The quantity equation

- The **quantity equation**

$$M \times V = P \times Y$$

follows from the preceding definition of velocity.

- It is an *identity:* it holds by definition of the variables.

Money demand and the quantity equation

- M/P = **real money balances**, the purchasing power of the money supply.
- A simple money demand function:

$$(M/P)^d = kY$$

where

k = how much money people wish to hold for each dollar of income.

(k is exogenous)

Money demand and the quantity equation

- money demand: $(M/P)^d = kY$
- quantity equation: $M \times V = P \times Y$
- The connection between them: $k = 1/V$
- When people hold lots of money relative to their incomes (k is high), money changes hands infrequently (V is low).

back to the Quantity Theory of Money

- starts with quantity equation
- assumes V is constant & exogenous:

$$V = \overline{V}$$

- With this assumption, the quantity equation can be written as

$$M \times \overline{V} = P \times Y$$

The Quantity Theory of Money, *cont.*

$$M \times \overline{V} = P \times Y$$

How the price level is determined:

- With V constant, the money supply determines nominal GDP ($P \times Y$)
- Real GDP is determined by the economy's supplies of K and L and the production function (chap 3)
- The price level is P = (nominal GDP)/(real GDP)

The Quantity Theory of Money, *cont.*

- *Recall from Chapter 2:* The growth rate of a product equals the sum of the growth rates.
- The quantity equation in growth rates:

$$\frac{\Delta M}{M} + \frac{\Delta V}{V} = \frac{\Delta P}{P} + \frac{\Delta Y}{Y}$$

The quantity theory of money assumes V is constant, so $\frac{\Delta V}{V} = 0$.

The Quantity Theory of Money, *cont.*

Let π (Greek letter "pi") denote the inflation rate: $\pi = \frac{\Delta P}{P}$

The result from the preceding slide was: $\frac{\Delta M}{M} = \frac{\Delta P}{P} + \frac{\Delta Y}{Y}$

Solve this result for π to get $\pi = \frac{\Delta M}{M} - \frac{\Delta Y}{Y}$

The Quantity Theory of Money, *cont.*

$$\pi = \frac{\Delta M}{M} - \frac{\Delta Y}{Y}$$

- Normal economic growth requires a certain amount of money supply growth to facilitate the growth in transactions.
- Money growth in excess of this amount leads to inflation.

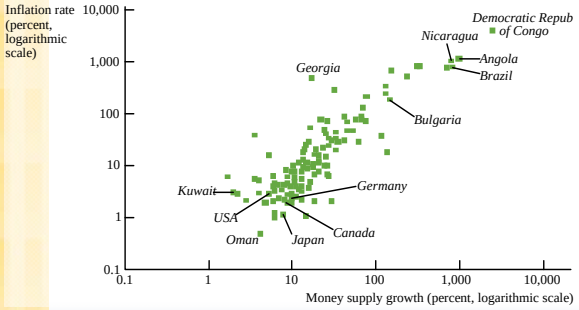
The Quantity Theory of Money, *cont.*

$$\pi = \frac{\Delta M}{M} - \frac{\Delta Y}{Y}$$

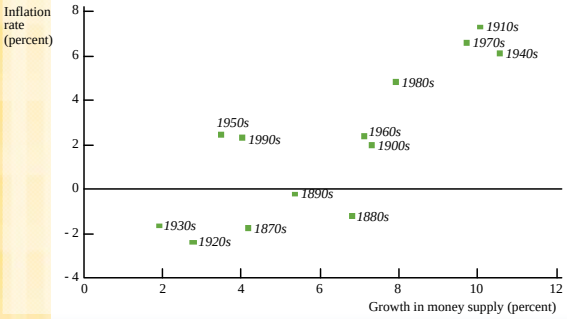
$\Delta Y/Y$ depends on growth in the factors of production and on technological progress (all of which we take as given, for now).

Hence, the Quantity Theory of Money predicts a one-for-one relation between changes in the money growth rate and changes in the inflation rate.

International data on inflation and money growth



U.S. data on inflation and money growth



Inflation at the end of Edo period

- At the end of Edo period, Huge inflation happened.
- Standard explanation:foreign countries requested to open the border of Japan. The demand for Japanese goods increased and it lead to inflation at the end of Edo period
- Other explanation: gold went out of country and lead to inflation.
- Those are not true. Recently economic history research shows that failure of monetary policy caused inflation at the end of Edo period.

Inflation at the end of Edo period(2)

- In Edo, there is koban(gold coin) and ichibu (silver coin).
- 4 ichibu=1 koban
- However, edo government keeps decreasing the amount of silver included in the ichibu.
- This means, initially ichibu=commodity money, but later ichibu was becoming fiat money.
- This was needed since the amount of money should be increased as the economic transaction increases and the economy grows.
- Moderate level of increase of money supplly is needed as long as Y grows. (Remember quantity theory of money MV=PY)
- Also edo government could enjoy huge **seigniorage.**

Inflation at the end of Edo period(3)

- US came at the end of period to request to open the country for Japan.
- Japan-US Treaty of Amity and Trade was made.
- Article five of the treaty defined that same type of currency is exchanged with the same quantity(同種同量規定).

Inflation at the end of Edo period (4)

- In the US, silver coin was used as currency and it was a commodity money.
- In Japan, ichibu(silver coin) was used as currency but it was fiat money.
- US request to exchange more ichibu for their siliver coin since Japanese ichibu does not include so much silver in it.
- Japanese side said that comparing the amount of silver included in ichibu and US silver coin does not make sense since ichibu is fiat money.

Inflation at the End of Edo period(5)

- Japanese side could not convince the US side because many who were involved in the negotiation both US side and Japanese side did not have sufficient knowledge and they did not know the importance of distinguishing fiat money and commodity money.
- In addition, Edo government made critical mistakes in monetary policy.
- As a result, Japanese economy experiences huge inflation.

Inflation at the End of Edo period (6)

- Some of Japanese people could adjust this inflation very quickly (merchant and farmer) but other could not.
- Sword man class used to receive annual nominal fixed income. They could not adjust to this inflation.
- As a result, in the sword man class, 尊皇攘夷運動 (movement to expel foreigner and transfer the governance to emperor) happened.

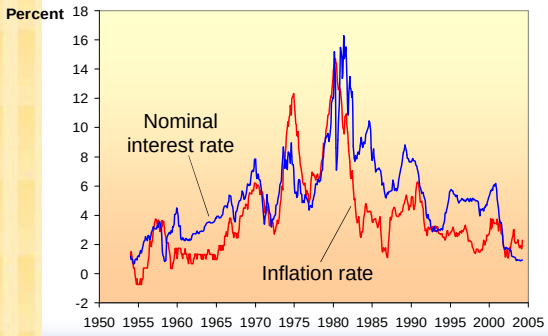
Inflation and interest rates

- Nominal interest rate, i
  not adjusted for inflation
- Real interest rate, r
  adjusted for inflation:
  $r = i - \pi$

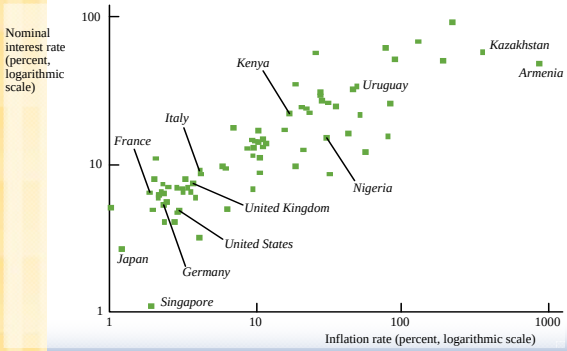
The Fisher Effect

- The Fisher equation: $i = r + \pi$
- Chap 3: $S = I$ determines r.
- Hence, an increase in π
  causes an equal increase in i.
- This one-for-one relationship
  is called the **Fisher effect**.

U.S. inflation and nominal interest rates, since 1954



Inflation and nominal interest rates across countries



Japanese Inflation rate and interest rate