CHAPTER 4

Money and Inflation

MACROECONOMICS SIXTH EDITION

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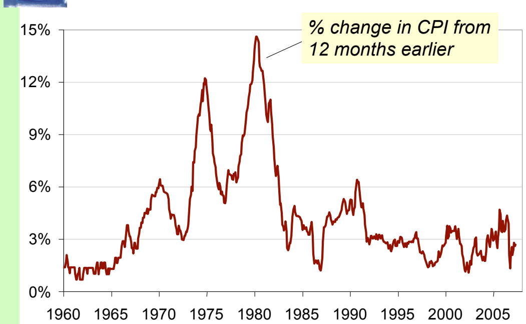
PowerPoint® Slides by Ron Cronovich

In this chapter, you will learn…

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

U.S. inflation, 1960-2007



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

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

Discussion Question

Which of these are money?

a. Currency
b. Checks
c. Deposits in checking accounts ("demand deposits")
d. Credit cards
e. Certificates of deposit ("time deposits")

The money supply and monetary policy definitions

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

The central bank

- Monetary policy is conducted by a country's **central bank**.
- In the U.S., the central bank is called the **Federal Reserve** ("the Fed").

The Federal Reserve Building
Washington, DC

Money supply measures, May 2007

symbol	assets included	amount ($ billions)
C	Currency	$755
M1	**C** + demand deposits, travelers' checks, other checkable deposits	$1377
M2	**M1** + small time deposits, savings deposits, money market mutual funds, money market deposit accounts	$7227

The Quantity Theory of Money

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

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 2007,
  - $500 billion in transactions
  - money supply = $100 billion
  - The average dollar is used in five transactions in 2007
  - 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

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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)

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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.

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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)

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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).

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Back to the quantity theory of money

- starts with quantity equation
- assumes V is constant & exogenous: $V = \bar{V}$
- With this assumption, the quantity equation can be written as

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

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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.*

π (Greek letter "pi") denotes 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 predicts a one-for-one relation between changes in the money growth rate and changes in the inflation rate.

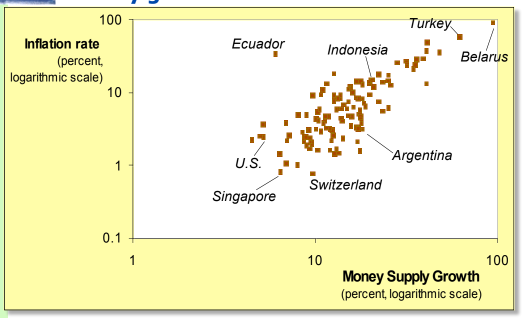
Confronting the quantity theory with data

The quantity theory of money implies

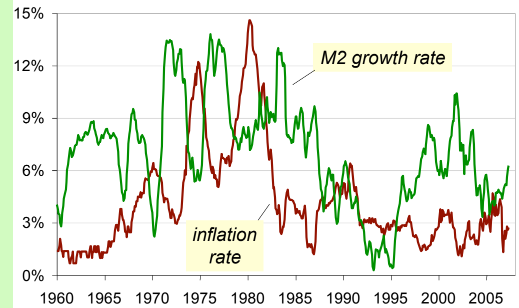
1. countries with higher money growth rates should have higher inflation rates.
2. the long-run trend behavior of a country's inflation should be similar to the long-run trend in the country's money growth rate.

Are the data consistent with these implications?

International data on inflation and money growth



U.S. inflation and money growth, 1960-2007



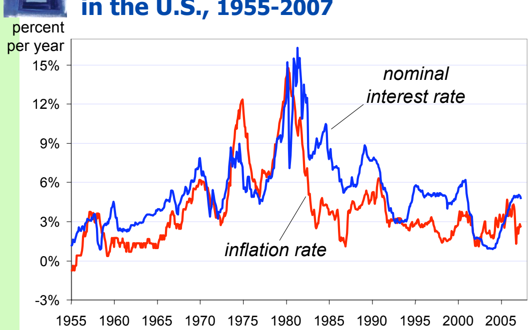
Inflation and interest rates

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

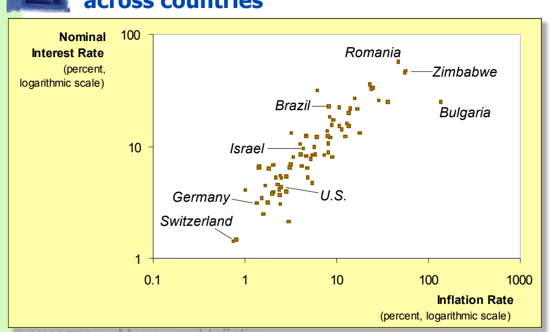
The Fisher effect

- 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**.

Inflation and nominal interest rates in the U.S., 1955-2007



Inflation and nominal interest rates across countries



Exercise:

Suppose V is constant, M is growing 5% per year, Y is growing 2% per year, and $r = 4$.

a. Solve for i.

b. If the Fed increases the money growth rate by 2 percentage points per year, find Δi.

c. Suppose the growth rate of Y falls to 1% per year.

- What will happen to π?
- What must the Fed do if it wishes to keep π constant?

Answers:

V is constant, M grows 5% per year, Y grows 2% per year, $r = 4$.

a. First, find $\pi = 5 - 2 = 3$.
Then, find $i = r + \pi = 4 + 3 = 7$.

b. $\Delta i = 2$, same as the increase in the money growth rate.

c. If the Fed does nothing, $\Delta\pi = 1$.
To prevent inflation from rising, Fed must reduce the money growth rate by 1 percentage point per year.

Money demand and the nominal interest rate

- In the quantity theory of money, the demand for real money balances depends only on real income Y.
- Another determinant of money demand: the nominal interest rate, i.
  - the opportunity cost of holding money (instead of bonds or other interest-earning assets).
- Hence, $\uparrow i \Rightarrow \downarrow$ in money demand.

The money demand function

$$(M/P)^d = L(i, Y)$$

$(M/P)^d$ = real money demand, depends

- negatively on i
  - i is the opp. cost of holding money
- positively on Y
  - higher $Y \Rightarrow$ more spending $\Rightarrow$ so, need more money

("L" is used for the money demand function because money is the most liquid asset.)

The money demand function

$$(M/P)^d = L(i, Y) = L(r + \pi^e, Y)$$

When people are deciding whether to hold money or bonds, they don't know what inflation will turn out to be.

Hence, the nominal interest rate relevant for money demand is $r + \pi^e$.

Equilibrium

$$\underbrace{\frac{M}{P}}_{\text{The supply of real money balances}} = \underbrace{L(r + \pi^e, Y)}_{\text{Real money demand}}$$

What determines what

$$\frac{M}{P} = L(r + \pi^e, Y)$$

variable	how determined *(in the long run)*
M	exogenous (the Fed)
r	adjusts to make $S = I$
Y	$\bar{Y} = F(\bar{K}, \bar{L})$
P	adjusts to make $\frac{M}{P} = L(i, Y)$

How P responds to ΔM

$$\frac{M}{P} = L(r + \pi^e, Y)$$

- For given values of r, Y, and π^e, a change in M causes P to change by the same percentage – just like in the quantity theory of money.

What about expected inflation?

- Over the long run, people don't consistently over- or under-forecast inflation, so $\pi^e = \pi$ on average.
- In the short run, π^e may change when people get new information.
- EX: Fed announces it will increase M next year. People will expect next year's P to be higher, so π^e rises.
- This affects P now, even though M hasn't changed yet….

How P responds to $\Delta \pi^e$

$$\frac{M}{P} = L(r + \pi^e, Y)$$

- For given values of r, Y, and M,

$$\uparrow \pi^e \;\Rightarrow\; \uparrow i \quad \text{(the Fisher effect)}$$
$$\Rightarrow\; \downarrow (M/P)^d$$
$$\Rightarrow\; \uparrow P \;\text{ to make } (M/P) \text{ fall}$$

to re-establish eq'm

The Classical Dichotomy

Real variables: Measured in physical units – quantities and relative prices, *for example:*

- quantity of output produced
- real wage: output earned per hour of work
- real interest rate: output earned in the future by lending one unit of output today

Nominal variables: Measured in money units, *e.g.,*

- nominal wage: Dollars per hour of work.
- nominal interest rate: Dollars earned in future by lending one dollar today.
- the price level: The amount of dollars needed to buy a representative basket of goods.

The Classical Dichotomy

- Note: Real variables were explained in Chap 3, nominal ones in Chapter 4.
- ***Classical dichotomy***: the theoretical separation of real and nominal variables in the classical model, which implies nominal variables do not affect real variables.
- ***Neutrality of money***: Changes in the money supply do not affect real variables. In the real world, money is approximately neutral in the long run.

Chapter Summary

Money

- the stock of assets used for transactions
- serves as a medium of exchange, store of value, and unit of account.
- Central bank controls the money supply.

Quantity theory of money assumes velocity is stable, concludes that the money growth rate determines the inflation rate.

Chapter Summary

Nominal interest rate

- equals real interest rate + inflation rate
- the opp. cost of holding money
- Fisher effect: Nominal interest rate moves one-for-one w/ expected inflation.

Money demand

- depends only on income in the Quantity Theory
- also depends on the nominal interest rate
- if so, then changes in expected inflation affect the current price level.

Chapter Summary

Classical dichotomy

- In classical theory, money is neutral--does not affect real variables.
- So, we can study how real variables are determined w/o reference to nominal ones.
- Then, money market eq'm determines price level and all nominal variables.
- Most economists believe the economy works this way in the long run.